

ENVIRONMENTAL IMPACT ASSESSMENT (EIA) REPORT

**GOLF COURSE: AMATERRA JAMAICA LTD., DUNCANS
TRELAWNY**



Prepared by:



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EXECUTIVE SUMMARY

- i. Amaterra Jamaica Ltd. intends to develop a resort complex on approximately 850 acres ~ 344 hectares of land in Duncans Trelawny. One of the main components of this development is a proposed eighteen (18) – hole championship golf course, a first for the parish of Trelawny. Also included in the golf course development is a driving range, clubhouse and maintenance area. A sod farm is also proposed for the propagation of sod to be used as turf on the fairways, greens and tees of the golf course. It is anticipated that this project will be completed within two (2) years.
- ii. The Golf Course has been proposed as a complementary feature to the overall Amaterra development plans which includes villas, condominiums, and hotels (2000 rooms in total). A “Town Centre Village” has also been proposed, which will include a business park with commercial units, conference centre and amenities including a police station, fire station and health facilities. Other recreation type activities proposed includes an Equestrian Centre, Water Park and Amphitheatre.
- iii. The Amaterra property is located in the north east section of the parish of Trelawny along the Duncans to Coral Spring main road.
- iv. The area for the proposed development is currently undeveloped. The coastal zones consist of beachfront areas and cliff rock faces.
- v. The golf course will be constructed on approximately eighty - nine (89) hectares of land and will traverse throughout the entire 344 hectare property. The course will consist of eighteen (18) holes, which will include Fairways, Greens, Tees and Roughs with intermittent water features and sand bunkers. A sod farm will also be constructed on approximately four (4) hectares of land just south of the property.
- vi. The major turf grass proposed to be used on the Fairways, Greens, Tees and Driving Range is the now popular Seashore Paspalum (*Paspalum vaginatum*). Native trees and shrubs will be used on the ‘Rough’ areas of the golf course. This turf type has

been used on courses in Asia, South Africa, South America, Hawaii and the United States of America. It has also been widely used in the Caribbean. This turf type has been described as one of the most environmentally friendly turf types due to its many advantages such as tolerance of irrigation by recycled water and its resistance to drought and diseases, therefore reducing the amount of water needed for irrigation and the rate of chemical application during maintenance.

- vii. The chemicals required for the propagation of sod and maintenance of the golf course include Nitrogen, Potassium, Phosphorus and minor elements such as Iron and Magnesium *inter alia*. Other chemicals to be used include pesticides, herbicides and fungicides. The application of these chemicals varies during the grow-in period of the sod and the maintenance of the turf.
- viii. Approximately 2500 m³ of water will be required daily for the operation of the golf course. Water for the irrigation of the turf will be from recycled water from the sewage treatment plant, run-off and water from two (2) wells located within the development site. Potable water will be supplied by the National Water Commission (NWC).
- ix. Three (3) secondary wastewater treatment plants are proposed to serve the Amaterra Development. All sewage generated from the operations of the Clubhouse will be tied into one of these three sewage treatment plants. This system will involve the use of an STM -Aerator™ which combines the advantages of an activated sludge and fixed film process.
- x. Several regulations are or can be applicable to the development which serves to protect the developer, the public and to preserve the environment.
- xi. The proposed site for development is located within the Martha Brae watershed. Data shows that rainfall experienced in the area ranges from a low of 42 mm in July to a high of 178 mm in December. Wind speeds during the daytime show an average of 27 kilometres per hour (15 knots); this is reduced at night when wind speeds average 10 kilometres per hour (5 knots). The lowest wind speeds are experienced between December and March, whereas the highest wind speeds are observed between June

and July. Temperatures in the area range from a minimum of 21.9 °C in December to a maximum of 31.4 °C in August.

- xii. Both the NO₂ and SO₂ measured throughout the development area were undetected. PM₁₀ levels varied between 56 and 153 µg/m³.
- xiii. The water quality of the brackish pond 2 (BP2) located to the most northern boundary of the property located within the development area showed elevated levels of Total and Faecal Coliform, Biochemical Oxygen Demand and Dissolved Oxygen. Although this water will not be used for human consumption, these elevated levels are an issue of concern. These elevated values are likely to be as a result of human activity around the development area.
- xiv. Based on the results the water from the well located at Silver Sands should not be the major source for irrigation of the golf course as the salinity levels of the groundwater were well above what is suitable for irrigation purposes. Further abstraction from this well will also likely increase saline intrusion in this area.
- xv. The water in the marine environment also showed elevated levels of nutrients such as Nitrates and Phosphates. This could be as a result of the anthropogenic influences from surrounding communities such as the activities at the Jacob Taylor beach, which is adjacent to the property.
- xvi. The developer has also entered into an agreement with the National Water Commission (NWC) to improve the water supply between Martha Brae and Harmony Hall at an estimated cost of US \$ 7.8 Million to the developer.
- xvii. The proposed development area is dominated by the Montpelier Formation of the White Limestone Group. This unit consists of limestone beds which are typically well bedded and hard. Marl beds are also typically present within this formation, rendering the overall permeability of this unit poor. Limestone beds of the Coastal Group are also present in the vicinity of the development but are, as in the rest of the island, confined towards the coast.

- xviii.** No major or minor faults were identified during field work due to the dense vegetation. However, an examination of the geological map of Jamaica indicates that a pair of SW-NE trending faults dissects the area. It is quite likely, however, that these faults will not represent a direct threat to the development of the area.
- xix.** The soil classification in this area is Bonny Gate Stony Loam. The concentrations of magnesium, sodium, manganese and iron are within the ranges expected for Jamaican soils. The soil may require nitrogen and potassium supplementation and although Phosphate supplementation should not be required in the initial stages of operation, it will likely be required periodically. While there was significant variation in the zinc concentration in the three soil samples, none of the levels measured would be considered detrimental to plant response.
- xx.** Overall, the impact of the development of the golf course on the flooding in the Silver Sands community is marginal when compared to the pre-development flood discharge with a likely increase in the average inundation depth of less than 0.1m.
- xxi.** The average noise values for the area ranged from a low of 54 dB (A) in the community of Duncans to a high of 69 dB(A) for Stewart Castle where the main source of noise was from vehicular traffic along the highway.
- xxii.** The development area can be divided into three (3) zones including a Dry Limestone Forest zone, Mangrove Swamp zone and a Beach zone. Eighty-seven (87) species of plants were observed throughout the development area, five (5) of which are endemic to Jamaica. One (1) of the plant species observed is classified as an endangered species and is protected by the Endangered Species Act (2000) and listed as a CITES Appendix II species; No rare or threatened plant species were observed during the survey of the area. Four (4) invasive alien species were observed.
- xxiii.** Sixty-nine (69) species of birds representing twenty-two (22) families were observed during the survey. Fifteen (15) of these species are endemic to Jamaica. One of these species is considered endangered; this species however was not thought to reside in this area but came to the site to forage. No rare, threatened or invasive alien species were observed during the survey.

- xxiv.** Eleven (11) species of butterflies were observed during the butterfly survey, one (1) of which is endemic to Jamaica. No rare, threatened, protected or endangered species were observed in the assessment.
- xxv.** There is an extremely high level of endemism among Jamaican land snails however and it would not be presumptuous to expect that there are endemic species of land snails in the area. Two (2) species of reptiles identified are endemic to Jamaica. This includes *Anolis lineatopus* and the Jamaica Yellow Snake (*Epicrates subflavus*) The Jamaican Yellow Snake (*Epicrates subflavus*) is protected under the Wildlife Protection Act (1945) as well as the Endangered Species Act (2000). One (1) species observed was identified as being an Invasive Alien Species; the Indian Mongoose (*Herpestes auropunctatus*).
- xxvi.** The marine assessment conducted shows that the benthic reef community of the site is dominated by macroalgae (47%). The mean hard coral cover is reasonably high (28%). There is a low occurrence of coral disease. Sponges and Gorgonians are present in reasonable amounts. Eleven (11) coral species, five (5) species of macroalgae and thirty-seven (37) fish species were observed. Two (2) major seagrass beds were observed off-shore which was dominated by one (1) species of seagrass. There is a possibility that the area is also used by sea turtles as a nesting site.
- xxvii.** The study area represents a complex, mostly undisturbed ecosystem with a variety of communities with specific habitats and niches. Important animal-animal and animal-plant interactions were also observed including symbiosis, mutualism and predation. The ecology observed within the development area has been influenced by specific factors including the physical attributes of the study area (climate, soil and geology) and to a lesser extent anthropogenic activity. Several adaptations to the climate of the area were observed among species however.
- xxviii.** Census data shows that the population in the study area is approximately 4,613. The population in these communities represents 6 % of the population of the parish of Trelawny which is 73,066.

- xxix.** The total female population of the study area is 2,308 and the total male population is 2,305 which is roughly a 50-50 ratio of males to females.
- xxx.** The 2001 census data from the Statistical Institute of Jamaica (STATIN) show that approximately 37% of the population of the study area is less than 15 years of age. This is higher than the national figure of 35% of the population being less than 15 years of age. In contrast to this approximately 14 % of the population of the study area is over the age of 60. This shows somewhat less agreement with the national figure of 10.2%.
- xxxi.** The growth of the population in the parish of Trelawny has shown an increase of approximately 2.6 % between 1991 and 2001. This rate is very marginal when compared to the island's average population growth rate of 9.5 % or the growth rates of adjacent parishes St. Ann and St. James which are 11.6 % and 13. 57 % respectively, within the same time period. Presently there is no evidence of overcrowding in the area.
- xxxii.** A wide range of economic activities are evident within the area through self-employed and small businesses. These ventures range from grocery shops, restaurants and bars. Commercial fishing is also another major economic activity concentrated at the Jacobs Taylor Fishing Beach which borders the property. This is a very vibrant fishing cooperative known as the "Friendly Society Fisherman's Cooperative" which has over thirty-five (35) active members.
- xxxiii.** The employment rate within the study area was over 35 % for persons who were employed full-time and 50 % for persons who were either self employed or employed part-time.
- xxxiv.** Within the study area the churches are central areas for community members to interact. Only one (1) community centre is located within the study area, which is in Spicy Hill. No recreational parks or playing areas are located in the study area.

- xxxv.** The Amaterra Development's main access is via the Duncans to Coral Spring main road which is a part of the newly upgraded North Coast highway. The road conditions within some of the surrounding communities are in deplorable condition however. Within the development area the roads are unpaved parochial thoroughfares.
- xxxvi.** All the residents in close proximity to the development site have access to electricity or have electricity in their homes.
- xxxvii.** Approximately 54 % of the respondents in the socio-economic assessment had access to piped water in their homes. The remaining population said they accessed water from standpipes and catchments in the area. The main source of water supply in the area is by the National Water Commission (NWC).
- xxxviii.** Fixed line services provided by Cable and Wireless Jamaica Ltd. are available in the communities within the study area. Most residents in the area said they also relied on cellular service (Digicel, Cable and Wireless and Miphone) for their means of telephone communication.
- xxxix.** Garbage is collected in the area by the Western Parks and Markets Waste Management Ltd. at least once per week, and is disposed of at the solid waste disposal site located at Grange Farm on the Daniel Town Road which is operated by the National Solid Waste Management Authority (NSWMA).
- xl.** Most of the residents interviewed had indoor plumbing suitable for piped water in their homes with toilet facilities. This sewage is disposed of in individual absorption pits.
- xli.** The major hospital in Trelawny is the Falmouth Hospital. This is situated some thirteen kilometres (13) kilometres away from the study area. Within the town of Duncans located about 1.5 km from the study area is a Type III Health centre and two (2) private doctors' offices.
- xlii.** The closest Fire Station to the study area is the Falmouth Fire Station, which is located approximately 13 km from the project site and serves the entire parish of Trelawny.

- xl.iii.** Three (3) police stations are in close proximity to the development site. The closest of the three (3) is the Duncans police station, located about 2 km away. The other two (2) are located in Rio Bueno approximately 7 km and in Clarks Town, which is approximately 6.6 km from the development site. Crime and violence is not perceived as a major issue in the area.
- xl.iv.** Most of the residents within the study area travel by taxi or minibus.
- xl.v.** Within the development area, Stewart Castle has been declared a National Heritage Site by the National Heritage Trust of Jamaica.
- xl.vi.** More than eighty percent (80%) of the respondents to the survey were aware of the proposed Amaterra development. However less than thirty percent (30 %) of these respondents were aware that a golf course was included in the development plans. Most knew of the hotels proposed however.
- xl.vii.** Approximately forty percent (40 %) of those interviewed said they utilised the property, whether it was for docking of boats and equipment by fisherfolk or the harvesting of wood for charcoal burning and the construction of fish traps.
- xl.viii.** The general perception of the development of the golf course was positive. The basis of these positive responses was due to the anticipation of primary and secondary income generation activities that would arise from the development. Concerns were raised however about potential negative impacts that the development could have on the environment.
- xl.ix.** The analysis of alternatives to the project was divided into two (2) sections. Firstly the project alternatives were analysed included the 'no action scenario', agriculture, mining and quarrying, and housing and resort type development. The second level of analysis included the alternatives to project scale, design and implementation which included the analysis of the construction of a nine (9) hole golf course. Based on the environmental and socio economic assessments of the area the chosen alternative to the project was the proposed golf course design.

- I. The project may have major negative environmental impacts on the water quality (terrestrial and marine), as well as negative ecological impacts and impacts to ambient air quality, noise, and soil quality of the area. Minor negative impacts will include those to the climate and hydrogeology of the area. Mitigation measures have been proposed to reduce these impacts.
- ii. The project may have major socio-economic benefits locally and nationally. This will be through the increase in direct and indirect employment and income generating activities, the improvement of social amenities in the area and the overall improvement of way of life for the residents in the surrounding communities. Mitigation measures have been identified to enhance the positive impacts that have been identified as well as to reduce any potential negative impacts.
- iii. The hazards associated with the development include an increased likelihood of accidents, technological hazards, impacts to human health and increased susceptibility to natural hazards such as hurricanes and tropical storms.
- iiii. Timely and consistent monitoring by the relevant agencies, the developer and the residents of the community will be the key factor in ensuring that the development is implemented and operated in a sustainable manner.

TABLE I: SUMMARY OF ENVIRONMENTAL MITIGATION MEASURES

ENVIRONMENTAL COMPONENT	MITIGATION MEASURES	ADDED COST TO THE DEVELOPER
PHYSICAL		
CLIMATE		
SITE PREPARATION AND CONSTRUCTION PHASES	o Maintain all mature trees (trees greater than 25 cm) throughout the development;	\$ 0.00
	o Remove only vegetation that is absolutely necessary for the construction of the golf course;	\$ 0.00
	o Ensure that buffer areas and green belts are incorporated in the golf course design;	\$ 0.00
	o Clear vegetation only after 90 % of sod has been established at the sod farm ;	\$ 0.00
	o All raw materials must be sourced as close as possible to the construction site thus reducing the emissions from vehicular traffic;	\$ 0.00
	o Recruit staff from the surrounding communities to decrease the travelling distance thus reducing emissions from vehicular traffic;	\$ 0.00
	o Ensure that all vehicles involved in the transport of construction material and staff, and machinery involved in the construction is properly maintained and serviced; and	\$ 0.00
	o Machines must not be left idling for unnecessary periods of time; this will save fuel and reduce emissions.	\$ 0.00
OPERATION PHASE	o Ensure that all machinery and vehicles used in the maintenance of the golf course are regularly maintained.	\$ 0.00
	o Implement a traffic system that involves appropriate signals and signs to ensure the smooth flow of traffic must be implemented. This will reduce the idling of vehicles that may occur and therefore reduce the emissions in the area.	\$ 0.00
	o Ensure that buffer areas and green belts that are incorporated in the golf design are delineated by containment measures such as fencing so as to prevent the impact of secondary opportunistic clearance in the area as a result of increased accessibility created by the development;	\$ 0.00
AIR QUALITY		
SITE PREPARATION AND CONSTRUCTION PHASES	o The clearing of vegetation must be carried out on a phased basis. Vegetation should not be cleared in the area for the golf course until sod has reached ninety percent (90 %) grow-in at the sod farm. Vegetation should only be cleared from areas that have been designated to be included in the golf course design.	\$0.00
	o Ensure that all material (sand and aggregate) stockpiled on the site to be used in construction activities are regularly sprayed to reduce the effects of wind whipping.	~\$1500/day
	o Ensure that all trucks carrying aggregate and sand are covered during delivery to the site.	\$ 0.00

	o Care must be taken in the unloading construction materials (aggregate, sand and cement) to prevent spillage. If a spill occurs, this should be cleaned up as soon as possible thereafter.	\$ 0.00
	o Extra care must be taken to reduce dust in periods when wind speed are greatest and the rainfall amounts are lowest which is between June and July, e.g. This will involve extra wetting of the construction area to suppress dust particles.	~\$ 1,500.00/day
	o Retain a buffer area of trees and other vegetation especially to the most northern section of the property (the coast) and generally around the perimeter of the development site which will serve as a natural windbreaks which may reduce the level of dispersion of dust particles generated during this phases of the development.	\$ 0.00
	o All staff employed at the construction site must be provided with dust masks and be asked to use them.	~\$6,000.00/quarter
	o All raw materials must be sourced as close as possible to the construction site thus reducing the emissions from vehicular traffic.	\$ 0.00
	o All waste must be transported off-site for processing, not burnt or stored for any longer than is absolutely necessary.	\$ 0.00
	o Recruit staff from the surrounding communities to decrease the travelling distance thus reducing emissions from vehicular traffic.	\$ 0.00
	o Ensure that all vehicles involved in the transport of construction material and staff, and machinery involved in the construction is properly maintained and serviced.	\$ 0.00
	o Machines must not be left idling for unnecessary periods of time; this will save fuel and reduce emissions.	\$ 0.00
	o Where possible, the use of the machinery must be scheduled to have most use when the residents are not in the area.	\$ 0.00
	o Perform road repair and construction at times that persons are expected to be at work and school, as this produces noxious gases.	\$ 0.00
	o Ensure that all machinery and vehicles used in the maintenance of the golf course are regularly maintained ;	\$ 0.00
OPERATION PHASE	o Implement a traffic system that involves appropriate signals and signs to ensure the smooth flow of traffic must be implemented. This will reduce the idling of vehicles that may occur and therefore reduce the emissions in the area;	\$ 0.00
	o As far as possible use the most 'environmentally friendly pesticides'. In an effort to reduce the level of volatilization that may occur, select and use pesticides that have low vapour pressures and high water solubility;	\$ 0.00
	o Irrigate after the application of pesticides to reduce the level of volatilization.	\$ 0.00
WATER QUALITY		

SITE PREPARATION AND CONSTRUCTION PHASES	o If diesel and motor oil are to be stored on site, ensure that they are properly contained in a bunded area (With capacity to contain 1½ times the amount of substances stored). This area must be situated away from all water bodies and signs indicating the storage of these substances erected.	\$ 0.00
	o Provide workers at the development site with chemical toilets during this phase of the development. A reasonable ratio would be eight (8) workers per toilet.	~\$ 20,000.00/quarter
	o Store all raw materials away from the vicinity of water bodies located on the property and away from the coastal areas to avoid contamination in these areas.	\$ 0.00
	o General refuse generated during these phases of the development must be stockpiled in one central area of the development site, away from existing water bodies and collected, transported and disposed of appropriately at the designated disposal site.	\$ 0.00
	o Clearance of vegetation must be avoided in periods of heavy rainfall (between October and December) to reduce the impact of runoff.	\$ 0.00
	o Avoid clearance of vegetation when periods of wind speed are highest (June to July).	\$ 0.00
	o Vegetation should not be cleared until sod has reached a 90 % grow-in at the sod farm.	\$ 0.00
	o Install siltation traps within the drainage design to collect silt and sediments ensuring that they do not end up in adjacent aquatic areas.	\$ 0.00
	o Conduct periodical water quality monitoring to ensure that standards are maintained.	~\$35,000.00/quarter
OPERATION PHASE	o Ensure that all areas of the golf course are lined with geotextile material to prevent the contamination of ground water in the area ;	\$ 0.00
	o Maintain a vegetation buffer around natural and marine environments to reduce the nutrient loading to these waterways.	~\$3,000.00/month
	o Develop and implement a comprehensive Nutrient Management Programme for the maintenance of course. Golf course maintenance staff should be trained in these best practices.	\$ 0.00
	o Fertilizer applications should be based on the results of regular soil testing to avoid over application of nutrients.	~\$ 25,000/quarter
	o Use as far as possible slow-release fertilizers to reduce the potential of leaching and run-off into water bodies. The application of these fertilizers must be timed to minimize the leaching from soil by rainfall or irrigation.	\$ 0.00
	o Irrigate after fertilization to reduce volatilization;	\$ 0.00
	o Monitor irrigation of the turf especially in periods of high levels of rainfall which is typically October – December);	\$ 0.00
	o Ensure that all machinery and vehicles used in the maintenance of the golf course are regularly maintained and that maintenance of these vehicles is always conducted in the stipulated area. All grease and oil from this area must be collected in an oil/water	~\$ 30,000.00

	separator and properly disposed of by a licensed waste disposal company.	
	o Incorporate constructed wetland features within the water features within the golf course, such as reed beds, these if properly designed and maintained can remove or manage the nutrient loading to these water features . This will provide natural filtration features for fertilizers and pesticides used in golf course maintenance, as well as assisting with the decrease in the rate of eutrophication within these ponds ;	~\$10,000/month for maintenance
	o Apply practices and use products that reduce the potential for contamination of ground water and surface water which includes the physical removal of weeds, use of slow-release products and choosing the most 'environmentally friendly products available	\$ 0.00
	o The use of fertilizer can be adjusted to consider natural sources of nitrogen. Grass clippings can be recycled throughout the entire golf course. It is estimated that these clippings can provide approximately 0.45 kg/ 100 m ² of Nitrogen per year. Where these clippings are not used, they must be properly collected, stored and disposed of. Rainfall can also provide natural source of Nitrogen which is estimated to be approximately 0.09 – 0.22 kg / 100 m ² /year.	\$ 0.00
	o Establish 'no-spray' zones and buffer areas particularly around areas where there are water features and other surface waters. Staff should be trained to identify and operate with care in these areas; Native species, especially those with deep rooting systems should be planted in these areas as a natural means of ground water attenuation;	\$ 0.00
	o Prevent the contamination of ground water by the designation of a maintenance area for the maintenance of vehicles and other equipment to be used for the upkeep of the turf. This area should be paved with an impervious material and all run-offs from this area channelled and collected in a catchment area, after which it can be properly disposed;	\$ 0.00
	o Ensure that all chemicals are properly stored in a specific location. All chemicals stored in this area must be properly labelled. The area where chemicals will be stored and handled must be constructed with an impermeable surface. This area should also be bunded with the capacity to contain 1½ times the amount of substances stored	\$ 0.00
	o Monitor surface water quality to help with the regulation of nutrient loading;	~\$35,000.00/ quarter
	o Employ more environmentally-sensitive turf management techniques within ten (10) metres of all wetlands, water bodies to eliminate or minimize nutrient and chemical inputs	\$ 0.00
	o Take weather into consideration when applying pesticides	\$ 0.00
	o When applying pesticides employ spot-treatment to affected areas	\$ 0.00
	o For holes closest to the shoreline raise the mowing height to slow and filter runoff	\$ 0.00
	o Reduce the recommended rate of application in out-play areas;	\$ 0.00
	o Determine pest thresholds and apply pesticides only when threshold has been exceeded	\$ 0.00
	o Use slow release fertilisers and employ spoon-feeding application of these fertilizers	\$ 0.00

	o Locate chemical storage and handling areas as far as possible from water course. Ideally a vegetative buffer should be incorporated in the design of the golf course between the storage area and water courses.	\$ 0.00
	o Care should be taken not to apply more fertilizer than is needed since there may be a growth surge in response to the nutrients which can lead to increased thatch production and predisposition to increased insect and or disease activity.	\$ 0.00
	o Monitor the Chloride level in irrigation water as this may suppress the uptake of Nitrogen in Seashore Paspalum.	~\$ 15,000/quarter
	o Ensure that there is proper storage and disposal of waste generated at the clubhouse	\$ 0.00
	o Conduct regular water quality monitoring of the sewage treatment facilities and water courses to ensure that these are in keeping with the prescribed water quality standards	~\$35,000.00/quarter
	o Ensure that there is proper blending of irrigation water with fresh water from run-off, this water must be tested regularly and fertilizers and pesticides adjusted accordingly to consider the input from this source.	\$ 0.00
	o Purchase and store only the amount of pesticide needed for the immediate future.	\$ 0.00
	o In the event of a spill, ensure that this cleaned up immediately.	\$ 0.00
	o Follow recommended mowing schedules and technique to maintain a healthy pest-resistant turf, and therefore reduce the amount of pesticides required.	\$ 0.00
	o Develop and follow an Integrated Pest Management Policy. This policy should include the times for treating pests and other turf problems. This should also include recommendations for mowing time, and also indicate how to use non-chemical options for pest control.	\$0.00
WATER QUANTITY		
SITE PREPARATION & CONSTRUCTION PHASES	o As far as possible ensure that water is conserved during these phases of the development;	\$0.00
	o If the upgrading works proposed are not implement prior to the start of these activities , the developer should identify other sources of water to be used in this stage of the development; and	\$0.00
	o Ensure that t community benefits from the upgrading works to the water supply proposed.	\$ 0.00
OPERATION PHASE	o Ensure that the water supply is upgraded as proposed (See Appendix 5) before the commissioning of the golf course takes place; If this does not occur the developer should identify other sources of water for this phase of the development;	\$0.00
	o Irrigation systems must be regularly checked to ensure there is proper water distribution in all areas;	\$0.00
	o Install a filtration system within the irrigation ponds to ensure that nozzles do not become blocked with suspended solids which can reduce irrigation efficiency and uniformity;	\$0.00
	o Incorporate evapo-transpiration rates and weather data into the daily irrigation decisions; and	\$ 0.00

	o Reduce the level of irrigation on all unused or minimally used areas of the property.	\$ 0.00
SOILS & GEOLOGY		
SITE PREPARATION AND CONSTRUCTION PHASES	o Only remove vegetation from areas for the golf course construction ;	\$0.00
	o Only remove vegetation after sod has completed 90 % grow-in;	\$0.00
	o Install appropriate drainage systems to direct water away from slopes;	\$ 0.00
	o Avoid as far as possible the traversing of bare soil by vehicles to reduce soil compaction;	\$ 0.00
	o Designate a main access route for heavy machinery;	\$ 0.00
	o Avoid Site Preparation in period when wind velocities are highest which is between June and July;	\$ 0.00
	o Avoid Site Preparation and Construction activities in periods of heavy rainfall, when soil is saturated which are typically between the months of October and December;	\$ 0.00
	o Areas storing hazardous substances such as diesel must be properly contained in a bunded area (With capacity to contain 1 ½ times the amount of substances stored. This area must be situated away from project activities and signs indicating the storage of these substances erected. Care must be taken when handling these hazardous substances to avoid spills.	\$ 0.00
	o In the event of a spill the contaminated soil must be removed and disposed of at a licensed landfill.	\$ 0.00
OPERATION PHASE	o Ensure that general refuse is collected regularly and is transported and disposed of appropriately at the designated disposal site.	\$ 0.00
	o Develop and implement a comprehensive Nutrient Management Programme for the maintenance of course. Golf course maintenance staff should be trained in these best practices.	\$ 0.00
	o Irrigate after fertilization to reduce volatilization;	\$ 0.00
	o Apply practices and use products that reduce the potential for contamination of soils including the physical removal of weeds, use of slow-release products and choosing the most 'environmentally friendly products available	\$ 0.00
	o Establish 'no-spray' zones within the development area. Staff should be trained to identify these areas;	\$ 0.00
	o Prevent the contamination of soils by the designation of a maintenance area for the maintenance of vehicles and other equipment to be used for the upkeep of the turf. This area should be lined with an impervious material and all run-offs from this area channelled and collected in a catchment area, after which it can be properly disposed;	\$ 0.00
	o Ensure that all chemicals are properly stored in a specific location. All chemicals stored in this area must be properly labelled. The area where chemicals will be stored and handled must be constructed with an impermeable surface. This area should also be bunded with the capacity to contain 1½ times the amount of substances stored	\$ 0.00
	o Reduce the recommended rate of application of fertilizers in out-play areas	\$ 0.00

	o Use slow release fertilisers and employ spoon-feeding application of these fertilizers	\$ 0.00
	o Purchase and store only the amount of pesticide needed for the immediate future.	\$ 0.00
	o In the event of a spill, ensure that this cleaned up immediately.	\$ 0.00
	o Follow recommended mowing technique to maintain a healthy pest-resistant turf, and therefore reduce the amount of pesticides required.	\$ 0.00
	o Develop and follow an Integrated Pest Management Guidelines this should outline the times when treating pests and other turf problems will be most effective and environmentally sound. This could include like recommendations for mowing time, and also should include the results from the investigation of non-chemical options for pest control.	\$ 0.00
	o Seashore Paspalum is tolerant to salts therefore rock salt may be used to control weeds, which would reduce the amount of herbicide that may be needed.	\$ 0.00
HYDROGEOLOGY		
SITE PREPARATION AND CONSTRUCTION PHASES	o Designate a main access route for heavy machinery;	\$ 0.00
	o Utilise impervious material for areas that require paving, such as parking lots to increase run-off. Parking lots may be designed to accommodate the average number of parking spaces. Additional parking spaces can be covered with gravel to reduce the amount of run-off from this area.	\$ 0.00
	o Ensure that the drainage plan proposed is implemented as stipulated on the plan.	\$ 0.00
	o Phase the clearing of vegetation on slopes.	\$ 0.00
	o Additional drainage may be put in place to convey the flood discharge to the sea and the retention areas used primarily to retain water for irrigation and smaller flood discharges.	\$ 0.00
	o The provision of a system of culverts should be considered at the intersection of the major flowpath leading to the large depression and the proposed road south of the depression in Basin 2.	\$ 0.00
OPERATION PHASE	o Ensure that all drains and culverts collecting water within the site are regularly cleaned and maintained.	\$ 0.00
NOISE & VIBRATION		
SITE PREPARATION AND	o Access roads should be cut that are exclusively used for the transportation of workers, goods and materials. These roads should be sited in such a way that the noise from this movement affects as few of the existing residents as possible.	\$0.00
	o Where possible silenced machinery and instruments should be employed to reduce the impact of noise on the existing residents and workers.	\$0.00
	o Machinery, vehicles and instruments that emit high levels of noise should be used on a phased basis to reduce the overall impact. These pieces of equipment such as drills, graders and cement mixers should also be used when the least number of residents can be expected to be affected, for example during periods where most residents are at work	\$0.00

CONSTRUCTION PHASES	or school.	
	o Workers, especially those working with machinery, vehicles and instruments that emit high levels of noise should be supplied with ear plugs and ear muffs to reduce the risk of hearing impairment. Prolonged exposure to this impact should be reduced where possible.	~\$ 15,000.00 /quarter
	o Temporary barriers such as earth berms, zinc fencing and sound dampening fencing such as acoustic screens should be employed to reduce the impact of noise to the existing residents;	\$ 0.00
	o Construction hours should be limited to the hours of 8:00 a.m. and 6:00 p.m. daily.	\$0.00
OPERATION PHASE	o Ensure that there is proper traffic signage and signals where necessary or appropriate to effect the free and safe movement of traffic and there reduce the noise caused by traffic build-up.	\$0.00
	o Ensure that the golf course adheres to its opening hours which are between 6:00 a.m. and 8:00 p.m. daily.	\$ 0.00
	o Ensure that deliveries to the golf course are made between 8:00 a.m. and 5:00 p.m. daily.	\$ 0.00
	o Ensure that maintenance works on the golf course occurs between the hours of 8:00 a.m. and 5:00 p.m. daily.	\$0.00
LANDSCAPE AND AESTHETICS		
SITE PREPARATION AND CONSTRUCTION PHASES	o Remove as little vegetation throughout the site as possible.	\$ 0.00
	o Conduct vegetation clearance on a phased basis and only after sod has achieved a 90 % grow in at the sod farm.	\$ 0.00
	o Re-vegetate cleared areas as soon as possible.	\$ 0.00
	o Retain vegetation screens from the mail vantage point along the highway to reduce the visual effect of this stage of the development.	\$ 0.00
	o Ensure that local building materials and muted colours are used to reduce the visual impacts of the development and the landscaping to hide it or blend in with the local environment. The developer is encouraged to mimic the Georgian style of construction, which the nearby town of Falmouth boasts.	\$ 0.00
OPERATION PHASE	o Ensure that the golf course and the buildings incorporated within its designs are regularly maintained.	\$ 0.00
BIOLOGICAL IMPACTS: TERRESTRIAL ENVIRONMENT		
FLORA		
SITE PREPARATION AND	o Only clear vegetation that is absolutely necessary for the construction activities; this vegetation should be cleared only after there has been 90 % grow- in of the sod at the sod farm;	\$0.00

CONSTRUCTION PHASES	o Retain all mature trees (> 25 cm diameter at breast height (DBH)) during this phase of the development;	\$0.00
	o Perform translocation of important plant species such as the endemic orchids. The developer can make arrangements with either of the two (2) orchid sanctuaries in Jamaica which are the Schwallenburg Orchid Sanctuary located in St. Ann or the Martins Hill Orchid Sanctuary located in Manchester to accept these species. Both sanctuaries are operated by the West Indies Alumina Company (WINDALCO) Ltd. A nursery should be established for the propagation of native species which should be reintroduced into the golf course landscape design.	\$0.00
	o Avoid the use of Invasive Alien Species in the landscaping activities (A list of these Invasive Alien Species are shown in Appendix 6)	\$0.00
	o Determine access roads which are to be used by machinery used in the construction and site clearance phase of the development to avoid the unnecessary trampling of vegetation that will be maintained within the development area.	\$ 0.00
	o Ensure that 'green belts' which have been proposed for the golf course design are large as possible as small patches may not be able to support viable populations of some species and these small patches tend to more susceptible to edge effect. It possible position these green belts in adjacent to existing vegetated areas. In addition species richness tends to increase with area, which would be the desired outcome of the incorporation of green belts.	\$ 0.00
OPERATION PHASE	o Physically delimit the remaining neighbouring forests by some means of fencing which will reduce the impact of secondary opportunistic clearance in the area as a result of increased accessibility created by the development;	\$ 0.00
	o Develop and implement a comprehensive Nutrient Management Programme for the maintenance of course. Golf course maintenance staff should be trained in these best practices;	\$ 0.00
	o Establish and maintain 'no-spray' zones throughout the golf course	\$ 0.00
	o Limit the fertilizer applications in the vicinity of the Mangrove Zone namely Holes 17 and 16;	\$ 0.00
	o Use slow release fertilizers throughout the golf course;	\$ 0.00
	o Utilise as far as possible the most 'environmentally friendly chemicals for the maintenance of the turf.	\$ 0.00
	o Physically delimit the remaining neighbouring forests by some means of fencing which will reduce the impact of secondary opportunistic clearance in the area as a result of increased accessibility created by the development;	\$ 0.00
FAUNA – AVIFAUNA		
SITE PREPARATION AND	o Maintain all mature trees (trees > 25 cm) within the development;	\$ 0.00
	o Only remove vegetation that is necessary for the construction of the golf course;	\$ 0.00
	o Reduce edge effect and habitat loss by physically delimit the remaining neighbouring	\$ 0.00

CONSTRUCTION PHASES	forests by some means of fencing which will reduce the impact of secondary opportunistic clearance in the area as a result of increased accessibility created by the development;	
	o Incorporate as much local plants found within the area into the final landscaping of the property;	\$ 0.00
	o Birds tend to be most active during the early morning and late evening. Construction activities must therefore be limited to the hours of 8:00 a.m. and 6:00 p.m.	\$ 0.00
	o The developer may encourage birds to utilise rough areas as habitats by installing nest boxes and birdhouse within these areas.	\$ 0.00
	o The developer should incorporate trees that are used by bird species for foraging to attract bird species to the area.	\$ 0.00
OPERATION PHASE	o Establish 'no-spray' zones throughout the golf course, especially in the remaining vegetated areas of the golf course to reduce the effect of pesticides on the remaining fauna within these vegetated areas.	\$ 0.00
FAUNA – BUTTERFLIES		
SITE PREPARATION AND CONSTRUCTION PHASES	o Plant native shrubs and herbs throughout the development such as <i>Lantana sps.</i> to encourage the butterflies to remain in the area.	\$ 0.00
	o Incorporate green belts within the golf course design to ensure that butterfly species remain in the area.	\$ 0.00
OPERATION PHASE	o Establish 'no-spray' zones throughout the golf course, especially in the remaining vegetated areas of the golf course.	\$ 0.00
OTHER MACRO FAUNA		
SITE PREPARATION AND CONSTRUCTION PHASES	o If possible, introduce site clearing on a phased basis to allow species the opportunity to relocate to suitable nearby habitats and to reduce the shock to the various habitats that may be disturbed.	\$ 0.00
	o During site preparation and construction phases, the spoilage and waste should be removed, relocated or stored in a manner that does not allow for the disturbance of surrounding habitats or the species that remain.	\$ 0.00
	o Where Yellow Snake species are observed, these should be captured and translocated to a nearby Wildlife Sanctuary. The developer may contract the services of the Seven Oaks Wildlife Sanctuary in Runaway Bay for their assistance in these translocation activities.	\$ 0.00
OPERATION PHASE	o Establish no spray zones within the golf course. Staff must be trained to identify these areas;	\$ 0.00
	o Apply practices and use products such as the physical removal of weeds, use of slow-release products and choosing the most 'environmentally friendly products available;	\$ 0.00
	o When applying pesticides employ spot-treatment to affected areas	\$ 0.00
	o Follow recommended mowing schedules and technique to maintain a healthy pest-resistant turf, and therefore reduce the amount of pesticides required.	\$ 0.00

	o Develop and follow an Integrated Pest Management Policy. This policy should the times for treating pests and other turf problems. This could also include recommendations for mowing time, and also indicate how to use non-chemical options for pest control such as rock salt.	\$ 0.00
	o The reservation of green spaces and buffer zones through out the development that are uninterrupted by aspects of the development may be used for a “passive” habitat creation. Areas of the site can be replanted with plant species that may encourage the return of associated animal species.	\$ 0.00
BIOLOGICAL IMPACTS: MARINE ENVIRONMENT		
SITE PREPARATION AND CONSTRUCTION PHASES	o If diesel and motor oil are to be stored on site, ensure that they are properly contained in a bunded area (With capacity to contain 1½ times the amount of substances stored). This area must be situated away from all water bodies and signs indicating the storage of these substances erected;	\$ 0.00
	o Provide workers at the development site with chemical toilets during this phase of the development. A reasonable ratio would be eight (8) workers per toilet;	~\$ 20,000.00/quarter
	o Store all raw materials away from the vicinity of water bodies located on the property and away from the coastal areas to avoid contamination in these areas;	\$ 0.00
	o General refuse generated during these phases of the development must be stockpiled in one central area of the development site, away from existing water bodies and collected, transported and disposed of appropriately at the designated disposal site;	\$ 0.00
	o Clearance of vegetation must be avoided in periods of heavy rainfall (between October and December) to reduce the impact of runoff;	\$ 0.00
	o Avoid clearance of vegetation when periods of wind speed are highest (June to July);	\$ 0.00
	o Vegetation should not be cleared until sod has reached a 90 % grow-in at the sod farm; and	\$ 0.00
	o Conduct periodical water quality monitoring to ensure that standards are maintained.	\$ 0.00
	o Ensure that all development of the golf course is located at least 30M from the high water mark.	\$ 0.00
	o Ensure that artificial lighting does not directly illuminate the beach area. If lights are to be used in this area they should be low pressure sodium lights that are no higher than 4 m above the ground.	\$ 0.00
OPERATION PHASE	o Maintain wetlands along the coast around all waterways (man-made, natural and marine environments) to reduce the nutrient loading to these waterways. Ensure that all machinery and vehicles used in the maintenance of the golf course are regularly maintained. Fertilizer applications should be based on the results of regular soil testing.	\$ 0.00
	o Use as far as possible slow-release Nitrogen to reduce the potential of leaching and run-off into water bodies.	\$ 0.00
	o Develop and implement a comprehensive Nutrient Management Programme for the maintenance of course. Golf course maintenance staff should be trained in these best	\$ 0.00

	practices.	
	o The application of fertilizer must be timed to minimize leaching from rainfall or irrigation;	\$ 0.00
	o Irrigate after fertilization to reduce volatilization;	\$ 0.00
	o Reduce irrigation in periods of high levels of rainfall which is typically between the months of October and December;	\$ 0.00
	o Apply practices and use products that reduce the potential for contamination of ground water and surface water which includes the physical removal of weeds, use of slow-release products and choosing the most 'environmentally friendly products available	\$ 0.00
	o Establish 'no-spray' zones and buffer areas particularly around areas where there are water features and other surface waters. Staff should be trained to identify these areas;	\$ 0.00
	o Ensure that all chemicals are properly stored in a specific location. All chemicals stored in this area must be properly labelled. The area where chemicals will be stored and handled must be constructed with an impermeable surface. This area should also be bunded with the capacity to contain 1½ times the amount of substances stored	\$ 0.00
	o Employ more environmentally-sensitive turf management techniques within ten (10) metres of all wetlands, water bodies to eliminate or minimize nutrient and chemical inputs	\$ 0.00
	o In order to reduce the amount of Nitrogen needed grass clippings will be recycled throughout the entire golf course. It is estimated that this will provide approximately 0.45 kg/ 100 m ² /year. Where they are not used, they must be properly collected and stored and disposed of properly. Rainfall can also provide natural source of Nitrogen which is estimated to be approximately 0.09 – 0.22 kg / 100 m ² /year. The use of fertilizer can therefore be adjusted to consider these other sources of nitrogen.	\$ 0.00
	o Take weather into account for the application of pesticides;	\$ 0.00
	o When applying pesticides as far as possible employ spot-treatment;	\$ 0.00
	o For holes closest to the shoreline raise the mowing height to slow and filter runoff	\$ 0.00
	o Reduce the recommended rate of application in out-play areas;	\$ 0.00
	o Determine pest thresholds and apply pesticides only when threshold has been exceeded;	\$ 0.00
	o Use slow release fertilisers and employ spoon-feeding application of these fertilizers;	\$ 0.00
	o Locate chemical storage and handling areas as far as possible from water course. Ideally a vegetative buffer should be incorporated in the design of the golf course between the storage area and water courses;	\$ 0.00
	o Care should be taken not to apply more fertilizer than is needed since there may be a growth surge in response to the nutrients which can lead to increased thatch production and predisposition to increased insect and or disease activity;	\$ 0.00
	o Monitor the Chloride level in irrigation water as this may suppress the uptake of Nitrogen in Seashore Paspalum.	\$ 0.00
	o Ensure that there is proper storage and disposal of waste generated at the clubhouse	\$ 0.00
	o Conduct regular water quality monitoring of the sewage treatment facilities, water courses to ensure that these are in keeping with the prescribed water quality standards (See Section 11.1.3)	\$ 0.00

	o Ensure that there is proper blending of irrigation water with fresh water from run-off	\$ 0.00
	o Purchase and store only the amount of pesticide needed for the immediate future.	\$ 0.00
	o In the event of a spill, ensure that this cleaned up immediately.	\$ 0.00
	o Follow recommended mowing technique to maintain a healthy pest-resistant turf, and therefore reduce the amount of pesticides required.	\$ 0.00
	o Develop and follow an Integrated Pest Management Guidelines this should outline the times when treating pests and other turf problems will be most effective and environmentally sound. This could include like recommendations for mowing time, and also could include the results from the investigation of non-chemical options for pest control.	\$ 0.00
	o Monitor the water quality in the wells that will provide water for irrigation of the golf course to ensure that the levels of saline intrusion are not exceeded. These wells should be secured from public domain so that persons do not utilise the water in these wells for potable use.	\$ 0.00
	o Ensure that artificial lighting does not directly illuminate the beach area. If lights are to be used in this area they should be low pressure sodium lights that are no higher than 4 m above the ground.	\$ 0.00

TABLE II: SUMMARY OF SOCIO-ECONOMIC MITIGATION MEASURES

SOCIO-ECONOMIC COMPONENT	MITIGATION MEASURES	COST
SOCIAL STRUCTURE		
DEMOGRAPHY		
SITE PREPARATION AND CONSTRUCTION PHASES	o As far as possible employ persons from the surrounding communities during this phase of the development to reduce the numbers of persons that will migrate to the area seeking employment.	\$ 0.00
OPERATION PHASE	o As far as possible employ persons from the surrounding communities during this phase of the development to reduce the numbers of persons that will migrate to the area seeking employment.	\$ 0.00
	o The Local Planning Authority must ensure that development within the parish, and the areas surrounding the development area takes place in an orderly and sustainable manner.	\$ 0.00
COMMUNITY COHESION		
SITE PREPARATION AND CONSTRUCTION	o As far as possible ensure that there is community involvement in the golf course design and implementation.	\$ 0.00

PHASES	o As far as possible employ persons from the surrounding communities during these phases of the development.	\$ 0.00
OPERATION PHASE	o The developer should develop a Corporate Social Responsibility Programme which could provide assistance to the community such as the construction of a community centre and develop golf programmes for youth in the community.	~\$1,500,000.00 over three (3) years
ECONOMIC STRUCTURE		
EMPLOYMENT AND INCOME		
SITE PREPARATION AND CONSTRUCTION PHASES	o As much as is possible it is recommended that persons from the nearby communities be employed to work on the construction site. This will avoid any feelings of resentment and will ensure that the community derives the most benefits from the development.	\$ 0.00
	o As far as possible purchase supplies to be used in the construction of the golf course from nearby suppliers.	\$ 0.00
	o Identify a specific area on the project site for vending type activities ensuring that there are garbage receptacles throughout the project site.	\$ 0.00
OPERATION PHASE	o As much as is possible it is recommended that persons from the nearby communities be employed to work during the operation of the golf course. This will avoid any feelings of resentment and will ensure that the community derives the most benefits from the development.	\$ 0.00
	o As far as possible purchase goods and supplies from suppliers within the area to ensure that the community reaps the maximum benefit from the development.	\$ 0.00
	o The Local Planning Authority must play an important role in ensuring that the development slated for the area is monitored and implemented in an orderly and sustainable manner.	\$ 0.00
INFRASTRUCTURE		
ROAD NETWORK		
SITE PREPARATION AND CONSTRUCTION PHASES	o The developer must improve the road network which provides access to the project area. This should be accompanied by an upgrade in the drainage along this road network. Ideally the road improvement works should take place prior to the infrastructural works at the development site.	\$0.00
	o These road improvements must be scheduled between 9:00 a.m. and 4:00 p.m. daily, so as not to disrupt traffic in the area and to abate the increase in ambient noise levels in the community.	\$0.00
OPERATION PHASE	o Ensure that roads are regularly maintained.	\$0.00
UTILITIES		
ELECTRICITY		
OPERATION PHASE	o Install energy saving lights within the club house and other buildings;	\$0.00
	o Utilise solar panels for equipment such as water heaters and lighting around the golf course;	\$0.00
	o Lights that are not operated by solar power should be fixed with light sensors to regulate the duration of on-time for these lights;	\$0.00

	o Ensure that clubhouse is designed in such a manner that there is reduction in the energy use associated with the operation of air conditioning units; and	\$0.00
	o Train golf course operation employees in the benefits of energy conservation.	\$0.00
WATER AVAILABILITY		
SITE PREPARATION AND CONSTRUCTION PHASES	o Ensure that there is adequate water available to supply the increase in demand that the construction activities will pose. It may be necessary for the upgrading works by the National Water Commission (NWC) to be undertaken prior to the start of the construction of the golf course.	\$0.00
OPERATION PHASE	o Ensure that there is an upgrade to the water supply in the area prior to the operation of the course;	\$0.00
	o Water consumption during this phase can be reduced with the installation of water conservation fixtures in buildings, the maximising of recycled water in the irrigation activities , the frequent maintenance of irrigation systems to be installed along the golf course and a the conducting of training for golf course workers on the importance of water conservation.	\$ 0.00
TELECOMMUNICATIONS		
OPERATION PHASE	o Liase with the telecommunications provider from the early stages of the development so that infrastructure work can be integrated with road upgrade works if necessary.	\$0.00
WASTE		
SOLID WASTE		
SITE PREPARATION AND CONSTRUCTION PHASES	o The developer should seek to hire a private licensed solid waste collection company to reduce the impact on the local collections services.	\$0.00
	o All the refuse generated from this phase of the development should be properly transported and disposed of at the nearest licensed solid waste facility.	\$0.00
	o Ensure that vending during these phases of the development is localised.	\$0.00
	o Provide garbage receptacles around the project site.	\$0.00
	o Ensure that all debris and garbage generated during this stage of the development is placed in a central place on the project site and collected by a licensed garbage disposal company who will deposit at the approved disposal site.	\$0.00
OPERATION PHASE	o The developer should seek to hire a private licensed solid waste collection company, who will collect solid waste at least five (5) times per week to reduce the impact on the local collections services.	\$ 0.00
	o All refuse and debris generated from this phase of the development should be properly transported and disposed of at the nearest licensed solid waste facility.	\$ 0.00
	o All containers which were previously used to store pesticides and other chemicals should be bored with holes to ensure that these containers are not reused.	\$ 0.00
SEWAGE EFFLUENT		
SITE PREPARATION	o Ensure that chemical toilets are provided for use by employees during these phases of the development. A reasonable ratio would be one (1) chemical toilet per eight (8) workers.	\$0.00

AND CONSTRUCTION PHASES		
OPERATION PHASE	The developer should ensure that all sewage treatment plants are maintained regularly and that all effluent released is within or below the irrigation standards for effluent as stipulated by the Natural Resources Conservation Authority (NRCA).(See Section 11 for Effluent Standards)	\$ 0.00
SOCIAL SERVICES		
HEALTH SERVICES		
SITE PREPARATION AND CONSTRUCTION PHASES	Provide a First Aid Kit on site for any minor injuries that may occur on site.	\$ 0.00
	Inform and make arrangements with the nearest Health Clinic to accommodate any major injuries that may occur in these phases of the project.	\$ 0.00
EMERGENCY SERVICES		
FIRE SERVICES		
SITE PREPARATION AND CONSTRUCTION PHASES	Burning should not be employed as a method of in the site preparation activities;	\$0.00
	Bund areas where flammable substances will be stored. These bunds must be designed to hold approximately 1 ½ times the amount of the substances that will be stored;	\$ 0.00
	Place warning signs in areas where flammable substances will be stored;	\$ 0.00
	Erect signs which include the numbers of the Falmouth Fire Station within the construction site	\$ 0.00
POLICE SERVICES		
SITE PREPARATION AND CONSTRUCTION PHASES	As much as is possible it is recommended that persons from the nearby communities be employed to work on the construction site. This will avoid any feelings of resentment that may be felt from locals and may reduce the level of crime and violence during these phases of the development.	\$0.00
	Despite the added expense it is recommended that there be adequate security present at the site at all times.	\$0.00
OPERATION PHASE	Ensure that all buildings are properly secured ; and	\$0.00
	Ensure that there is adequate security on site at all times.	\$ 0.00
TRANSPORTATION		
OPERATION PHASE	The developer may wish to implement a transportation system for workers, in the event that problems with access to transportation by workers becomes evident.	\$0.00

TABLE III: SUMMARY OF HAZARD IMPACT ASSESSMENT MITIGATION MEASURES

HAZARD	MITIGATION MEASURES	COST
TECHNOLOGICAL HAZARDS		
SITE PREPARATION AND CONSTRUCTION PHASES	o Provide all employees with safety and protective gear including hard hats, safety goggles, dust masks, gloves and safety shoes. Employees will be required to wear these at all times on the project site.	\$0.00
	o Designate the roles and responsibilities of employees, which will enable a clear chain of command during a fire or explosion and allows persons to be aware of their responsibilities in the event of such occurrences.	\$0.00
	o Ensure that all machinery used on the site is properly maintained and inspected before use.	\$0.00
	o Install several suitable, approved fire extinguisher at accessible, conspicuous and unobstructed points throughout the development area.	~\$30,000.00
	o Place a fully equipped first aid kit on the project site.	~\$3000.00
	o Place conspicuous warning signs where hazardous or flammable substances will be stored.	\$0.00
	o Where flammable substances will be stored, this should be done in a bunded area which is able to contain 1 ½ times the substances that are stored on site. Different chemicals must not be stored in the same bund.	\$0.00
	o Place information signs around the project site, which list the numbers of the person responsible for handling emergencies on the site, the Falmouth Fire Department, and the Falmouth hospital.	\$ 0.00
	o Keep an emergency log to document any occurrences of fires and explosions as well as to record any damage to the property and human injuries. This log must also contain emergency contact information for all employees.	\$ 0.00
OPERATION PHASE	o Only purchase the amount of chemicals that will be used in the short-term.	\$0.00
	o The developer must inform the Local Fire Department about the project so that measures may be put in place in anticipation of the increase demand on the fire services.	\$0.00
	o Designate the roles and responsibilities of employees, which will enable a clear chain of command during a fire or explosion and allows persons to be aware of their responsibilities in the event of such occurrences.	\$0.00
	o Ensure that all machinery used on the site is properly maintained and inspected before use.	\$ 0.00
	o Install several suitable, approved fire extinguishers at accessible, conspicuous and unobstructed points throughout the clubhouse and the maintenance area.	\$ 0.00
	o Place conspicuous warning signs where hazardous or flammable substances will be stored.	\$ 0.00
	o Where flammable substances will be stored, this should be done in a bunded area which is able to contain 1 ½ times the substances that are stored on site. Different chemicals must	\$ 0.00

	not be stored in the same bund.	
	o Place information signs around the project site, which list the numbers of the person responsible for handling emergencies on the site, the Falmouth Fire Department, and the Falmouth hospital.	\$ 0.00
	o Keep an emergency log to document any occurrences of fires and explosions as well as to record any damage to the property and human injuries. This log must also contain emergency contact information for all employees.	\$ 0.00
ACCIDENTS/GENERAL HUMAN HEALTH		
SITE PREPARATION AND CONSTRUCTION PHASES	o Provide all employees with safety and protective gear including hard hats, safety goggles, dust masks, gloves and safety shoes. Employees will be required to wear these at all times on the project site.	\$0.00
	o Designate the roles and responsibilities of employees, which will enable a clear chain of command in the event of an accident and allows persons to be aware of their responsibilities in the event of such occurrences.	\$0.00
	o Place a fully equipped first aid kit on the project site. Ensure that a crew member is trained in basic first aid practices.	\$0.00
	o Place information/warning signs around the project site, which indicates where hazardous and flammable material will be stored. Signs must also be placed around the construction site displaying the numbers of the person responsible for handling emergencies on the site, the Falmouth Fire Department, and the Falmouth hospital.	\$0.00
	o Keep an emergency log to document any occurrences of any accidents that may occur on the site. This log must also contain emergency contact information for all employees.	\$0.00
	o Ensure that all machinery operating at the project is regularly serviced and maintained.	\$0.00
	o Ensure that persons operating equipment on the site are authorised, capable and trained to do so.	\$ 0.00
	o Liaise with local health clinics informing them of the development so that measures may be put in place in anticipation of the increase demand on the health services	\$ 0.00
OPERATION PHASE	o Ensure that there is a fully operation medical station which will attend to both guests and workers on site.	\$0.00
	o Ensure that workers with the responsibility in the maintenance area are supplied with safety gear and will be required to wear these at all times	\$ 0.00
	o Ensure that only the required amounts of chemicals to be used in the short-term will be stored at the maintenance facility	\$ 0.00
	o Ensure that chemicals are stored in a safe and secure environment, and that only authorised persons will be allowed in these storage areas. These areas should be properly signed to indicate that hazardous chemicals are stored in this area.	\$ 0.00
	o Ensure that pesticides and fertilisers are administered only by trained personnel	\$ 0.00

	o Develop and implement a Health and Safety Training Manual for the golf course for employees of the golf course.	\$ 0.00
	o Do not apply pesticides, fertilizers or irrigate the golf course during opening hours.	\$ 0.00
	o Ensure that there are 'no-spray' zones within the golf course and that staff is trained to identify these areas.	\$ 0.00
	o Develop and implement and health and safety training manual for staff.	\$ 0.00
	o The golf course will be irrigated by several sources of water including the treated effluent from two (2) of the sewage treatment plants on site. It is important that the effluent maintains the irrigation standards as stipulated by the Natural Resources Conservation Authority (NRCA), to ensure that the health of guests and workers is not compromised. Where recycled water is stored in water features throughout the golf course, this should be properly labelled in several languages to indicate that the water has been recycled and not suitable for human consumption. Purple has been tagged as the universal colour for signs in places where recycled water is stored.	\$ 0.00
	o Bore holes in containers which were previously used to store pesticides and other chemicals to prevent re-use. All pesticide packaging should be collected and disposed of by a licensed waste disposal operator. o	\$0.00
NATURAL HAZARDS		
HURRICANES & TROPICAL STORMS		
SITE PREPARATION AND CONSTRUCTION PHASES	o Relocate all mobile machinery and equipment to suitable storage facilities.	\$0.00
	o Ensure that any loose roofing material is securely fastened prior to the hurricane.	\$0.00
	o Keep a logbook and record all damage that may have occurred after the hurricane.	\$0.00
	o Do not use electrical or mechanical machinery after the hurricane without proper inspection.	\$0.00
	o Remove all stockpiled material (aggregate and sand) and move to proper storage facilities.	\$0.00
	o Evacuate all project personnel from development site.	\$0.00
	o Ensure that holes to be located along the coast are designed so that they have sufficient elevation to take into account the possibility of storm surges associated with tropical storms and hurricanes as well as sea level rise which is thought to be a repercussion of climate change.	\$ 0.00
OPERATION PHASE	o Relocate all mobile machinery and equipment to suitable storage facilities.	\$0.00
	o Ensure that any loose roofing material is securely fastened prior to the hurricane.	\$0.00
	o Keep a logbook and record all damage that may have occurred after the hurricane.	\$ 0.00
	o Ensure that all raw materials used in the maintenance of the golf course are properly secured and that the area is sufficiently bunded to ensure that there is containment in the event of an accident.	\$ 0.00

	o Do not apply fertilizers or pesticides prior to a hurricane as intense periods of rain may increase run-off and therefore may cause possible contamination of adjacent water resources.	\$ 0.00
	o Following the hurricane water quality monitoring should be conducted on all water ways and ambient waters in the vicinity of the golf course.	\$ 0.00
EARTHQUAKES		
SITE PREPARATION AND CONSTRUCTION PHASES	o Ensure that employees are aware of the precautions to take during an earthquake.	\$0.00
	o Ensure that staff at the construction site is aware of the measures to be implemented during an earthquake.	\$0.00
	o Designate the roles and responsibilities of employees, which will enable a clear chain of command in the event of an accident and allows persons to be aware of their responsibilities in the event of such occurrences.	\$0.00
	o Place a fully equipped first aid kit on the project site	\$0.00
	o Place information signs around the project site, which list the numbers of the person responsible for handling emergencies on the site, the Fire Department, and the Falmouth hospital.	\$0.00
	o Ensure that employees are aware of the precautions to take during an earthquake.	\$0.00
OPERATION PHASE	o Ensure that employees are aware of the precautions to take during an earthquake.	\$0.00
	o Ensure that staff at the construction site is aware of the measures to be implemented during an earthquake.	\$0.00
	o Designate the roles and responsibilities of employees, which will enable a clear chain of command in the event of an accident and allows persons to be aware of their responsibilities in the event of such occurrences.	\$ 0.00
	o Place a fully equipped first aid kit on the project site	\$ 0.00
	o Place information signs around the project site, which list the numbers of the person responsible for handling emergencies on the site, the Fire Department, and the Falmouth hospital.	\$ 0.00
	o All areas which are used for storage where chemicals are stored for use in the maintenance of the golf course should be checked for damage, leaks and spills.	\$ 0.00
	o All hazardous chemicals must be stored should be banded to hold 1 ½ times the amount of chemical stored.	\$ 0.00
	o All spills should be cleaned up immediately and all hazardous waste disposed according to regulations.	\$ 0.00
LANDSLIDES		
Site Preparation and Construction Phases	o Retain vegetation along steep slopes, which will assist in maintaining the current slope stability, and lessen the potential for erosion at the development site.	\$ 0.00

1.0 INTRODUCTION

Amaterra Jamaica Ltd. intends to develop a resort complex on approximately 850 acres ~ 344 hectares of land in Duncans, Trelawny. One of the main components of this development is a proposed eighteen (18) - hole championship golf course, the first of its kind for the parish of Trelawny. Also included in the golf course design is a driving range, clubhouse and maintenance area. A sod farm is also proposed for the propagation of turf to be installed on the golf course.

This Golf Course has been proposed as a complementary feature to the overall Amaterra development plan which includes villas, condominiums, and hotels (2000 rooms in total). A “Town Centre Village” has also been proposed, which will include a business park with commercial units, conference centre and amenities including a police station, fire station and health facilities. Other recreation type activities proposed include an Equestrian Centre, Water Park and Amphitheatre.

An environmental permit application was submitted to the National Environment and Planning Agency (NEPA) for consideration, and based on the screening of this application; an Environmental Impact Assessment (EIA) was requested for the development of the golf course by the Agency. The approved Terms of Reference (TOR) for the conduct of this EIA is shown in **Appendix 1**.

A Strategic Environmental Assessment (SEA) for the development plan was conducted in December 2005, and has been submitted to the National Environment and Planning Agency (NEPA) for review. This SEA was granted an environmental permit from the Agency in April 2005. Following discussions between the developer, the consultants and NEPA, this Environmental Impact Assessment (EIA) refers to baseline data that was presented in the approved SEA. This data has been used to describe the present situation and for the most part has been used for comparison with data that was collected during this study.

This report aims to present the assessment criteria, the methodologies for the assessments, the identification of the possible impacts of the project, to analyse project alternatives, recommend mitigation measures for all impacts identified, and to give an

outline of an appropriate environmental monitoring plan for the development as stipulated by the TOR issued by NEPA.

The objectives of this EIA are as follows:

- o To describe the proposed development project;
- o To describe the legislative and regulatory considerations associated with the project;
- o To describe the present status of the environment on the project site;
- o To describe the present status of the socio-economic attributes of the project site;
- o To identify and predict any potential positive, negative, reversible, irreversible, short and long term impacts, as well as any cumulative and synergistic environmental and socio-economic impacts that may arise from the project;
- o To assess the hazards associated with the development;
- o To facilitate mitigation of possible negative impacts caused by the proposed development;
- o To recommend measures to enhance any positive impacts identified;
- o To outline possible alternatives to the project; and
- o To outline a suitable environmental management and monitoring plan for the duration of the project.

1.1 STRUCTURE OF THE REPORT

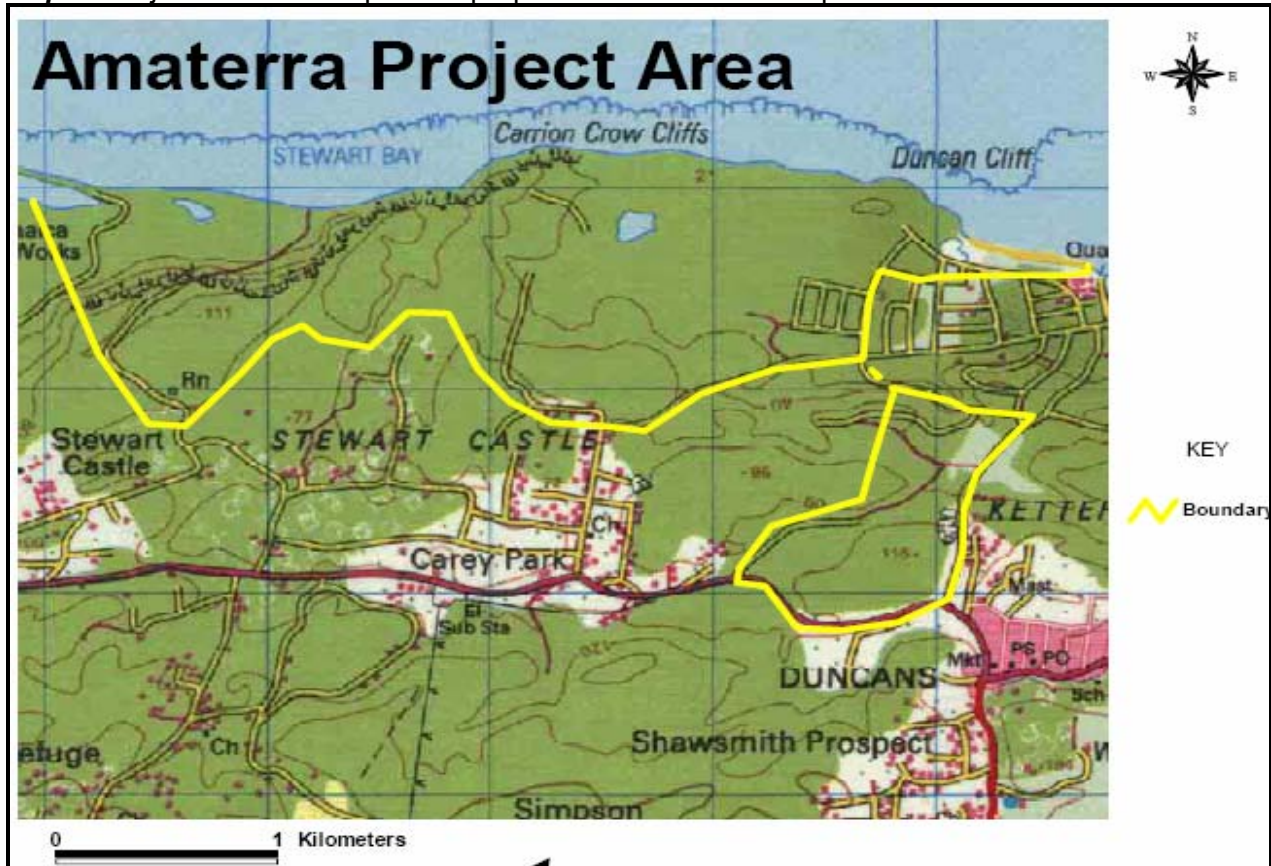
The report is divided into thirteen (13) sections including the introductory chapter. **Section 2** of the report provides a description of the project including location and description of activities. This is followed by **Section 3**, which presents an overview of all the pertinent laws and regulations that must be considered for this type of development activity. **Sections 4** and **5** provide a description of the current Socio-Economic and Environment attributes of the study area respectively. All the suitable alternatives to the project design are presented in **Section 6**. In **Section 7, 8** and **9** the environmental, socio-economic and hazard impacts are analysed and mitigation measures presented. A draft-monitoring plan for the development is presented in **Section 10**. **Section 11** provides an overview of the conclusions and recommendations made. This is followed by the Bibliography in **Section 12** and the Appendices in **Section 13**.

2.0 PROJECT DESCRIPTION

2.1 PROJECT LOCATION

The Amaterra property is located in the north east section of the parish of Trelawny along the Duncans to Coral Spring main road. This is shown in **Map 1** below.

Map 1: Project Location Map of the proposed Amaterra Development



Source: TEMN (2005)

2.2 DESCRIPTION OF THE AREA TO BE DEVELOPED CURRENT LAND USE AND FUTURE DEVELOPMENT FOR THE AREA

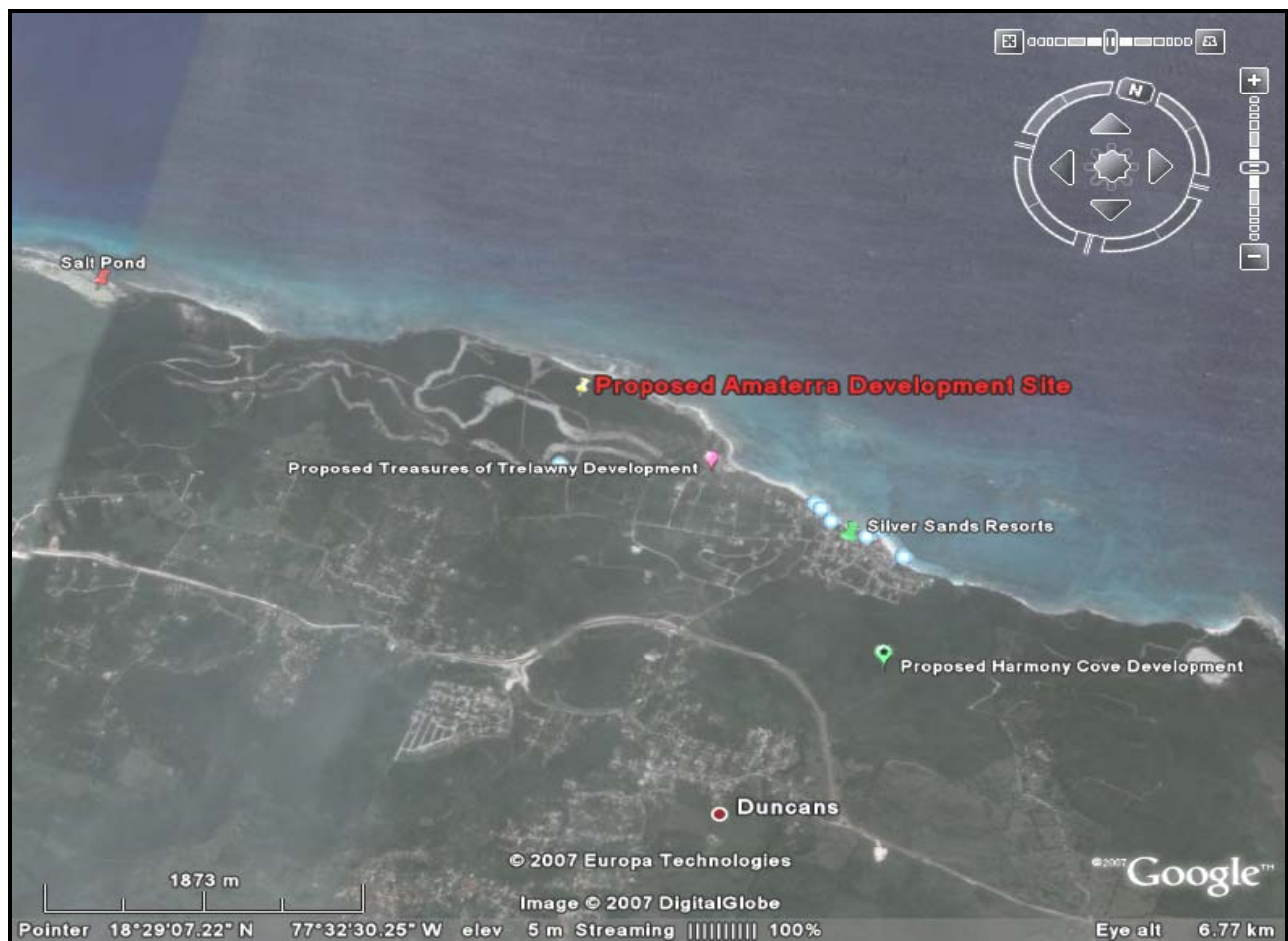
The area for the proposed development is currently undeveloped. The coastal zones consist of beachfront areas and cliff rock faces. To the east of the property is the Silver Sands property, which is a tourist resort consisting of over ninety (90) villas. An abandoned salt mining factory, previously operated by the Jamaica Salt Works, is located to the west of the property. Information gleaned from local residents and the developer shows that this

factory ceased operation over thirty (30) years ago. To the east is a small quarrying pit. Surrounding the development site are several residential communities including the communities of Stewart Castle, Carey Park, Duncans Hill and Kettering. The developer in recent times has had problems with unplanned settlements on the property but this has been rectified.

The proposed development area according to the Development Order for the parish of Trelawny is zoned for resort type development.

Other resort type development has also been proposed for the area. This includes the Treasures of Trelawny and the Harmony Cove Developments both located east of the Amaterra development site.

Figure 1: Figure showing the aerial image of the proposed Amaterra development



Source: Google Earth (2007)

2.3 PROPOSED PROJECT DESIGN & IMPLEMENTATION

2.3.1 GENERAL DESCRIPTION OF THE PROJECT

The golf course will be constructed on approximately eighty - nine (89) hectares of land, and will traverse throughout the entire 344 hectare property (See **Table 1** & **Appendix 2**). The course will consist of eighteen (18) holes, including Fairways, Greens, Tees and Roughs, with intermittent water features and sand bunkers. The course will also feature a driving range, a club house and a maintenance area as shown in **Figure 2** below. A sod farm has also been proposed for the propagation of sod to be used for the turf of the golf course.

Figure 2: Figure showing the activities to be carried out during the development

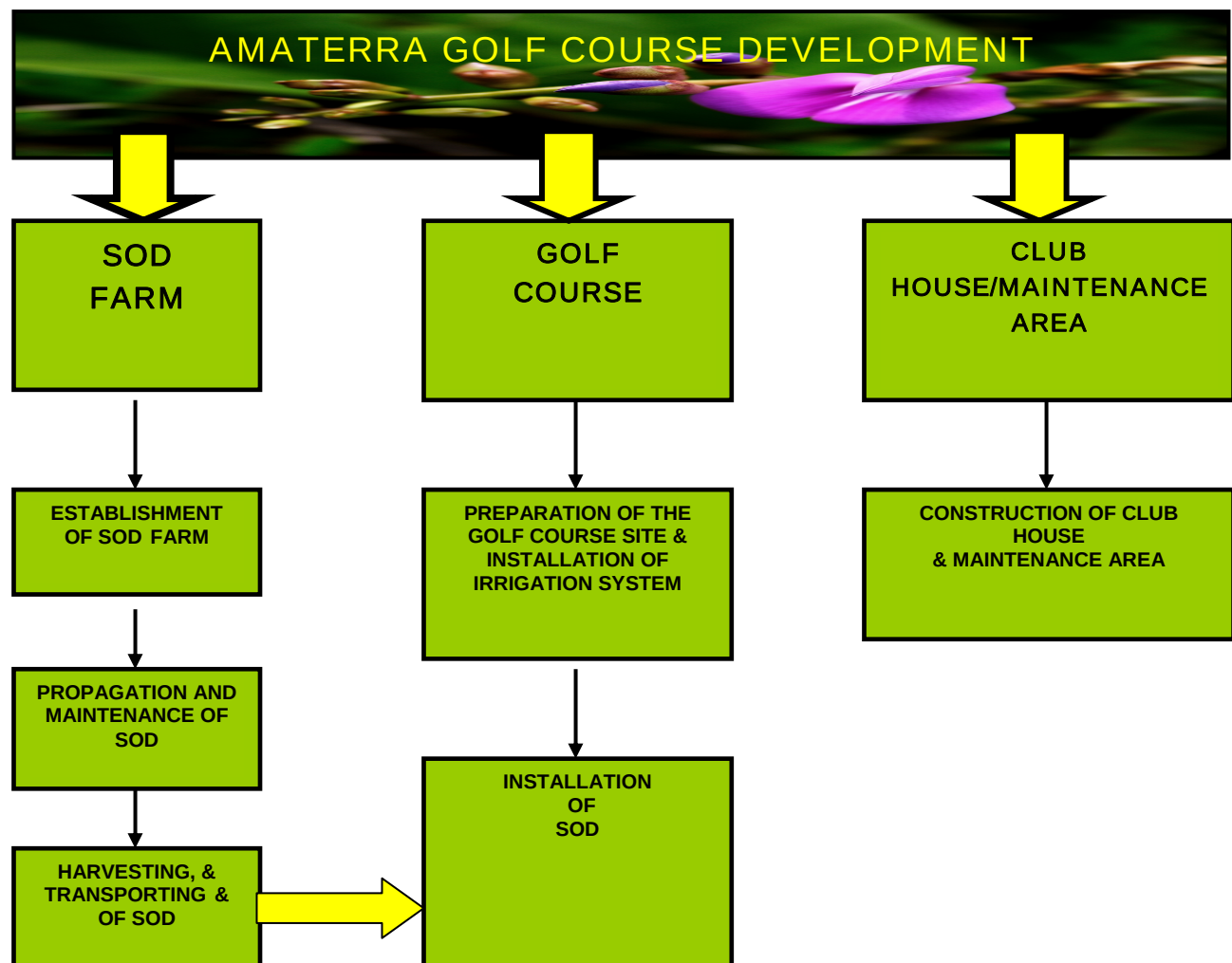


Table 1: Table showing the land use area for each component of the golf course

COMPONENT	SIZE/HECTARE
Tees	3.13
Fairways	19.5
Greens	1.5
Roughs	26.5
Water features, bunkers, other	27.5
Subtotal (Components of the Golf Course)	78.13
Sod Farm	4
Club House	2.9
Maintenance and Storage	2.7
Other	1.27
TOTAL	89

2.3.2 TURF TYPE

Taking into account the advantages to the environment and the relatively low maintenance, the major turf grass proposed to be used on the Fairways, Greens, Tees and Driving Range is Seashore Paspalum (*Paspalum vaginatum*). Seashore Paspalum is a warm season perennial grass that is native to tropical and subtropical regions of North and South America. Adams (1972) lists thirty (30) species of Paspalum grass which have been identified in Jamaica, including Seashore Paspalum (*Paspalum vaginatum*). This species is also not listed as an Invasive Alien Species nor does it have the potential to become invasive (CHM, 2007.) Native trees and shrubs will be used on the 'Rough' areas of the golf course.

2.3.2.1 GLOBAL USE OF SEASHORE PASPALUM

Seashore Paspalum is currently being maintained on courses in Asia, South Africa South America, Hawaii and the United States of America. This species has also been introduced to the Caribbean and is being utilized on courses such as the:

- Emerald Bay Resort: Exuma, Bahamas;
- Divi Resort : Grand Cayman, Cayman Islands;
- Cap Cana Golf Resort: Cap Cana, Dominican Republic;
- Trump International Golf Club :Canouan, St. Vincent, Grenadines, and;

- The Royal St. Kitts Golf Course: St. Kitts.

2.3.2.2 CHARACTERISTICS OF SEASHORE PASPALUM

Extensive research has been undertaken on Seashore Paspalum worldwide. Based on its many advantageous characteristics, Seashore Paspalum has been described as one of the most environmentally 'friendly' turf grass utilized on golf courses to date. **Table 2** below shows how characteristics of Seashore Paspalum compared to other popular turf types. These and other advantages are discussed below.

Table 2: Table showing the comparison of characteristics of four (4) commonly used Turf Grasses

ENVIRONMENT	SPECIES			
	Bermuda Grass	Seashore Paspalum	Zoysia Grass	Centipede Grass
Soil Type	Wide range	Wide range	Wide range	Acid-infertile
Drought Tolerance	Good	Good	Medium	Medium
Salt Tolerance	Good	Excellent	Good	Poor
Wear Tolerance	Good-Excellent	Good-Excellent	Good-Excellent	Poor
Nematode Tolerance	Poor	Good	Poor	Poor
Maintenance Level	Medium – High	Medium	High	Low

Adapted from: EPA, 2002

2.3.2.3 ADVANTAGES OF SEASHORE PASPALUM

2.3.2.3.1 DROUGHT RESISTANCE

Seashore Paspalum is highly drought resistant and can survive in an area that receives less than two hundred and fifty (250) days of rainfall per year. This is due to its extensive and deep root system. This will reduce the amount of water needed to meet the irrigation requirement for the golf course.

2.3.2.3.2 ADAPTABILITY TO COASTAL ENVIRONMENTS

One of the most outstanding characteristics of Seashore Paspalum (*Paspalum vaginatum*) is its ability to tolerate the physical conditions associated with coastal environments. This species is a native to sand dunes and therefore thrives in coastal areas. This species displays the highest salt tolerance of all turf grasses and is highly tolerant to saline soil

conditions and salt spray. This species is so tolerant to saline conditions, that it can be watered with seawater.

2.3.2.3.3 TOLERANCE TO RECLAIMED WATER

Seashore Paspalum (*Paspalum vaginatum*) is also very tolerant to recycled, gray, and effluent wastewater. Therefore treated effluent from the sewage treatment facilities located on property may be used to irrigate the golf course without causing damage to the turf.

2.3.2.3.4 HERBICIDE REQUIREMENTS

This species has a high shoot density and is therefore more competitive against weeds and other grasses. This will reduce the amounts of herbicides that will be needed to maintain the golf course.

2.3.2.3.5 PESTICIDE REQUIREMENTS

Seashore Paspalum is less susceptible to insects and diseases as compared to other turf grasses, therefore reducing the amount of pesticides that has to be used during the maintenance of the turf.

2.3.2.3.6 FERTILIZER REQUIREMENTS

Seashore Paspalum has nutrient uptake and utilization mechanisms which provide functional growth and development under very low nutrient imbalance situations. As compared to other turf grasses such as Bermuda grass, this species has a lower nutrient requirement and a higher and more efficient uptake system. This will reduce the amount of fertilizer that will be needed as compared to other species, to maintain a healthy turf.

2.3.2.3.7 SOIL VERSATILITY

Seashore Paspalum is adaptable to a wide range of soil types. This species can survive in heavy to poorly drained soils.

2.3.2.3.8 AESTHETICS

Seashore Paspalum is soft with a cushioning texture that can help prevent skin abrasions, ankle and knee problems and ‘turf toe’ which are common ailments in golfing. It holds mowing stripe patterns and is much prettier than improved Bermuda grass.

2.3.3 PROJECT DESCRIPTION: SOD FARM

The proponent intends to establish a Sod Farm on approximately four (4) hectares of land just south of the property. Turf will be propagated at this site, which will be then transferred to the location of the golf course. The area for the sod farm will be cleared of any vegetation, levelled and tilled.

2.3.3.1 PROJECT DESCRIPTION: SOD FARM

Seashore Paspalum does not produce highly viable seeds and therefore has to be propagated vegetatively through rhizomes, stolons, verticuttings or sprigs.

2.3.3.1.1 RECOMMENDED NUTRIENT REQUIREMENTS FOR THE ESTABLISHMENT OF SOD

A. Nitrogen (N)

Seashore Paspalum absorbs very little Nitrogen (N) during the first month of growth. This is because the grass prioritizes root development and growth during this time. Nitrogen levels at this time will be kept low.

B. Potassium (K)

Medium to high levels of Potassium (K) will be essential during sod establishment to promote rhizome development root formation and root growth.

C. Phosphorus (P)

Application of Phosphorus (P) will be especially important during sod establishment as it is required for root development and plant growth.

2.3.3.1.2 RECOMMENDED FERTILIZER (N: P: K) APPLICATION

Approximately 0.14 - 0.23 kg / 100 m² of 1:2:2 N: P: K fertilizer will be applied biweekly for the first month during sod establishment. Once the stolons start growing, the amount of nitrogen applied may be increased. This will be coupled with regular verticutting or slicing to enhance grow – in. After about the first month after the sod has begun to grow-in, approximately 0.49 kg / 100 m² of a complete fertilizer of 1:1:1 N:P:K will be applied every 2 – 3 weeks until the area is about 90 % established. This will be coupled with verticutting or slicing to enhance growth.

After each verticut, it is recommended that a highly soluble nitrate source should be applied at 0.49 kg/100 m² on 7 – 14 day cycles to escalate the growth. **Table 3** below shows the estimated fertilizer use for the establishment of the sod farm.

It is important to note that Seashore Paspalum does not take up ammonia (NH₄⁺) or urea Nitrogen directly. These compounds must be transformed to NO₃⁻ Nitrogen. This can be enhanced alkaline soils by applying small amounts of lime to enhance the microbial conversion of NH₄⁺ and urea Nitrogen to NO₃⁻ Nitrogen.

Table 3: Table showing the estimated fertilizer use during the establishment of the sod farm

TIME OF APPLICATION	TYPE OF FERTILIZER	TOTAL AMOUNT OF FERTILIZER TO BE APPLIED UNTIL GROW-IN OF SOD/ KG
First month of sod establishment [applied biweekly for the first month]	1:2:1 N:P:K	~337.82 – 554.99
Growing Period [applied every 2 – 3 weeks until the area is about 90 % established]	1:1:1 N:P:K	~1,182.37
Nitrogen applied on 7-14 day cycles as necessary after each verticut	Soluble Nitrogen	~1,182.37
TOTAL		~1,520.19 – 1,737.36

2.3.3.1.3 RECOMMENDED HERBICIDES AND PESTICIDES APPLICATION

It may be necessary to apply a pre-emergent herbicide during the establishment of the sod. **Appendix 3** outlines the recommended pesticides and herbicides that can be utilized in the maintenance of this turf type, along with the Material Safety Data Sheets (MSDS) for these chemicals.

2.3.3.1.4. RECOMMENDED IRRIGATION DURING SOD ESTABLISHMENT

It will be important to ensure that the area where the sod has been established is kept moist especially during the first two (2) weeks of planting. After root initiation the irrigation schedule will be lengthened in intervals between fertilizer applications. Approximately 500 m³ of water will be required daily for the irrigation of sod.

2.3.3.2 HARVESTING OF SOD

It is estimated that the grow-in time will be approximately three to four (3 – 4) months. Once the sod has reached 100 % grow-in it will be cut into thick squares or rolls with the underlying soil and roots, and transported to the designated area and laid down to form instant turf cover.

To prevent damage to the plant material the sod will be removed quickly from the sod farm and transported to the golf course site where it will be installed. This sod layer will consist of approximately 9.4 mm of mineral soil and 8.5 mm of soil. Care will be taken when harvesting the sod to ensure that there is minimal removal of mineral soil. This will reduce the level of soil loss at the sod farm, and enhance rapid rooting on the prepared site. It is estimated that 500 – 1500 bushels of Seashore Paspalum sod will be applied per hectare.

2.3.3.3 OPERATION OF SOD FARM

2.3.3.3.1 STAFF REQUIREMENTS

The operation of the Sod Farm will require the employment of approximately ten (10) to fifteen (15) persons full time for a period of approximately six (6) months. This number will however be reduced to approximately five (5) persons after there has been grow - in of the sod and the sod farm is only operating to maintain the course and therefore operations will be scaled down.

2.3.3.3.2 WATER REQUIREMENTS

Water for the use on the sod farm will be provided by the National Water Commission (NWC). Water will be necessary for the irrigation of the sod during grow-in and for consumption by the employees. The water consumption of the employees (~10

employees) was calculated by the water usage of employees which is approximately 55 litres = 0.055 m³ per employee per day (EHU, 2005). The average daily consumption per employees is therefore approximately .55 m³ per day. The daily estimated water consumption during the establishment of sod farm at this site has been estimated at approximately 500.5 m³ per day.

The water requirements for this phase of the development are outlined in **Table 4** below.

Table 4: Table showing the water requirements for the operation of the Sod Farm

USE	AMOUNT (m ³ /day)
Irrigation of Sod	500
Employees	0.55
Total	500.55

2.3.4 PROJECT DESCRIPTION: GOLF COURSE

The golf course will consist of eighteen (18) holes with intermittent water features and sand bunkers. The area for the development of the golf course will be prepared after the sod has been 90 % established at the sod farm. This will reduce the level of soil erosion from wind and water and the dust generated during the preparation of the area. The preparation for the area includes the steps outlined below.

2.3.4.1 REMOVAL OF VEGETATION

The establishment of the golf course will require the removal of vegetation. This will include, clearing, under-brushing, and grubbing. Clearing will involve the removal and disposal of trees and brush. Under-brushing is the removal and disposal from treed areas of undergrowth, deadwood, and surface debris. Grubbing is the excavation and disposal of boulders, rock fragments and debris, and stumps and roots uncovered in the ground surface.

2.3.4.2 GRADING, EXCAVATION AND FILLING

The site will be graded, excavated and filled to elevations. Before the area is filled the entire course will be lined with a geotextile material to prevent the leaching of fertilizers, herbicides and pesticides to ground water resources. Fill will be sourced to raise elevations and create features using large earthmovers. In the design of the course, there will be an

evenly balanced cut and fill: where material is excavated or cut in one area (to create a lake or sand bunker), an equal amount of material will be used in other areas to create mounds or elevated tees. The natural drainage of the area will be enhanced and developed. Intersections between differing slopes will be accomplished by smoothly rounded transition curves and the man-made grades will taper into the existing grades to create a natural appearance.

In the absence of appropriate soil cover, the method of construction will involve the imploding of the existing karst terrain to choke the numerous cavities. Subsequently from bedrock brushing efforts, one would bed the fairways, place a fabric filter, then place a crushed rock layer over which they would place the 1 ½ inch thick sod. This would be worse case scenario, as opposed to soil conditions.

2.3.4.3 INSTALLATION OF THE IRRIGATION SYSTEM

The irrigation system for the golf course will also be installed during the preparation of the area for the golf course. Water from the effluent collection ponds will be administered to the golf course via subsurface or drip irrigation system. Where sprinklers are to be used these will not be higher than one (1) meter.

2.3.4.5 MAINTENANCE

2.3.4.4.1 RECOMMENDED FERTILIZER REQUIREMENTS

Nutrients will be required for the maintenance of the turf. A list of environmentally friendly fertilizers is presented in **Appendix 3**. The nutrients that will be required and the recommended rate of application for use on Seashore Paspalum are outlined below.

A. Nitrogen (N)

i. Tees, Greens and Fairways

It is recommended that 1.47 – 2.94 kg/ 100 m² /year of Nitrogen should be applied to the Tees Greens and Fairways. This rate of application will however vary depending on the concentrations of nitrogen found in the soil and the loading which is expected from the use of recycled water for irrigation. This is discussed in **Section 4.14**.

ii. Roughs:

The rough areas will need minimal maintenance and therefore the fertilizer requirements for these areas will be lower than the Tees, Greens or Fairways. To prevent the roughs from going off colour due to minimal Nitrogen applications it is recommended that low maintenance Calcium Nitrate should be applied at 0.16- 0.32 kg /100 m² /year.

B. Potassium (K)**i. Tees, Greens and Fairways**

Once the turf is established and is in use Potassium will be necessary for wear and stress tolerance, tolerance to saline conditions, drought resistance and disease resistance of the turf. In coastal environments, such as this, excess Sodium (Na) may suppress Potassium (K) uptake. High volume leaching to enhance net downward movement of salts and can deplete the soil K, as it is one of the most mobile nutrients. It is therefore recommended that approximately 0.41 – 0.82 kg/100 m² K₂O should be applied on a monthly schedule. This rate of application will however be dependent on the soil concentrations for Potassium which will be discussed in **Section 4.14**.

ii. Roughs

Minimal amounts of Potassium will be applied to the rough areas where necessary.

C. Phosphorus (P)**i. Tees, Greens and Fairways**

For the maintenance of Tees, Greens and Fairways an application rate of 0.14 -0.23 kg / 100 m²/year is recommended with applications being undertake three (3) to six (6) times per year where necessary. This rate of application will be dependent on the soil concentrations of Phosphorus which is discussed in **Section 4.14**. This rate will also depend on the concentrations of Phosphorus from the loading by the use of recycled water for irrigation purposes.

ii. Roughs

Minimal amounts of Phosphorus should be applied to the rough areas where necessary.

D. Minor Elements

i. Tees, Greens and Fairways

Micronutrients are sometimes not available for plant uptake. Micronutrients such as Iron (Fe) should be applied at 0.45 kg/ 100 m² /month to provide a quick-green up without promoting a growth surge. Magnesium (Mg) is good for colour retention and Manganese (Mn) plus Zinc (Zn) are key nutrients for activating the salinity tolerance mechanism. These minor elements should be monitored and applied where necessary. The rate of application of these micronutrients will be dependent on the levels of the concentrations of these elements found in the soil which is discussed in **Section 4.14** of this report.

2.3.4.4.1 OVERALL NUTRIENT REQUIREMENTS FOR THE AMATERRA GOLF COURSE

Table 5 below outlines the recommended overall nutrients to be applied for the maintenance of the golf course. As previously mentioned, the level of application will depend on the soil concentrations for these nutrients at the development site. This will also be dependent on the level of nutrient loading by the use of recycled water for irrigation purposes on the golf course.

2.3.4.4.2 WEED CONTROL

A healthy turf that is fertilized, irrigated and mowed properly will out-compete many weeds. Due to regulations as outlined in the Pesticides Control Act of 1975, only herbicides approved by the Pesticides Control Authority (PCA) of Jamaica will be used to control weeds on the golf course. A list of herbicides approved by the PCA for use on Seashore Paspalum and the respective Material Safety Data Sheets (MSDS) are presented in **Appendix 3**.

Table 5: Table showing the overall nutrients to be applied for the maintenance of the golf course

NUTRIENTS	RECOMMENDED AMOUNT TO BE USED AT THE GOLF COURSE /Kg /year
TEES, GREENS & FAIRWAYS	
Nitrogen	~3547.11-7094.22
Potassium	~989.33-1978.66
Phosphorus	~337.82-554.99
Minor Elements	
o Iron (Fe)	~1085.85
o Magnesium (Mg)	Monitored and applied where necessary
o Manganese (Mn)	Monitored and applied where necessary
o Zinc (Zn)	Monitored and applied where necessary
ROUGHES	
Nitrogen	~424-848
Potassium	Monitored and applied where necessary
Phosphorus	Monitored and applied where necessary
Minor Elements	
o Iron (Fe)	~662.5
o Magnesium (Mg)	Monitored and applied where necessary
o Manganese (Mn)	Monitored and applied where necessary
o Zinc (Zn)	Monitored and applied where necessary

2.3.4.4.3 PEST CONTROL

Seashore Paspalum has some problems with pests. These include sod webworms, mole crickets, beetles and fire ants. **Appendix 3** lists the approved pesticides and their respective Material Safety Data Sheets (MSDS).

2.3.4.4.4 DISEASE CONTROL

The amount of fertilizer added and the presence of environmental stresses can make Seashore Paspalum susceptible to disease. These include Dollar Spot Disease and Fusarium Blight. **Appendix 3** lists some fungicides that can be used to control these diseases.

2.3.4.4.5 WATER REQUIREMENTS

A. Irrigation

Golf courses use a copious amount of water in its maintenance activities. Grass that is recently planted from sod has established only a portion of its root system and at this stage is more susceptible to drought stress. The area therefore will be irrigated to about 10 cm –

15 cm soil depth two (2) to three (3) times per day for the first four (4) to seven (7) days after planting and then be irrigated at least once daily for another two (2) weeks. The number of days in between irrigation will be gradually extended as the grass continues to establish itself. This will force the root system further down into the ground and hence increase drought tolerance.

It is estimated that on average a standard eighteen-hole golf course requires between 2650 m³ – 3785 m³ per day for irrigation. This amount is dependent on the rate of evapo-transpiration and the climatic conditions of the area that the golf course is to be established in. This is also dependent on the turf type that is laid at the golf course. The turf type proposed is the Seashore Paspalum which requires very little irrigation as compared to traditional turf types. Due to these characteristics it is not anticipated that the water requirements for this golf course will exceed approximately 2,500 m³ per day, this figure may however be decreased depending on the rainfall pattern which is experienced in the area during a give time. In an effort to augment scarce water resources, the developer intends to use three (3) sources of water for the irrigation of the golf course. These include the following:

i. Treated Effluent

The rising cost and increased scarcity of water has placed pressure on golf courses worldwide to identify alternatives to water needed for the irrigation of golf courses. In many locations the use of recycled water for golf course irrigation has become a viable strategy for coping with these increased costs and scarcity. It is recommended that recycled water used for the irrigation of golf courses be treated to at least a secondary level.

Three (3) secondary wastewater treatment plants are proposed to serve the Amaterra Development. This system will involve the use of an STM -Aerator™ which combines the advantages of an activated sludge and fixed film process (See **Appendix 4**) [*Applications for the Permit and Licenses to operate these facilities have been presented to the National Environment and Planning Agency (NEPA), and the Environmental Health Unit of the Ministry of Health and are awaiting approval*]. Two (2) of these plants, **Plant 1** located near H-1 and **Plant 2** marked as M-2 on the general site layout plan (See **Appendix 2**) will discharge into lined lagoons throughout the course, which will serve as the major source of irrigation for the golf course. It is estimated that each plant will discharge approximately

757 m³ of effluent daily totaling approximately 1514 m³ daily, which is approximately half of the water requirements for daily irrigation.

For this recycled water to be used for irrigation, the effluent must meet the Natural Resources Conservation Authority (NRCA) Effluent Standards for Irrigation (See **Section 11**). Information provided on the sewage plant to be installed shows that the process to be employed can consistently produce an effluent quality with total Nitrogen lower than 8 mg/l and Phosphorus below 2 mg/l, which are well within the irrigation standards as stipulated by the NRCA (See **Section 11**).

ii. Other Sources of Irrigation

- Run-off

Run-off from the site will also be channeled into the water features within the golf course, providing a 'freshwater' input and preventing fertilizer and pesticides from entering adjacent water resources.

- Wells

It is proposed that water will be abstracted from the two (2) wells located on the property. These wells were drilled to provide for the water need of the development. Chemical analysis of the water collected from these wells showed that the water was unsuitable for human consumption as the chloride level was too high for drinking purposes. The salinity levels should not be an issue, due to the type of turf which is proposed.

It is proposed that a series of lined ponds and lakes will collect all the effluent from the sewage plants, as well as the storm water from the drainage system. These lakes and ponds will be incorporated in the golf course design and will provide a source of water for the fairways and greens thus reducing fertilizer requirement for the golf course. The fairways and greens will also be lined with geotextile materials to prevent intrusion of the irrigation waters, and return flow, as well as occlusion of leachate to the aquifers. All the storm water runoff from the development will be collected in the drainage system for reuse (TEMN, 2005).

An average of fifty (50) persons will be employed to the golf course operation at any given time. It is estimated that the average water consumption per employee is 55 liters per day

(EHU, 2005). The water consumption for employees will therefore be approximately 2,750 liters/ 2.75 m³ per day. This is shown in **Table 6** below.

Table 6: Table showing the amount of water needed and source for the irrigation of the golf course

USE	Amount of Water Required/ m ³ /day
Water for Irrigation of Golf Course	2,500
Staff	2.75
TOTAL	~ 2,502.75

2.3.4.5 OPERATION

2.3.4.5.1 OPENING HOURS

The golf course and therefore the clubhouse will be between the hours of 6:00 a.m. and 8:00 p.m. daily, seven (7) days per week.

2.3.4.5.2 STAFF REQUIREMENTS

It is anticipated that approximately fifty (50) persons will be employed during the site preparation and construction phase of the golf course. This number will be reduced to approximately twenty (20) persons in the operation phase.

2.3.4.5.4 SEWAGE GENERATION AND TREATMENT

It is anticipated that the sewage generated by the golf course workers will be equal to the amount of water consumed (EHU, 2005) (See **Table 6** above) .Three (3) secondary wastewater treatment plants are proposed to serve the Amaterra Development. All sewage generated from the operations of the Clubhouse will be tied into one (1) of these sewage treatment plants. This system will involve the use of a STM -Aerator™ which combines the advantages of an activated sludge and fixed film process (See **Appendix 4**) [*Applications for the Permit and Licences to operate these facilities have been presented to the National Environment and Planning Agency (NEPA), and are awaiting approval*].

2.3.5 PROJECT DESCRIPTION: CLUBHOUSE & MAINTENANCE AREA

2.3.5.1 CLUBHOUSE AND MAINTENANCE AREA DESIGN

A clubhouse will be integrated within the Golf Course design which is located to the south of the property (See **Appendix 2**). This clubhouse will be fitted with all the amenities of a clubhouse including administrative offices, café, bar/lounge and locker rooms for club members.

A maintenance area will also be included in the golf course design. This area will be the central hub for the maintenance of the golf course and its main function includes the storage of equipment and materials needed for the daily upkeep of the turf.

2.3.5.2 OPERATION

2.3.5.2.1 OPENING HOURS

The golf course and therefore the clubhouse will be between the hours of 6:00 a.m. and 8:00 p.m. daily, seven (7) days per week.

2.3.5.2.2 STAFF REQUIREMENTS

It is anticipated that approximately twenty – five (25) persons will be directly employed during the site preparation and construction phase of the clubhouse and maintenance area. This number is expected to increase to fifty (50) {twenty (20) persons employed to the maintenance of the golf course and thirty (30) employed to the clubhouse} once the golf course and its auxiliary activities are in operation.

2.3.5.2.3 WATER REQUIREMENTS

Water for use in the construction and operation phase of the golf course will be provided by the National Water Commission (NWC) main supplying the area.

Approximately thirty (30) persons will be employed to the clubhouse during the operation phase of the development. The estimated water consumption for workers at a facility is 55 litres per day (EHU, 2005) totalling an average of 1,650 litres/ 1.650 m³ per day.

The water consumption of the patrons was calculated by the water usage of restroom fixtures (showers, toilets and faucets) and the seating capacities of the restaurant and bar/lounge. The attraction will have ten (10) toilets, two (2) urinals and eight (8) basins available to its patrons. The estimated water use for each of these fixtures is outline in **Appendix 6**. The Restaurant and Bar/Lounge is estimated to seat sixty (60) patrons comfortably at any given time. The estimated water consumption for these activities is outlined in *Appendix 5*. It is therefore estimated that the Club House will use an average of 11,530 litres of water per day (See *Table 7* below).

Table 7: Table showing the Estimated Water Consumption/Sewage Generation

USE	~AMOUNT (m ³ /day)
Staff	1.6
Patrons (Restroom use)	1.1
Restaurant and Bar/Lounge	9.3
Total	12

2.3.5.2.4 SEWAGE GENERATION AND TREATMENT

Chemical toilets will be provided to workers during the site preparation and construction phases.

In the operation phase, it is anticipated that the sewage generated by the facility will equal the amount of water consumed (EHU, 2005) (See **Table 7** above). Three (3) secondary wastewater treatment plants are proposed to serve the Amaterra Development. All sewage generated from the operations of the Clubhouse will be tied into one of these three sewage treatment plants. This system will involve the use of an STM -Aerator™ which combines the advantages of an activated sludge and fixed film process (See **Appendix 4**) [*Applications for the Permit and Licences to operate these facilities have been presented to the National Environment and Planning Agency (NEPA), and are awaiting approval*].

2.4 PROJECT IMPLEMENTATION

It is anticipated that the project will be implemented over a two (2) year period as outlined in **Table 8** below.

Table 8: Table Showing the Proposed Implementation Schedule of the Project

ACTIVITY	YEAR							
	1				2			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Establishment of Sod Farm								
Propagation of Sod and Sod Establishment								
Preparation of Golf Course								
Installation of Sod								
Sod Maintenance								
Construction of Club House and Maintenance Area								

3.0 POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

There are a number of pertinent laws relating to environmental protection that are applicable to any development and that a developer will need to be aware of when embarking on a particular type of development. There are also several statutory agencies that have powers to control certain types of development that have the potential to affect the environment. These powers of control are typically exercised through a system of permits that induce checks and balances on what kind and form of development can occur. A developer therefore must be prepared to present, explain, and in some cases alter an aspect of a proposal in order to comply with the permitting requirements.

This section is therefore intended as a guide to the relevant permitting requirements that deal with the environmental impacts of this proposed development and the agencies to which they relate as well as presents other legislation and regulations, which are applicable to the development.

3.1 JAMAICAN LAWS AND REGULATIONS

3.1.1 NATIONAL ENVIRONMENT AND PLANNING AGENCY (NEPA)

The National Environment and Planning Agency (NEPA) is the starting point for obtaining permits in relation to the environment. It is an amalgam of three (3) separate bodies. These are the:

- o Natural Resources Conservation Authority (NRCA);
- o Town Planning Authority (TPA) and;
- o Land Development and Utilisation Commission (LDUC).

The LDUC is not currently an active body and will not be addressed.

3.1.1.1 THE NATURAL RESOURCES CONSERVATION AUTHORITY (NRCA) ACT (1991)

The Natural Resources Conservation Authority (NRCA) operates under the NRCA Act of 1991, which gives the Authority the overriding responsibility for managing “the physical environment of Jamaica so as to ensure the conservation, protection and proper use of its

natural resources”. In order to do this, it gives the NRCA power, among other things, to require a permit for developments that fall into prescribed categories as outlined in Section 9 of the Act, which states:

“(2) Subject to provisions of this Section and Section 31, no person shall undertake in a prescribed area any enterprise construction or development of a prescribed description or category except under and in accordance with a permit issued by the Authority

‘(3) Any person who proposes to undertake in a prescribed area any enterprise, construction or development of a prescribed description or category for and manner to the Authority for and such application shall be accompanied by the prescribed fee.....

3.1.1.2 THE NATURAL RESOURCES (PERMIT AND LICENCE) REGULATIONS (1995)

In 1995 the then Natural Resources Conservation Authority (NRCA) promulgated the Natural Resources (Permit and Licence) Regulations 1995, which was since amended in 2004. Pursuant to these regulations is a list of the prescribed categories of developments. The categories that are applicable to this development include:

Development projects:

- o The construction of a golf courses; and
- o Water treatment facilities including water supply, desalination plants, sewage and industrial waste water.

Separate permit applications are required for each, that is, a permit to construct the golf course will be separate from a permit to construct a sewage plant even if it is for the same development.

It is important to note that although a permit may be issued to construct, this is separate from planning permits issued under the Town and Country Planning Act by the Town Planning Authority or by the Trelawny Parish Council. It is also important to note that planning permits cannot substitute for environmental permits or vice versa.

3.1.1.2.1 THE PERMITTING PROCESS

Developers who apply to the NRCA may be required to conduct an Environmental Impact Assessment (EIA) if the NRCA considers that the project has a potential to be or is in fact injurious to the natural environment. This is in accordance with Section 10 of the NRCA Act, which states:

“Subject to the provisions of this section the Authority may by notice in writing require an application for a permit of the person responsible for undertaking in a prescribed area, any enterprise, construction or development of a prescribed description or category

(a) To furnish to the Authority such documents or information as the Authority thinks fit;
(b) Where it is of the opinion that the activities of such enterprise, construction or development are having or are likely to have an adverse effect on the environment, to submit to the Authority in respect of the enterprise, construction or development, and environmental impact assessment containing such information as may be prescribed

And the applicant or, as the case may be, the person responsible shall comply with the requirement...”

The contents of this EIA is determined by the Terms of Reference (TOR) approved by NEPA (See **Appendix 1**) and the will include the likely effects the development will have on the environment as well as measures to reduce or otherwise mitigate negative effects.

Copies of the documents are placed in public areas such as public libraries, post offices or police stations so that interested stakeholders can view it. NRCA/NEPA may also request the developer to host a public meeting to discuss the contents of the EIA. “Guidelines for Conducting Public Presentations” have been produced which can be used if a public consultation meeting has been requested.

When considering permits, the NRCA is constrained by law to consult other government agencies that have interest in environmental issues (for example, water resources) when making its decisions as stated in Section 9 (5) of the NRCA Act which states:

“(5) In considering an application made under subsection (3) the Authority
(a) Shall consult with any agency or department of Government exercising functions in connection with the environment.”

Other agencies must also be minded to consider the NRCA's position on an issue, so that reference to plans for water use, drainage and other features will usually be made to and from these relevant agencies, some of which are discussed below.

3.1.1.2.2 ENVIRONMENTAL PERMIT

Once an environmental permit is issued it is to be displayed on the site. This permit is subject to terms and conditions which, if not followed, can result in enforcement action being taken according to the NRCA Act Section 18, which states:

“ Where it appears to the Authority that the activities of an undertaking in any area are such to pose a serious threat to the natural resources or to public health, the Authority may serve on the person who appears to have carried out or to be carrying out the activity, a notice (hereinafter referred to as an enforcement notice...”

This may include the suspension or revocation of the permit as outlined in Section 11 of the NRCA Act, which states:

“ The Authority may by notice addressed to the person to whom a permit was issued revoke or suspend the permit if it is satisfied that there has been a breach of any term or condition subject to which the permit was granted, or if such person fails or neglects to submit to the Authority Any documents, information or assessment required thereunder.”

The developer may appeal to the Minister responsible for environment matters against any term or condition of a permit, or against the refusal to grant one.

3.1.1. 2.3 ENVIRONMENTAL PERMIT AND LICENCE TO DISCHARGE

In addition to the permit to construct the golf course, the developer will have to apply for a licence if he intends to discharge any effluent including sewage or other wastewater (except for agricultural purposes), pursuant to section 12 NRCA Act which states:

“(1) Subject to the provisions in this section, no person shall-
(a) Discharge on or cause or permit the entry into waters, on the ground or into the ground of any sewage or trade effluent or any poisonous, noxious or polluting matter or
(b) Construct, reconstruct or alter any works for the discharge of any sewage or trade effluent or any poisonous, noxious or polluting matter.”

3.1.1.3 THE TOWN AND COUNTRY PLANNING ACT (1958)

The Town Planning Authority (TPA) is mandated to issue planning permits under the Town and Country Planning Act. Local Parish Councils in the area the development is intended to be located may also issue planning permission. Applications are usually made to the Parish Councils but on some occasions they are considered by the TPA.

Planning permission is required for any activity that is classified as “development” under the Act which is defined as “the carrying out of building, engineering, mining or other operations in, on, over or under land, or the making of any material change in the use of any buildings or other land.”

The kind of activity proposed must be one that is allowable under the relevant Development Order (DO) for the parish. The Development Order for Trelawny was produced in 1980; there is however a project which is ongoing by the National Environment and Planning Agency (NEPA) to revise this DO. This DO sets out the medium and long-term development plan for the parish and provides guidance as to how development in the Parish should proceed. DOs also authorize the carrying out of certain types of activities without the need for a planning permit.

3.1.1.3.1 THE PERMITTING PROCESS

It is important to note that no development that is a “prescribed category” under the NRCA Act will receive a planning permit unless it first receives an environmental (NRCA) permit.

3.1.1.3.2. THE PERMIT

A planning permit will also have its own terms and conditions set out. Planning Permission is to be sought by the developer for the construction of the clubhouse and other buildings. Additional approval of some sort will be needed for any activity that is a variant of what is set out in the permit. The applicant may appeal to the Minister responsible for Planning against the refusal of a permit or to its terms and conditions.

In addition to regulating development in Jamaica, the Act also includes a Tree Preservation Order under Section 25. This Order can be issued for the preservation of trees, groups of trees or woodlands. It is an offence to cut, destroy trees, groups of trees or

woodlands in areas declared under a Tree Preservation Order. Provision however may be made to ensure the replanting of trees or any part of a woodland area, which is felled in the course of permitted forestry operations.

3.1.2 LAND ACQUISITION ACT (1947)

The Land Acquisition Act of 1947 is administered by the ministry responsible for the management of Crown Lands. *Section 3* of the Act empowers any officer authorised by the Minister to enter and survey land in any area that is deemed to be required for public purpose. This officer may dig or bore the soil, cut any standing crops, bush or woodland and remove any fences and carry out any other activities, which may be necessary to determine the suitability of the land.

Section 5 of this Act authorises the Minister to publicly declare that an area is required for public purpose. The Minister will then instruct the Commissioner of Lands to take proceedings to acquire the land, which will include negotiations for purchase of the land.

If no agreement can be reached within a reasonable time the Commissioner will invite all interested parties to present in writing their interests in the land and the amount and particulars of their claims to compensation.

On the day specified, the Commissioner will enquire into the value of land and the interests of persons claiming compensation and will make an award as to the true area of the land, the compensation for the land and the apportionment of the compensation to the persons interested. If the party is still dissatisfied with the compensation presented the matter may be brought before the Supreme Court.

3.1.3 WATERSHED PROTECTION ACT (1963)

The Watershed Protection Act is also administered by the National Environment and Planning Agency (NEPA). This Act provides for the designation of watersheds for conservation purposes, to reduce soil erosion, ensure regular flow in rivers and streams, maintain optimum levels of groundwater, and encourage proper land use to protect watershed recharge. All Jamaica's watersheds have been designated as protected under this act.

3.1.4 WILDLIFE PROTECTION ACT (1945)

Under the Wildlife Protection Act (1945), it is illegal to remove, sell or have in ones possession a protected animal, use dynamite or other poisonous or noxious material to kill or injure fish, discharge or empty waste or industrial effluent into harbours, lagoons, estuaries, and streams.

This Act is administered by the National Environment and Planning Agency (NEPA) and authorises the establishment of Game Sanctuaries and Reserves.

3.1.5 THE ENDANGERED SPECIES (PROTECTION, CONSERVATION AND REGULATION OF TRADE ACT (2000)

The Endangered Species Act of 2000 provides for the conservation, protection and regulation of trade of endangered species. The primary purpose of this Act is to control the domestic trade of endangered species. Contained in this Act are four (4) Schedules. This Act seeks to monitor and control of the following:

- o The exportation of specimens that are derived from indigenous Jamaican animals or plants;
- o The exportation and importation of specimens that are derived from animals or plants which:
 - (i) are threatened with extinction and are or may be affected by trade;
 - (ii) may become so threatened if international trade in specimens of such species is not subject to strict regulation; and
 - (iii) require or are likely to require protection or the cooperation of other States in order to prevent or restrict exploitation.
- o The importation of animals or plants, the introduction of which has or is likely to have an adverse effect on the habitats and species of indigenous Jamaican animals or plants; and
- o The exportation or importation of specimens that are difficult to distinguish from specimens referred to in the bullet points above.

This Act was prepared so that the Government of Jamaica could fulfil its obligations under the Convention on International Trade of Endangered Species (See **Section 3.2.2**).

3.1.6 THE COUNTRY FIRES ACT (1942)

The land for the development will have to be cleared and therefore the developer may use fire as a means of clearing the land. The Ministry of Agriculture administers the Country Fires of Act of 1942. Under this Act it is an offence to:

- o Set fire to trash without serving officer of nearest police station with notice or clearing open space around trash.
- o Set fire to trash between 6 p.m. and 6 a.m.
- o Leave open –air fire unattended.
- o Failure by occupier of land to take responsible steps to extinguish fire on his land.
- o Set a fire contrary to order or permit.

3.1.7 SOLID WASTE MANAGEMENT AUTHORITY ACT (2001)

The Solid Waste Management Authority Act was enacted in 2001 and gives the National Solid Waste Management Authority (NSWMA) to have jurisdiction over the disposal of solid waste in Jamaica. Under this Act it is illegal to:

- o Dispose of solid waste in an unauthorised way or manner.
- o Operate a solid waste disposal facility or to collect, transfer/manage solid waste without a licence/certificate.
- o Throw or deposit litter in a public place.
- o Throw or deposit litter on another's premises without consent.

3.1.8 THE CLEAN AIR ACT (1964)

The Clean Air Act (1964) refers to developments where there are industrial works, which is, in the opinion of an inspector likely to result in the discharge of smoke, fumes, gases or dust into the air. Under this Act, an inspector has the power to inspect or examine premises where work is being carried out, take samples or make enquires with respect to this premises.

3.1.9 THE PUBLIC HEALTH NUISANCE REGULATIONS (1995)

The Public Health Nuisance regulations are administered by the Ministry of Health in Jamaica and were brought into force in 1995. Under these regulations it is an offence to

abate a nuisance or perform such an act to prevent the reoccurrence of a nuisance. A nuisance under the regulations is defined as:

- o A building or structure which is or likely to become a health hazard due to structural defects or unsanitary conditions;
- o Premises or other places where unsanitary conditions are present or are likely to become a health hazard;
- o Accumulation or deposit of solid waste, human or animal excreta;
- o Dust, smoke, fumes, gases or effluvia emitting from any manufacturing process or caused from trade or business;
- o Lack of water or water supply system;
- o Water supply that is not maintained in a sanitary condition; and
- o Discharge of sewage, industrial waste or any other noxious matter into the sea or any watercourse or unto any land.

3.1.10 THE PUBLIC HEALTH ACT (AIR, SOIL AND WATER REGULATIONS (1976)

The Public Health Act (Air, Soil and Water Regulations) of 1976 is responsible for regulating the construction, repair or alteration of sewage treatment facilities and is administrated by the Environmental Health Unit of the Ministry of Health.

3.1.11 THE PESTICIDES CONTROL ACT (1975)

The governing body of the Pesticides Control Act (1975) is the Pesticides Control Authority, whose mandate is to conduct the registration and control of pesticides usage in Jamaica. The governing body of this Authority is the Ministry of Health and the main functions include the following:

- o The registering of Pesticides;
- o The issuing of licences to import or manufacture registered Pesticides;
- o The authorization of persons to sell registered Pesticides;
- o The registration of premises where registered pesticides may be sold;
- o To issue licences to registered pest controllers; and

- o To consider and determine applications made pursuant to this Act and to deal with all aspects of the importation, manufacture packaging, preparation for sale, sale, disposal and use of pesticides and to advise the Minister on all matters in relation thereto.

A Licence is required if pesticides are to be imported to the country. Generally only pesticides which are registered are considered for importation.

3.1.12 THE BEACH CONTROL ACT (1956)

The Beach Control Act of 1956 is administered by the National Environment and Planning Agency (NEPA). Under this Act, 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 floor of the sea are declared to be vested in the Crown. 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 in connection with any trade or business or commercial enterprise without a licence granted under this Act.

3.1.13 THE JAMAICA NATIONAL HERITAGE TRUST ACT (1985)

The Jamaica National Heritage Trust Act was established in 1985. The main purpose of this Act is to promote the preservation of Jamaica's national monuments, anything designated as protected national heritage and to record any precious objects or works of art to be preserved and to identify and record any species of botanical or animal life to be protected.

3.1.14 THE TOURIST BOARD ACT (1985)

This Act is governed by the Tourist Board of Jamaica. Under this Act it is an offence to operate or maintain any tourism enterprise without a licence issued by the Board.

3.2 INTERNATIONAL CONVENTIONS AND REGULATIONS

3.2.1 CONVENTION ON BIOLOGICAL DIVERSITY (CBD) (1993)

The Convention on Biological Diversity (CBD) was negotiated under the auspices of the United Nations Environment Programme and entered into force in 1993. The three goals of the CBD are to (CBD, 2006):

- o Promote the conservation of biodiversity.
- o Sustainable use of its components.
- o The fair and equitable sharing of benefits arising out of the utilization of genetic resources.

To date over one hundred and seventy (170) countries have signed the agreement. Jamaica became signatory in 1995. As a signatory to the CBD Jamaica is obliged to:

- o Develop national strategies, plans or programmes for the conservation and sustainable use of biological diversity or adapt for this purpose existing strategies, plans or programmes which shall reflect, *inter alia*, the measures set out in this Convention relevant to the Contracting Party concerned; and
- o Integrate, as far as possible and as appropriate, the conservation and sustainable use of biological diversity into relevant sectoral or cross-sectoral plans, programmes and policies.

3.2.2 CONVENTION ON INTERNATIONAL TRADE OF ENDANGERED SPECIES (CITES), (1975)

The Convention on International Trade of Endangered Species (CITES) entered into force in 1975 under the administration of the United Nations. Jamaica became party to this Convention in 1997.

The main purpose of CITES is to regulate the international trade of, wild flora and fauna and to ensure the sustainable use of these species. The international trade in specimens of wild plants and animals is monitored and controlled using a trade control system of permits, certificates and export quota. In Jamaica a Scientific Authority administers this permit system, which is issued by the Natural Resources Conservation Authority (NRCA). Under

the convention there are three (3) categories of protection for animal and plant species which are contained in Appendices I, II and III respectively. Appendix I include species threatened with extinction and for which trade must be subjected to particularly strict regulation and authorized only in exceptional circumstances. Appendix II includes all species, which may become threatened unless trade in specimens of such species is subject to strict regulation in order to avoid unsustainable utilization. An export permit issued by the country of origin must accompany the export of any species included in Appendix II. Appendix III includes all species which any Party identifies as being subject to regulation within its jurisdiction, and needs the cooperation of other Parties in the control of its trade. [Adapted from: NEPA, 2003]

3.2.3 CONVENTION ON WETLANDS/RAMSAR CONVENTION, (1971)

The Convention on Wetlands, commonly known as the Ramsar Convention was signed in 1971 and came into force in 1975. Jamaica became party to this convention in 1997. This international treaty is one which provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources.

3.3 RELEVANT JAMAICAN POLICIES

3.3.1 MANGROVE AND COASTAL WETLANDS PROTECTION - DRAFT POLICY AND REGULATIONS (1996)

The Mangrove and Coastal Wetlands Draft Policy and Regulations were drafted in 1996. This policy seeks to provide a review of the factors that affect wetlands and the Government's roles and responsibility in this regard. Included in this policy are guidelines for the development of wetlands, maintenance of natural diversity in these areas and procedures for the cessation of destructive activities in these areas *inter alia*.

3.3.2 NATIONAL POLICY FOR THE CONSERVATION OF SEAGRASSES (1996)

The National Policy for the Conservation of Seagrasses in Jamaica was developed in 1996. The aim of this policy is to guide the issuing of licenses or permits for activities such as dredging, disposal of dredged material, beach development, and effluent disposal.

3.3.3 CORAL REEF PROTECTION AND PRESERVATION – DRAFT POLICY AND REGULATIONS (1996)

Similarly, a Draft Policy was drafted for coral reef protection and preservation in 1996. This policy reviews the factors which affect coral reefs island-wide and outlines the Government of Jamaica's roles and responsibility in seeking to protect these habitats.

4.0 DESCRIPTION OF THE ENVIRONMENTAL SETTING

This section of the report provides an overall description of the various elements including the physical and biological characteristics of the environment. It also outlines the methodologies employed in conducting the baseline research and presents the results and observations from these assessments.

4.1 THE PHYSICAL ENVIRONMENT

4.1.1 CLIMATE

METHODOLOGY

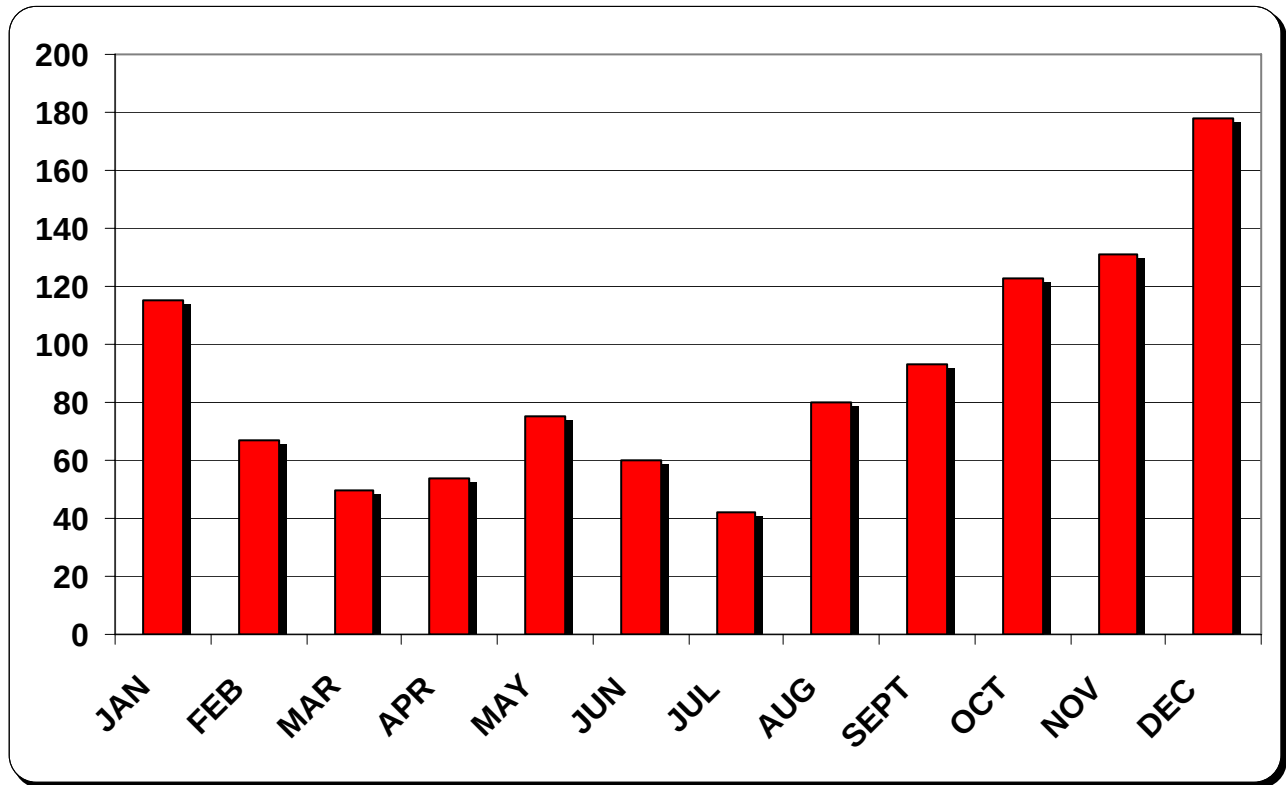
The data presented in this section was collected by secondary research. The National Meteorological Service of Jamaica is responsible for the collection of climate data for the island. Not much meteorological data is available for the area. The only mean data available is rainfall and the closest meteorological research centre to the proposed area is the weather station at the Sangster International Airport, which is located approximately 50 km from the area.

4.1.1.1 PRESENT STATUS: RAINFALL

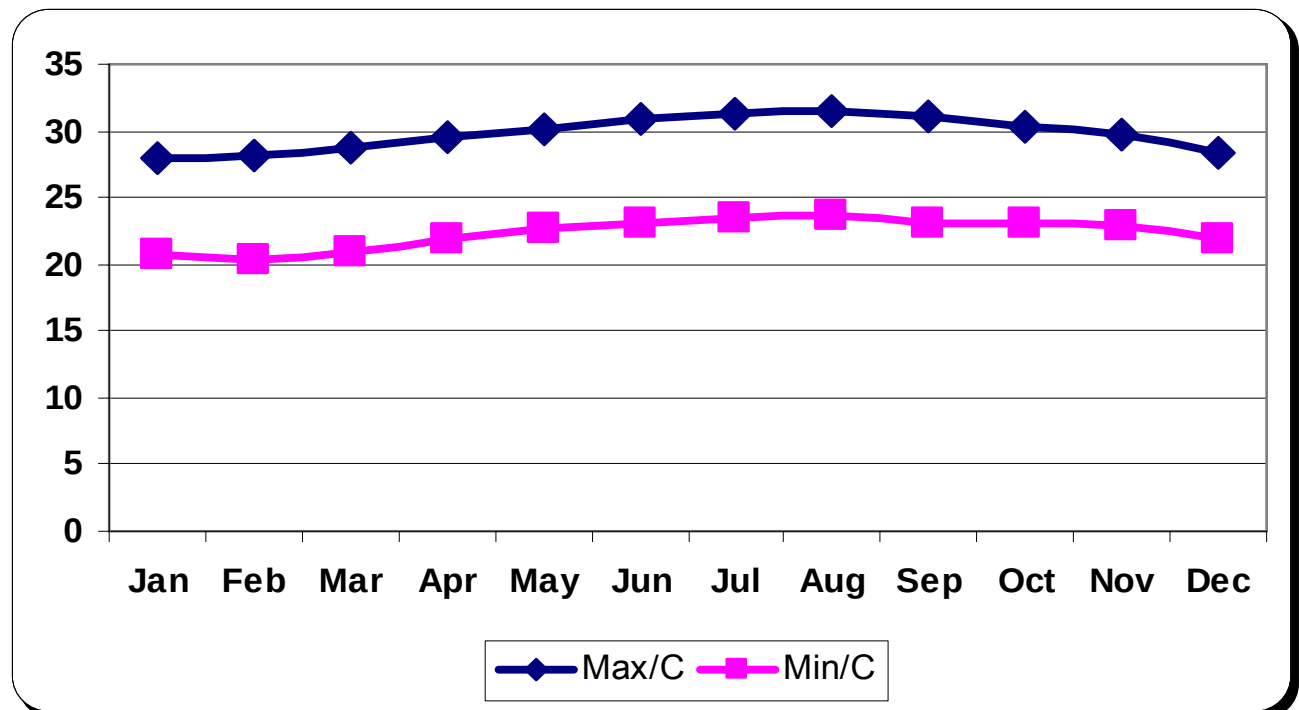
The proposed site for development is located within the Martha Brae watershed. The 30-year mean for rainfall data collected at the meteorological station in Duncans, Trelawny is shown in **Figure 3** below. The data shows that the average rainfall in the area ranges from a low of 42 mm in July to a high of 178 mm in December.

4.1.1.2 PRESENT STATUS: TEMPERATURE

The temperature recorded for Trelawny shows that temperatures range from a minimum of 21.9 °C in December to a maximum of 31.4 °C in August. This is shown in **Figure 4** below.

Figure 3: Graph showing the 30 Year Mean (1951-1980) Rainfall for Duncans, Trelawny

Source: National Meteorological Service, Jamaica (2007)

Figure 4: Graph Showing the Average Temperature Ranges for the Parish of Trelawny

Source: National Meteorological Service, Jamaica (2007)

4.1.1.3 PRESENT STATUS: WIND

The North Coast daily wind pattern is dominated by the Northeast Trade Winds. During the daytime these Trades combine with the breeze from the sea to give an East-North-easterly wind, at an average speed of 27 kilometres per hour (15 knots). At night the wind generally has a southerly component at an average speed of 10 kilometres per hour (5 knots). These trade winds are lowest between December to March, when the wind is composed of Trade winds, sea breeze and northerly winds associated with cold fronts and high pressure areas. The period between June and July has the highest daytime wind speeds of up to 42 kilometres per hour (23 knots).

4.1.1.4 PRESENT STATUS: RELATIVE HUMIDITY

Data from the National Meteorological Service of Jamaica shows that the relative humidity in coastal areas averages 84 % during the morning; this however falls to 71 % during the afternoon.

4.1.2 AIR QUALITY

PM₁₀ refers to particulate matter (PM) equal to or less than 10µm in size. Particulate matter between 10µm and 2.5µm is generated primarily from construction activities and road dust re-suspension, such as those to be undertaken in this type of activity, while finer particulates (<2.5µm) are primarily from combustion sources.

Nitrogen dioxide (NO₂) is a product of combustion processes (e.g. from vehicle exhaust) and is closely associated with other pollutants including particulate matter. It is toxic and is a precursor of ozone. Most atmospheric NO₂ is emitted as nitrous oxide (NO), and is oxidized to NO₂ by ozone (O₃). As NO₂ is typically easier to measure than other pollutants, it is often used as an indicator of the pollutant mixture as a whole.

Sulphur dioxide (SO₂) is emitted from power plants and diesel vehicles exhaust, as well as from industrial boilers, metal smelters and paper manufacturing. Both Sulphur Dioxide and Nitrogen Oxides can cause acid rain.

METHODOLOGY

Short term monitoring of PM₁₀, NO₂ and SO₂ was carried out by Technological and Environment Management Network (TEMN) during the conduct of a Strategic Environmental Assessment (SEA) in 2005. Because the prevailing conditions in the area have not changed since the conduct of this SEA, it was determined that current air quality sampling was not necessary. During that period, air quality sampling was conducted using the Airmetrics Minivol Portable Air Sampler. The instrument allows for simultaneous measurement of particulate matter and the noxious gases. The sampler has an active flow control circuit for a constant sampling flow rate. PM₁₀ was determined by drawing air through a particle size separator and subsequently through a quartz filter medium. SO₂ and NO₂ were measured by drawing air into a Tedlar bag; the contents are extracted to a drager tube containing a reactive medium that effects a colour change when exposed to the gas.

Samplers were placed at four (4) locations, near Silver Sands (AQ1), Carey Park (AQ2), Stewart Town (AQ3) and Duncans Hill (AQ4), and variables measured for a 24-hour period. The sample locations are shown in **Figure 5**.

PM₁₀ was measured at all sites. SO₂ and NO₂ were measured at three (3) of the four (4) sites due to limitation of equipment. The results were then compared with the Natural Resources Conservation Authority's (NRCA) Air Quality Regulations and the World Health Organisation's (WHO) Air Quality Guidelines which are shown respectively in **Tables 9** and **10** below.

Table 9: The Natural Resources Conservation Authority's Air Quality Guidelines for PM₁₀, SO₂ and NO₂

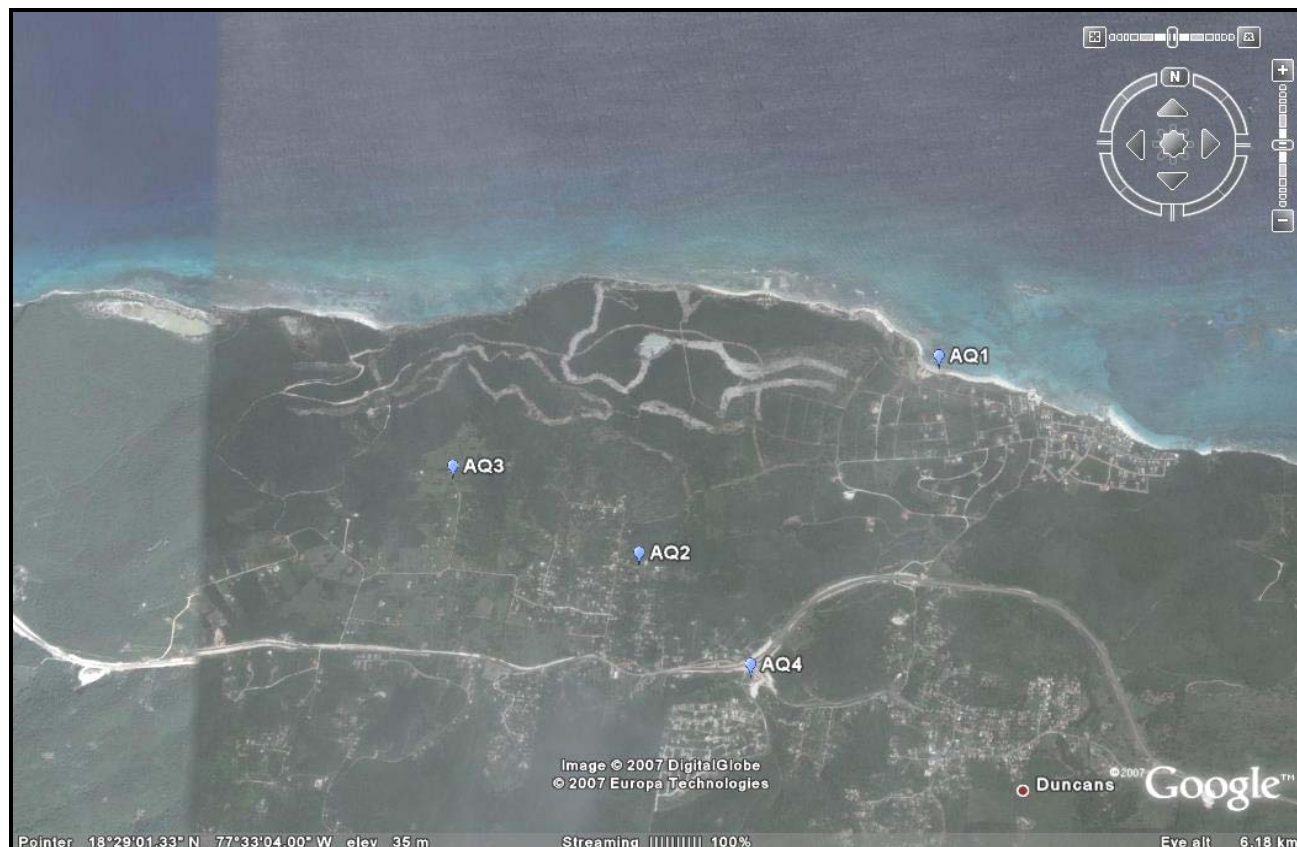
Pollutant	Averaging Time	Standard (maximum concentration in g/m ³)
PM ₁₀	Annual	50
	24-hour	150
Sulphur Dioxide (SO ₂)	Annual	80
	24-hour	365
	1-hour	700
Nitrogen Dioxide NO ₂	Annual	100

Source: NAAQS (2002)

Table 10: Table showing the World Health Organisation's (WHO) Air Quality Guidelines

Pollutant	Averaging Time	Standard (g/m^3)
PM ₁₀	Annual	20
	24-hour	50
NO ₂	Annual	40
	1-hour	200
SO ₂	24-hour	20
	10-minute	500

Source: World Health Organisation (2007)

Figure 5: Aerial image showing Air Sampling Locations

Source: Google Earth (2007)

4.1.2.1 PRESENT STATUS: SO₂ and NO₂

SO₂ and NO₂ at the sites measured were undetected. Levels of these pollutants are expected to be low as there is no industrial activity in the area. The results are shown in **Table 11** below.

Table 11: Table showing the results of the Air Quality Sampling

SITE NUMBER	SO ₂	NO ₂
AQ1	Not detected	Not detected
AQ2	Not detected	Not detected
AQ3	Not detected	Not detected

As these pollutants were not detected it is assumed that the levels are within the guidelines set in the Natural Resources Conservation Authority's (NRCA) Air Quality Regulations. As such one can also assume the levels meet the standards set forth in the World Health Organisation's (WHO) Air Quality Guidelines as well.

4.1.2.2 PRESENT STATUS: PM₁₀

PM₁₀ levels varied between 56 and 153 $\mu\text{g}/\text{m}^3$. The results are shown in **Table 12** below. All but one of the values conforms to the NRCA Air Quality Guidelines. The highest PM₁₀ levels, observed at Stewart Town, may be due to the monitor being located near to a denuded area. All values however exceed the 24-hour mean set in the WHO Air Quality Guidelines.

Table 12: Table showing the PM₁₀ results recorded at the sites

SITE	PM ₁₀ ($\mu\text{g}/\text{m}^3$)
AQ1	111
AQ2	28
AQ3	153
AQ4	56

4.1.3 WATER QUALITY & QUANTITY

4.1.3.1 WATER QUALITY

Marine and Terrestrial water quality was sampled during the conduct of the Strategic Environmental Assessment (SEA) in 2005. These values were compared with the water quality sampling results that were conducted during this Environmental Impact Assessment (EIA). Upon review of the water quality data from the SEA, it was noted that while the wells in the vicinity had been represented in the sampling, there were other water bodies (ponds) which fell within the boundaries of the proposed development which were not sampled. The

existing marine water quality data also did not include samples near the western boundaries of the property and thus additional water sampling was undertaken during this EIA.

METHODOLOGY

Water samples (BP1, BP2) were collected from two brackish ponds on the property (See **Figure 6** below). Two additional marine water samples were also collected, M1 near the western border of the property and M2 to the east as shown in **Figure 6** below. Samples were kept in cold storage (<4°C) until delivery to the laboratory for analysis. These methods of analysis are shown in **Table 13** below.

Table 13: Table showing the methods of analysis of Water Samples

PARAMETER	TEST METHOD	RANGE
BOD (mg/L)	Dilution HACH Method 8043	N/A
Faecal Coliform (MPN*/100ml)	SMEW** Method 9221	N/A
Total Coliform (MPN/100ml)	SMEW Method 9221	N/A
Dissolved Oxygen (mg/L)	DO Meter	0 to 20
Nitrate (mg/L)	Cadmium Reduction, HACH Method 8171	0 to 4.5
Phosphate (mg/L)	PhosVer3 (Ascorbic Acid), HACH Method 8048	0 to 2.5
Salinity (‰)	YSI Model 33 Salinity-Conductivity-Temperature Meter	0 to 40
Total Suspended Solids (mg/L)	Photometric (Non-filterable residue) Method, HACH Method 8006	0 to 750

*Most Probable Number

**Standard Methods for the Examination of Water and Wastewater, 20th Edition, 1998

The results of this analysis were then compared with the National Fresh Water Quality Standards. Where Jamaican standards have not been developed, international standards such as the World Health Organisations (WHO) and the United States Environmental Protection Agency (EPA) water quality standards were used for comparison.

Figure 6: Aerial image Showing Water Sampling Sites

The results of the water quality analyses are shown in **Table 12** below.

4.1.3.1.1 RESULTS: TERRESTRIAL WATER QUALITY: SURFACE WATER

The results of the Water Quality conducted are presented in **Table 14**. These results are discussed below.

Table 14: Table showing the Water Quality results for Ponds within the development area

PARAMETER	BP 1	BP 2	STANDARDS	
			*NRCA	**WHO LIMITS
Biochemical Oxygen Demand (mg/L)	8.4	0.9	0.8-1.7	
Faecal Coliform (MPN)	9	240	No Standard	Not detected
Total Coliform (MPN)	9	240	No Standard	Not detected
Dissolved Oxygen (mg/L)	10.7	9.5		Saturation point
Nitrate (mg/L)	0.88	3.08	0.10- 7.5	
Phosphate (mg/L)	0.08	0.04	0.01- 0.8	
Salinity (‰)	9.2 +/- 0.6	11.3 +/- 0.7	NA	
Total Suspended Solids (mg/L)	4	30	NA	

*NRCA: Natural Resources Conservation Authority's Ambient Freshwater Standards

**WHO: World Health Authority's Drinking Water Standards

A. Total and Faecal Coliform

Total and Faecal coliform at both pond sites (BP1 and BP2) were high by the World Health Organisation's (WHO's) drinking water standards. Total and faecal coliform at BP1 and BP2 was determined as 9 MPN/100ml; at BP2 total and faecal coliform were both 240 MPN/100ml.

B. Nitrate

Nitrate levels at both pond sites meet Natural Resources Conservation Authority's (NRCA's) Ambient Water Quality Standards. Nitrate levels of 0.88 and 3.08 mg/L were determined; this is well below the upper limit of 7.5 mg/L set by the NRCA and also meets the WHO standards.

C. Ortho phosphate

Ortho-phosphate levels were well below the NRCA standard, at 0.08 and 0.4 mg/L for BP1 and BP2, respectively.

D. Biochemical Oxygen Demand (BOD)

BOD at BP1 was 8.4 mg/L, exceeding the limit established by the Natural Resources Conservation Authority (NRCA). At BP2 the BOD was significantly lower at 0.9 mg/L

E. Dissolved Oxygen (DO)

Dissolved oxygen at both sites was high, at 10.7 and 9.5 mg/L for BP1 and BP2 respectively. The saturation point of fresh water at 32°C is 7.54. DO however may vary with depth and will also vary due to dissolved solids and salinity.

F. Total Suspended Solids (TSS)

TSS at BP1 was 4 mg/L; the value at BP2 was markedly higher at 30 mg/L. While there is no standard for TSS this should be monitored periodically as an indicator of runoff.

G. Salinity

Salinity at BP1 was 9.2 ‰ and 11.3 ‰ at BP2. This classifies the water bodies as brackish.

The water quality of the brackish pond 2 (BP2) located to the most northern boundary of the proper located within the development area showed elevated levels of total and faecal coliform, Biochemical Oxygen Demand and Dissolved Oxygen. Although this water will not be used for human consumption, these elevated levels are an issue of concern. These elevated values are likely to be as a result of human activity around the development area.

4.1.3.1.2 PRESENT STATUS: TERRESTRIAL WATER QUALITY: GROUND WATER

There are three (3) wells in close proximity to the development site. Two (2) are located near the Silver Sands property and one further east along the road to the community of Carey Park. The well in the vicinity of Carey Park seemed to be dry and contained a copious amount of debris and is no longer in use. Only one (1) of the other two (2) wells was accessible. Ground water level at this well was 14 metres below the earth's surface and about 0.5 M deep (TEMN, 2005). The results of the analysis of the water quality assessment are shown in **Table 15** below.

Table 15: Table showing the results of the Ground Water Quality Analysis

PARAMETER	RESULTS	WHO STANDARDS
Nitrate (mg/L)	3.6 mg/L	50
Phosphate (mg/L)	0.058 mg/L	N/A
Conductivity μ siemens	3,590 μ siemens	N/A

Adapted from: TEMN, 2005

A. Nitrate

Nitrate levels at this well are below the World Health Organisation's (WHO) Drinking Water Standards.

B. Phosphate

Phosphate (PO_4) in the water sample was found to be 0.0058 mg/L. No health-based guideline has been issued by the WHO.

C. Electrical Conductivity

The electrical conductivity measured at the well was 3,590 μ siemens. This indicates a high level of saline intrusion. According to permissible limits of conductivity for classes of irrigation water, the levels of electrical conductivity recorded at the site places it in "Class 5" (TEMN, 2005) which is unsuitable for irrigation purposes. An analysis of a report conducted

by Engineering Business Associates in 1975 in their assessment of water sources for the area also shows that the use of water from this well was also not a viable option due to the high level of saline intrusion observed from the water quality testing results. It is important to note that none of these wells provide potable water to the surrounding communities.

Based on the results the water from the well located at Silver Sands should not be the major source for irrigation of the golf course as the salinity levels of the groundwater were well above what is suitable for irrigation purposes. Further abstraction from this well will also likely increase saline intrusion in this area.

4.1.3.1.3 PRESENT STATUS: MARINE WATER QUALITY

The results of the water quality analyses are shown in **Table 16** below.

Table 16: Table showing the results of the Marine Water Quality Analysis

PARAMETER	GOLF COURSE EIA RESULTS		SEA RESULTS			*EPA STANDARDS	**NRCA STANDARDS
	M1	M2	OP1	OP2	OP3		
BOD (mg/L)	0.3	0.35	0.5	0.3	0.5	1.18 mg/L	
Faecal Coliform (MPN/100ml)	<3	<3	23	2	<2		
Total Coliform (MPN/100ml)	<3	<3	23	2	<2		
DO (mg/L)	7.6	7.25	6.5	6.4	6.4	4.8 mg/L	
Nitrate (mg/L)	1.76	1.76	0.057	0.022	0.09	0.081 mg/L	
O-Phosphate (mg/L)	0.09	0.03	0.046	0.051	0.03	0.055 mg/L	
Salinity (0/00)	28.5	28.5	Not Measured	Not Measured	Not Measured		
TSS (mg/L)	4	1	7	3	0		< 10 mg/L

Adapted from TEMN, 2005

* United States Environmental Protection Agency's Marine Water Quality Standards

** Draft Natural Resources Conservation Authority's Coral Reef Policy (1996) Proposed Coral Reef Criteria Value

A. Biochemical Oxygen Demand (BOD)

BOD at all marine sampling sites was low. The United States of America's Environmental Protection Agency's (EPA) standard is 1.18 mg/L

B. Total and Faecal Coliform

Total and Faecal Coliform were low at all sites except when compared to drinking water standards. This is likely due to commercial and recreational activities that take place at the nearby Jacob Taylor Beach. While the water is not potable the level of contamination indicated warrants periodic monitoring in the future.

C. Dissolved Oxygen (DO)

Dissolved Oxygen levels at all sites are well above the EPA's threshold value of 4.8 mg/L for marine waters.

D. Nitrate

Nitrate levels at M1 and M2 exceed the EPA standard of 0.081 mg/L. This may be attributed to the influence of land-based activities which take place in the surrounding communities.

E. Phosphate

Phosphate levels at M1 are also greater than the EPA standard of 0.055 mg/L. This may be attributed to the influence of land-based activities which take place in the surrounding communities.

F. Salinity

Salinity measurements are in concordance with expected values for seawater.

G. Total Suspended Solids (TSS)

TSS at all marine sites was low. While there is no standard for TSS this should be monitored periodically as an indicator of runoff.

- liv.** The water quality in the marine environment also showed elevated levels of nutrients such as Nitrates and Phosphates. This could be as a result of the anthropogenic influences from surrounding communities such as the activities at the Jacob Taylor beach, which is adjacent to the property.

4.1.3.2 WATER QUANTITY

Discussions with the developer and the residents have shown that the piped water supply is not very regular in the area. Three wells are located within the study area, but investigations show that due to high saline content, these wells are not used for the provision of potable water to the communities. Water is supplied to the area by the National Water Commission (NWC). In anticipation of the development, the Amaterra Jamaica Ltd.

developers have entered into an agreement with the National Water Commission (NWC) to improve the water supply between Martha Brae and Harmony Hall at estimated cost of US \$ 7.8 Million to the developer (See **Appendix 5**). This will supply the development with the water required for its operations.

4.1.4 SOILS & GEOLOGY

4.1.4.1 GEOLOGY

METHODOLOGY

Three (3) field days were used to make a geological assessment of the proposed development site. Traverses were conducted to record the rock and soil types present. An assessment of any geological hazards was made.

4.1.4.1.1 PRESENT STATUS

A. ROCK FORMATIONS

The proposed development area is dominated by the Montpelier Formation of the White Limestone Group. This unit consists of limestone beds which are typically well bedded and hard. Marl beds are also typically present within this formation, rendering the overall permeability of this unit as poor. Limestone beds of the Coastal Group are also present in the vicinity of the development but are, as in the rest of the island, confined towards the coast. These units are generally more porous and may have moderate to high permeability. Units of this Group were observed exposed along tracts of land adjoining the beach.

Other features on the property include a raised sea level notch feature that marks the sea level position prior to uplift of the north coast of the island in the geological past. Although areas where this feature can be observed are not limited, the preservation of this interesting geological feature is encouraged. The notch has been observed in reasonably close proximity to the beach (18°29'21.38"N, 77°34'9.39"W). The notch takes the form of a laterally extensive smooth curve which when well exposed, stands out against the otherwise rugged and eroded limestone outcrops. This feature is also known to occur east of the development area at Silver Sands where it is displaced by a SW-NE trending fault.

B. FAULTS

No major or minor faults were identified during field work due to the dense vegetation. However, an examination of the geological map of Jamaica (McFarlane, 1977) indicates that a pair of SW-NE trending faults dissects the area. The eastern member of this pair is known to displace the sea level notch at Silver Sands. The western member of this pair is shown to have a few minor faults branching out from it. It is this fault (and its offshoots) which run directly through the proposed development area. Although these faults were not readily evident, they may become exposed as the development proceeds. Mitigation steps, if necessary, can then be taken regarding the infrastructure. It is quite likely, however, that these faults will not represent a direct threat to the development of the area.

4.1.4.2 SOILS

Soil sampling was done in order to assess soil quality and determine future need for fertilisation during the operational phase of the project.

METHODOLOGY

Three soil samples were collected in polyethylene bags. The first few cm of topsoil were removed and approximately 1kg of soil sampled from the 'A' horizon. The locations of the sampling sites are listed in **Table 17**, and are shown on the aerial image in **Figure 7**.

Table 17: Table showing the GPS Coordinates of Soil Sampling Sites

SAMPLES	N	W
Sample 1	18°29.217'	77°32.320'
Sample 2	18°29.151'	77°32.663'
Sample 3	18°29.017'	77°32.862'

Figure 7: Aerial image showing Soil Sampling Sites



Source: Google Earth (2007)

Samples were extracted using *aqua regia* digestion and analysed for nutrients and metals as outlined in **Table 18**.

Table 18: Table showing the Analytical Methods used for Soil Analysis

PARAMETER	TEST METHOD	DETECTION LIMIT
Nitrate (mg/kg)	Colourimetry	5
Chloride (%)	Titrimetry	0.01
Phosphate (%)	Colourimetry	0.01
Magnesium (%)	Flame Atomic Absorption Spectrophotometry (F-AAS)	1 mg/kg
Sodium (%)	F-AAS	1 mg/kg
Potassium (%)	F-AAS	1 mg/kg
Manganese (%)	F-AAS	1 mg/kg
Iron (%)	F-AAS	1 mg/kg
Zinc (mg/kg)	F-AAS	1 mg/kg

4.1.4.2.1 PRESENT STATUS

The soil classification in this area is Bonny Gate Stony Loam. (TEMN, 2005). The characteristics of this soil formation are outlined in **Table 19** below. In many places throughout the site soil cover was poor, often with only a few centimetres of soil covering solid limestone.

Table 19: Table showing the characteristics of Bonny Gate Stony Loam

CHARACTERISTICS	VALUE
Internal Drainage	Very rapid
Nitrogen	Low
Potassium	High
Phosphate	Medium
pH	Mildly Alkaline

[Adapted from: ABIS - RADA 2006]

The results of the soil analyses are shown in **Table 20** below.

Table 20: Table showing the results of Soil Analysis

Parameter	Sample 1	Sample 2	Sample 3
Nitrate (mg/kg)	59	37.8	40
Chloride (%)	0.07	0.49	0.01
Phosphate (%)	0.74	0.46	0.41
Magnesium (%)	1.1	0.67	0.37
Sodium (%)	0.13	0.29	0.05
Potassium (%)	0.28	0.11	0.27
Manganese (%)	0.13	0.05	0.23
Iron (%)	5.83	4.22	7.85
Zinc (mg/kg)	144	30.8	89.3

The concentrations of magnesium, sodium, manganese and iron are within the ranges expected for Jamaican soils (Robotham, et al, 1987). The chloride concentration of *Sample 2* is considered high; while high soil chloride can stunt plant growth, this should not be an issue given the variety of grass intended for planting for the golf course.

Soil may require nitrogen and potassium supplementation as recommended in **Section 2.3.4.4.1**. The figures presented in this section represent the maximum rates of applications as these figures will be reduced due to the use of recycled water and run-off

for irrigation purposes. Phosphate supplementation should not be required in the initial stages of operation but will likely be required periodically; the recommended levels as shown in **Section 2.3.4.4.1** also represents the maximum values of application as recycled water will be used for irrigation. While there was significant variation in the zinc concentration in the three (3) soil samples, none of the levels measured would be considered detrimental to plant response.

4.1.5 HYDROGEOLOGY: FLOOD IMPACT ASSESSMENT

This section of the report represents the flood impact assessment of the development area and is based on the review of the hydrogeology of the area that was conducted during the preparation of the Strategic Environmental Assessment (SEA) in 2005.

There are several constraints that impacted on the findings of this flood assessment. These included:

- o The lack of measured flow data on the stream network within the development area. As a consequence, calibration and validation the hydraulic model was not possible. Some key parameters used in the model are therefore based on professional judgment only, hence their closeness to real values is not known.
- o Elevation profile of the proposed road network and of the inverts of proposed culverts was not available hence their schematisation in the hydraulic model was not possible.
- o The full extent of the existing drainage capacity in Silver Sands is not certain hence it was assumed that all the discharge would flow overland.

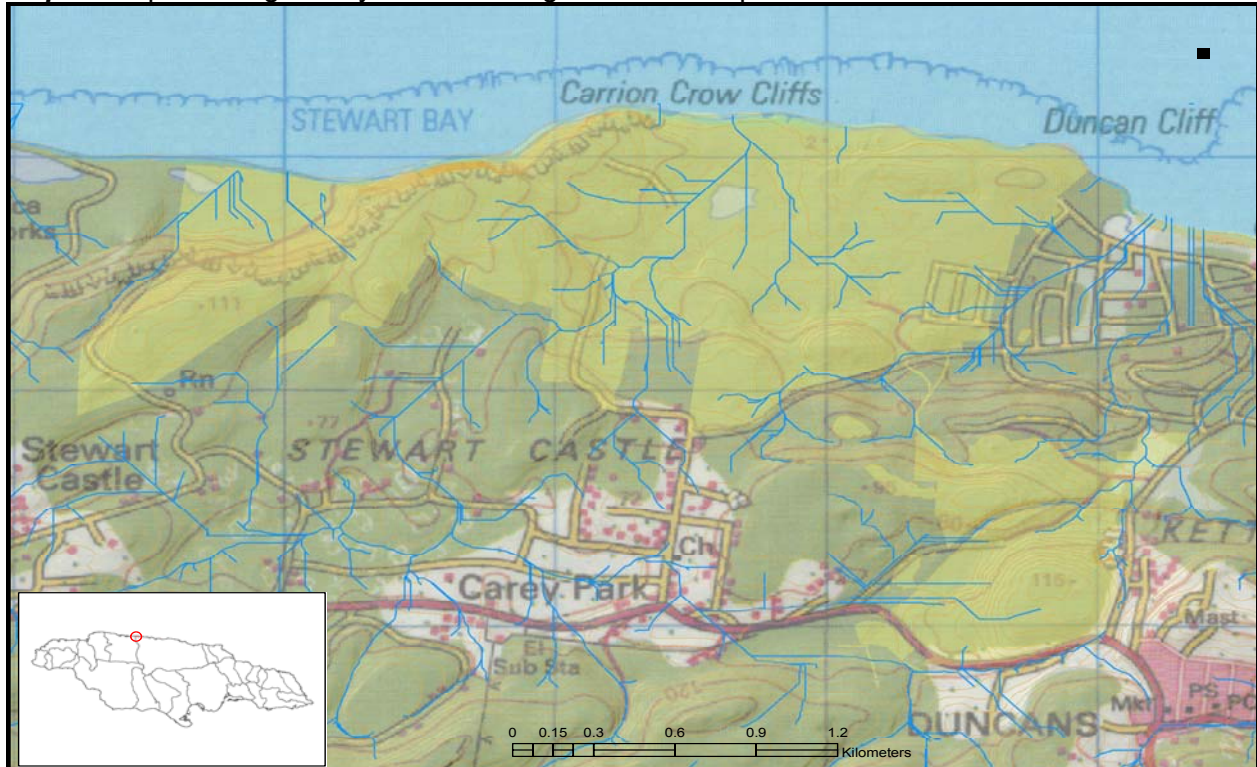
METHODOLOGY

The flood impact assessment was done using the HEC-RAS (*Hydrologic Engineering Center – River Analysis System*) model developed by the US Army Corps of Engineers. A digital terrain model (DTM) was developed from contours obtained from Eco-Librium Consultants Ltd. and contours digitized from 1:12,500 topographic maps produced by the Survey Department of Jamaica. Basin characteristics such as elevation and slope, as well as

cross-sectional data were generated from the DTM using ArcGIS and HEC-GeoRAS (an ArcGIS extension for support of HEC-RAS) software.

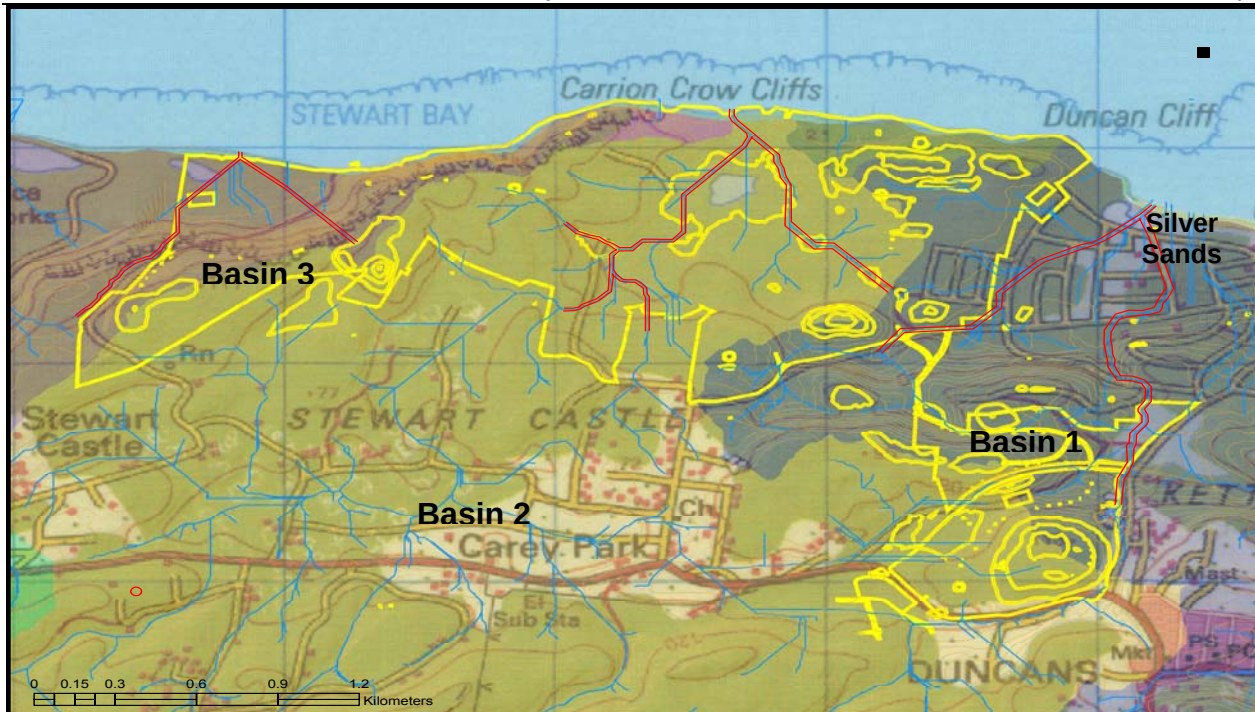
The development area is characterized by three distinct sub-basins identified as Basin 1, Basin 2 and Basin 3 (See **Map 3**). The flood analysis was done separately for each of the basins using pre- and post-development peak runoff values from the hydrological analysis done by Technological and Environmental Management Network (TEMN) Ltd in 2005.

Map 2: Map showing the Hydraulic Setting at the Development Area



Source: Map reproduced from 1:50,000 scale maps developed by the Survey Department

Map 3: Map showing the Three (3) sub-basins within the development area



Source: Map reproduced from 1:50,000 scale maps developed by the Survey Department

4.1.5.1 PEAK FLOWS BASIN 1

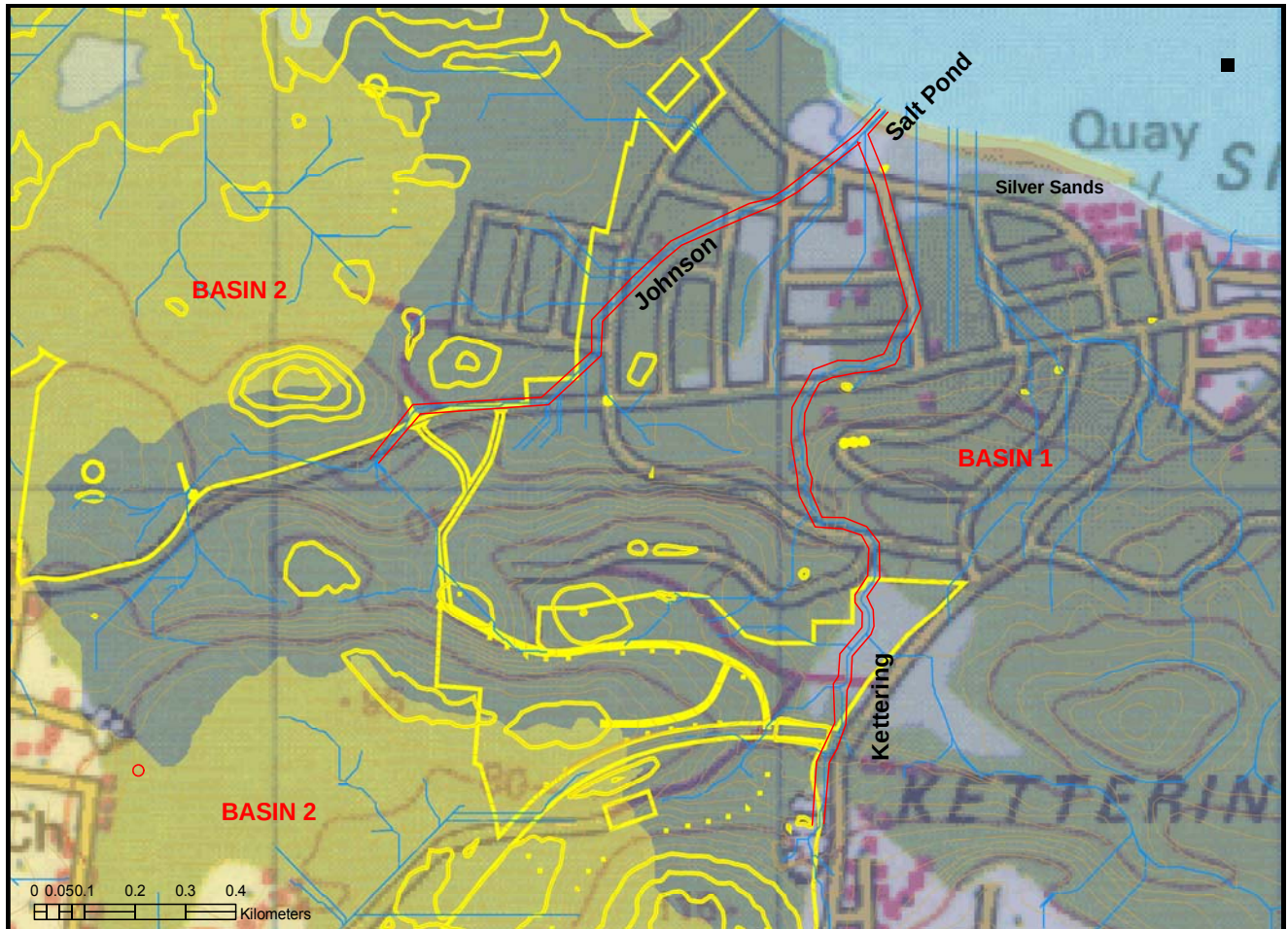
The peak flows and runoff volumes used in the HEC-RAS model for Basins 1, 2 and 3 are presented in **Tables 21, 22** and **23** respectively.

A. Basin 1

Table 21: Table showing the Peak flow rates and runoff volumes for Basin 1

Return Period (yrs)	Reach Segment	Peak Runoff Rate (m ³ /s)		Runoff Volume (1000m ³ /s)	
		Pre-Development	Post-Development	Pre-Development	Post-Development
10	Johnson	1.7	4.8	18.4	36.7
	Kettering	11.5	14.3	176.8	199.2
	Salt Pond	23.1	27.6	330.4	371.1
25	Johnson	2.7	6.6	29.9	52.3
	Kettering	17.8	21.4	274.1	302.0
	Salt Pond	36.1	42.0	514.6	564.8
50	Johnson	3.6	7.9	39.2	64.2
	Kettering	22.9	27.1	351.3	382.7
	Salt Pond	46.5	53.3	661.0	717.4
100	Johnson	4.3	9.0	48.7	75.8
	Kettering	27.5	32.1	428.7	463.1
	Salt Pond	55.7	63.2	808.1	869.7

Source: TEMN (2005)

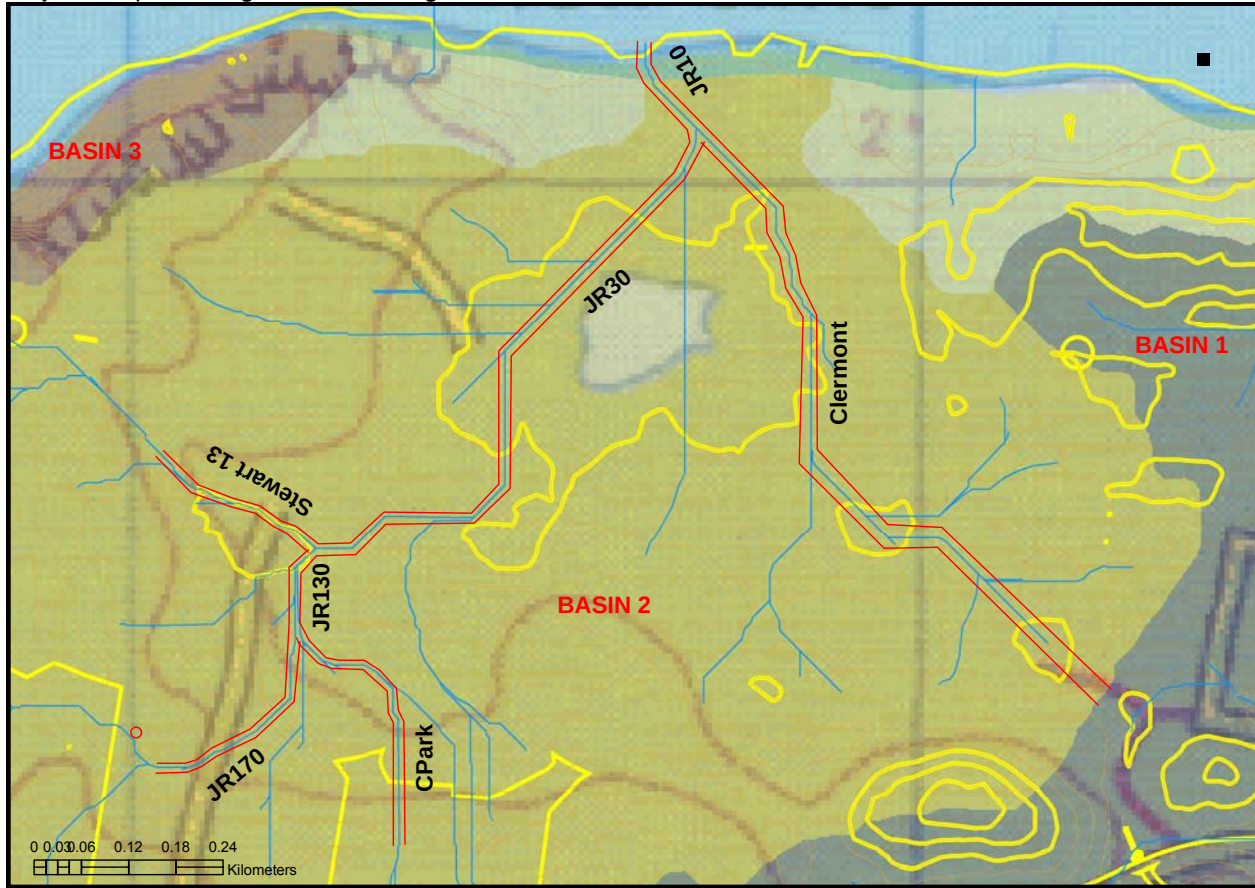
Map 4: Map showing the Reach Segments in Basin 1

Source: Map reproduced from 1:50,000 scale maps developed by the Survey Department

Table 22: Table showing the Peak flow rates and runoff volumes for Basin 2

Return Period (yrs)	Reach Segment	Peak Runoff Rate (m ³ /s)		Runoff Volume (1000m ³ /s)	
		Pre-Development	Post-Development	Pre-Development	Post-Development
10	JR10	29.8	36.7	415.5	517.5
	Clermont	3.9	6.8	64.8	90.4
	JR30	23.5	24.5	296.4	305.6
	Stewart13	2.6	4.2	29.0	44.4
	JR130	22.4	22.4	267.3	267.3
	Cpark	5.5	5.5	64.8	64.8
	Ws_Park	3.7	13.2	54.4	121.6
	JR170	7.8	7.8	84.4	84.4
25	JR10	49.4	59	660.1	797.3
	Clermont	6.2	10	99.2	131.9
	JR30	38.8	41.1	473.3	494.8
	Stewart13	4.1	6.4	46.3	67.7
	JR130	36.7	36.7	427.1	427.1
	Cpark	9.3	9.3	105.6	105.6
	Ws_Park	6.2	17.9	87.6	170.6
	JR170	12.9	12.9	137.5	137.5
50	JR10	61.9	72.1	833.9	985.2
	Clermont	7.6	11.8	123.1	158.9
	JR30	48.8	51.6	599.5	624.4
	Stewart13	5.1	7.8	58.7	83.6
	JR130	46.3	46.3	540.8	540.8
	Cpark	11.7	11.7	134.9	134.9
	Ws_Park	7.8	20.7	111.3	202
	JR170	16.6	16.6	175.6	175.6
100	JR10	76.0	87.0	1,038.3	1,203.8
	Clermont	9.3	14.1	150.9	189.4
	JR30	59.8	63.0	748.2	776.7
	Stewart13	6.1	9.2	73.4	101.9
	JR130	56.6	56.6	674.7	674.7
	Cpark	14.3	14.3	169.6	169.6
	Ws_Park	9.7	24.1	139.3	238
	JR170	20.3	20.3	220.8	220.8

Source: TEMN (2005)

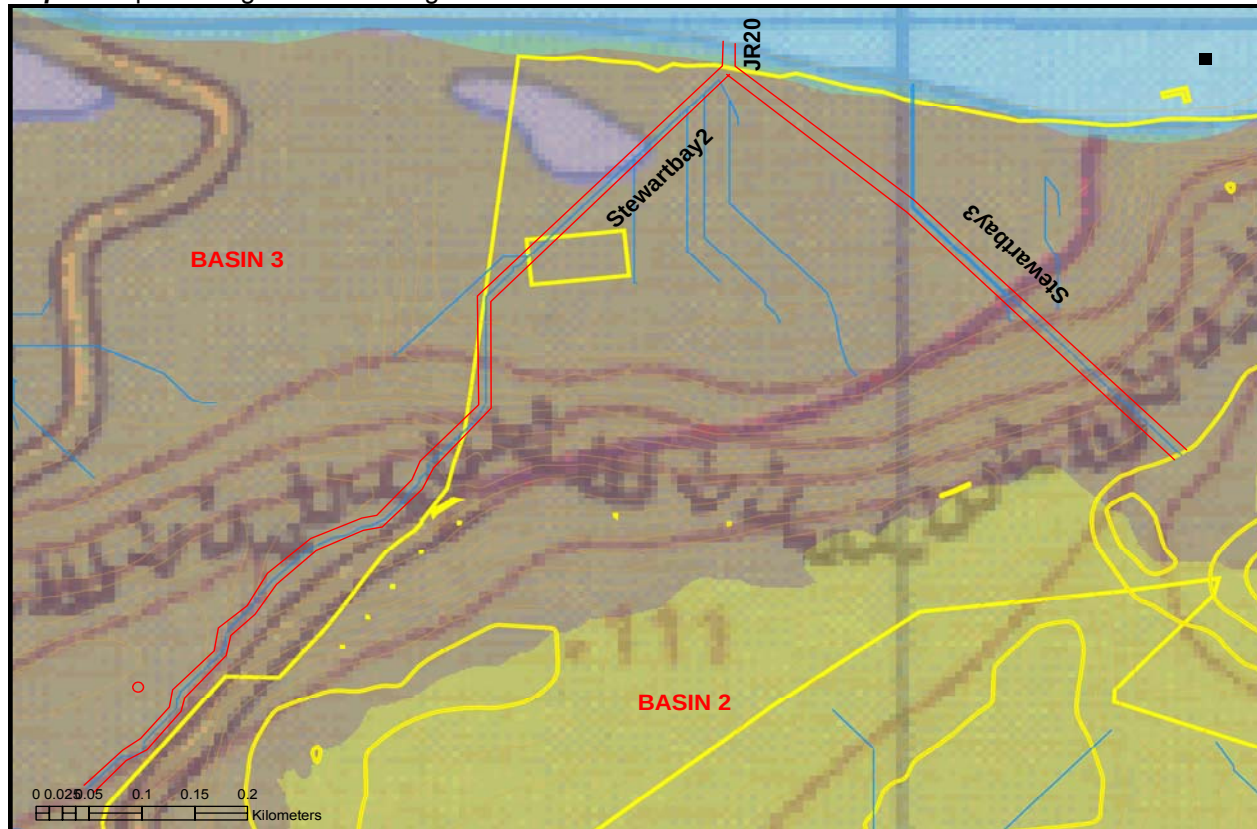
Map 5: Map showing the Reach Segments in Basin 2

Source: Map reproduced from 1:50,000 scale maps developed by the Survey Department

Table 23: Table showing the Peak flow rates and runoff volumes for Basin 3

Return Period (yrs)	Reach Segment	Peak Runoff Rate (m ³ /s)		Runoff Volume (1000m ³ /s)	
		Pre-Development	Post-Development	Pre-Development	Post-Development
10	Stewart Bay 2	1.7	5.2	19.4	39.9
	Stewart Bay 3	0.5	2.3	22.1	47.6
	JR20	1.8	5.8	41.5	87.5
25	Stewart Bay 2	2.7	6.5	29.6	52.9
	Stewart Bay 3	0.8	3.1	33.5	63.0
	JR20	2.7	7.3	63.1	115.9
50	Stewart Bay 2	3.3	7.3	36.6	61.3
	Stewart Bay 3	1.0	3.5	41.4	73.1
	JR20	3.4	8.3	78.0	134.4
100	Stewart Bay 2	1.7	5.2	19.4	39.9
	Stewart Bay 3	0.5	2.3	22.1	47.6
	JR20	4.0	9.2	95.4	155.2

Source: TEMN (2005)

Map 6: Map showing the Reach Segments in Basin 3

4.1.5.2 Mannings Roughness Coefficient

The Mannings roughness coefficients used are $0.05\text{m}^{1/3}/\text{s}$ for the channels and $0.08\text{m}^{1/3}/\text{s}$ for the overbanks. Conservative roughness values were used because there was no data for calibration or validation of the model.

4.1.5.3 Present Status

Several constraints were evident in the evaluation of the Hydraulic situation at the Amaterra Development site. These are as follows.

- o The lack of measured flow data on the stream network within the development area. As a consequence, calibration and validation the hydraulic model was not possible. Some key parameters used in the model are therefore based on professional judgment only, hence their closeness to real values is not known.
- o Elevation profile of the proposed road network and of the inverts of proposed culverts was not available hence their schematization in the hydraulic model was not possible.

- o The full extent of the existing drainage capacity in Silver Sands is not certain hence it was assumed that all the discharge would flow overland.

A. Basin 1 – Silver Sands

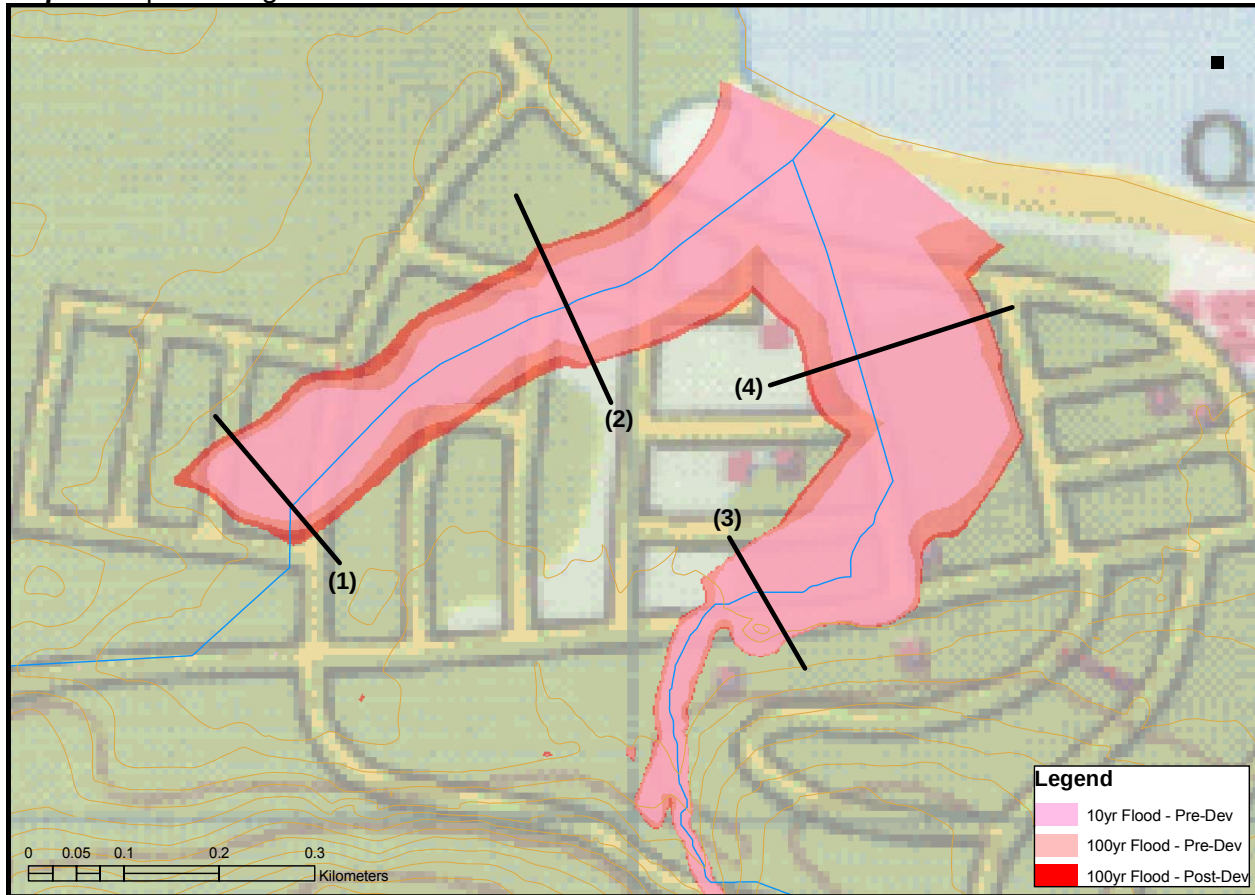
The results of the hydraulic analysis are presented in **Map 7** and **Table 24**. The map shows the likely extent of flooding in the Silver Sands Community on the basis that all the floodwaters flow overland. For clarity, only the 100yr return period flood extent for both the pre- and post-development runoffs and the 10yr return period flood extent for the pre-development runoff are displayed. The flood extents for the other modeled floods lie within these limits.

From the map it is observed that the increase in the flood extents due to the development is marginal and does not significantly exacerbate flooding in the Silver Sands community when compared with the pre-development flood extents. The average inundation depths at the 4 cross-sections shown in the map are presented in **Table 24**. The figures show that in general, the increase in the average inundation depths is less than 0.1 m. The overall impact of the development on flooding in the community can therefore be described as very marginal.

The dimensions (height 6.0m and width 6.5m) of the elliptical culvert^[1] located close to the intersection of the North Coast Highway and Silver Sands main road (not shown in Map) appears adequate to discharge the increased runoff resulting from the development provided that it is not blocked.

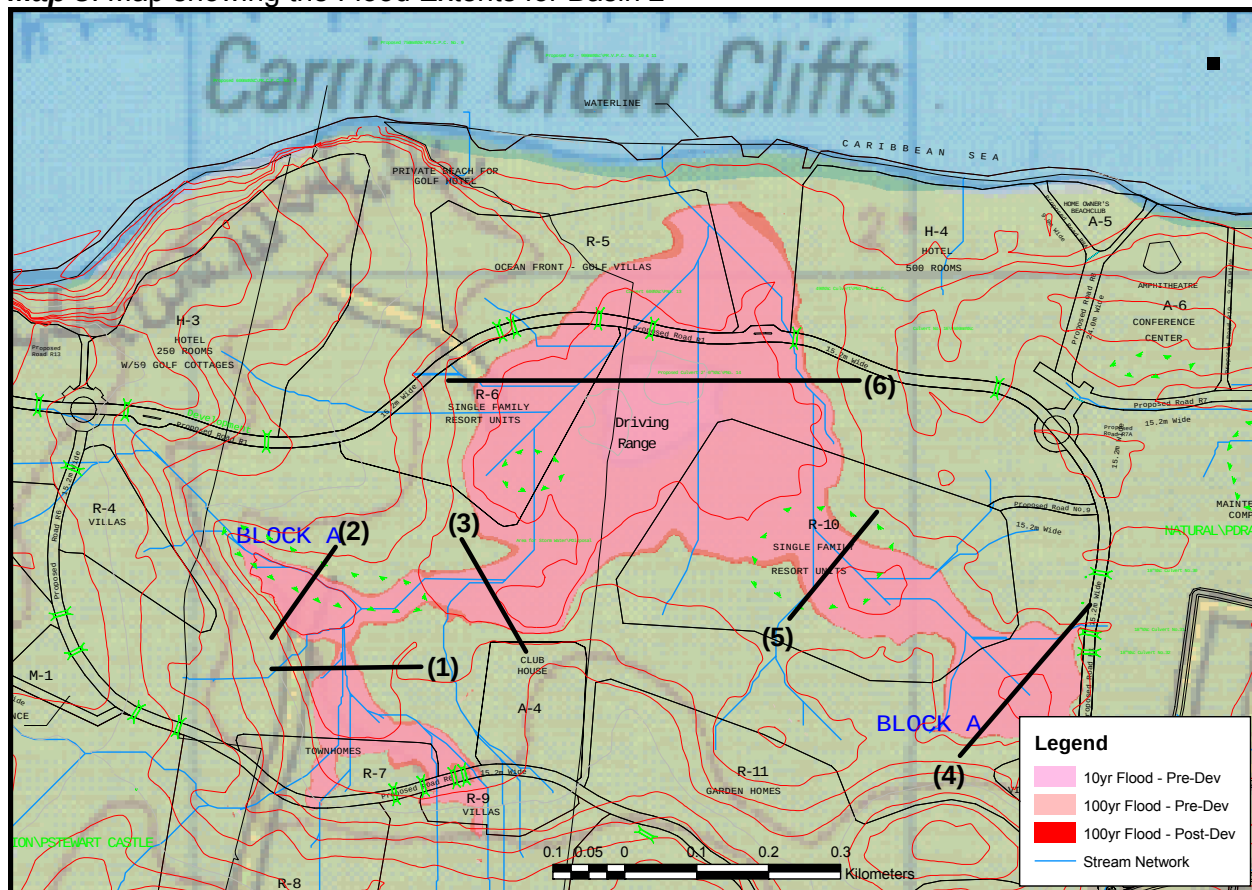
Table 24: Average Inundation Depth and Water Surface Elevations in *Basin 1*

PROFILE		10yr		25yr		50yr		100yr	
Cross-sections		Pre-Dev	Post-Dev	Pre-Dev	Post-Dev	Pre-Dev	Post-Dev	Pre-Dev	Post-Dev
(1)	WS Elev (m) a.m.s.l.	3.72	3.86	3.78	3.92	3.82	3.96	3.85	3.98
	<u>Avg. Inun. Depth (m)</u>	<u>0.19</u>	<u>0.28</u>	<u>0.23</u>	<u>0.32</u>	<u>0.25</u>	<u>0.34</u>	<u>0.27</u>	<u>0.35</u>
(2)	WS Elev (m) a.m.s.l.	2.71	2.78	2.78	2.84	2.82	2.88	2.85	2.91
	<u>Avg. Inun. Depth (m)</u>	<u>0.13</u>	<u>0.17</u>	<u>0.16</u>	<u>0.2</u>	<u>0.18</u>	<u>0.22</u>	<u>0.2</u>	<u>0.24</u>
(3)	WS Elev (m) a.m.s.l.	4.93	4.97	5.01	5.04	5.06	5.1	5.1	5.14
	<u>Avg. Inun. Depth (m)</u>	<u>0.25</u>	<u>0.28</u>	<u>0.31</u>	<u>0.33</u>	<u>0.34</u>	<u>0.37</u>	<u>0.38</u>	<u>0.4</u>
(4)	WS Elev (m) a.m.s.l.	1.94	1.97	2.0	2.03	2.04	2.07	2.07	2.1
	<u>Avg. Inun. Depth (m)</u>	<u>0.19</u>	<u>0.21</u>	<u>0.23</u>	<u>0.24</u>	<u>0.25</u>	<u>0.27</u>	<u>0.27</u>	<u>0.29</u>

Map 7: Map showing the Flood Extents in *Basin 1*

B. Basin 2

The results of the hydraulic analysis of Basin 2 are presented in **Map 8** and **Table 25**. The map shows the likely extents of flooding within Basin. As in the previous section, for clarity, only the 100 yr return period flood extent for both the pre- and post-development runoffs and the 10 yr return period flood extent for the pre-development runoff are displayed. The flood extents for the other modeled floods lie within these limits.

Map 8: Map showing the Flood Extents for Basin 2

Source: Drainage plan developed by Kevin Tucker Design Group

Table 25: Average Inundation Depth and Water Surface Elevations in Basin 2

Profile		10yr		25yr		50yr		100yr	
Cross-sections		Pre-Dev	Post-Dev	Pre-Dev	Post-Dev	Pre-Dev	Post-Dev	Pre-Dev	Post-Dev
(1)	WS Elev (m) a.m.s.l.	12.26	12.26	12.37	12.38	12.44	12.44	12.5	12.5
	Avg. Inun. Depth (m)	<u>0.31</u>	<u>0.32</u>	<u>0.38</u>	<u>0.39</u>	<u>0.42</u>	<u>0.43</u>	<u>0.46</u>	<u>0.46</u>
(2)	WS Elev (m) a.m.s.l.	10.55	10.57	10.73	10.75	10.83	10.86	10.92	10.95
	Avg. Inun. Depth (m)	<u>0.92</u>	<u>0.93</u>	<u>1.07</u>	<u>1.09</u>	<u>1.15</u>	<u>1.17</u>	<u>1.22</u>	<u>1.25</u>
(3)	WS Elev (m) a.m.s.l.	7.18	7.19	7.31	7.31	7.37	7.4	7.42	7.46
	Avg. Inun. Depth (m)	<u>0.29</u>	<u>0.3</u>	<u>0.38</u>	<u>0.38</u>	<u>0.42</u>	<u>0.44</u>	<u>0.46</u>	<u>0.48</u>
(4)	WS Elev (m) a.m.s.l.	8.91	8.99	8.98	9.06	9.01	9.09	9.05	9.13
	Avg. Inun. Depth (m)	<u>2.56</u>	<u>2.62</u>	<u>2.61</u>	<u>2.67</u>	<u>2.63</u>	<u>2.69</u>	<u>2.66</u>	<u>2.72</u>
(5)	WS Elev (m) a.m.s.l.	6.86	6.92	7.0	7.06	7.07	7.13	7.15	7.2
	Avg. Inun. Depth (m)	<u>0.72</u>	<u>0.75</u>	<u>0.8</u>	<u>0.83</u>	<u>0.84</u>	<u>0.87</u>	<u>0.88</u>	<u>0.91</u>
(6)	WS Elev (m) a.m.s.l.	6.86	6.92	7.0	7.06	7.08	7.13	7.15	7.21
	Avg. Inun. Depth (m)	<u>2.39</u>	<u>2.42</u>	<u>2.48</u>	<u>2.52</u>	<u>2.53</u>	<u>2.57</u>	<u>2.59</u>	<u>2.62</u>

The results displayed do not take into account the proposed road network and culverts. It is observed that the flood extents of the full range of floods modeled (10 – 100 yr) are

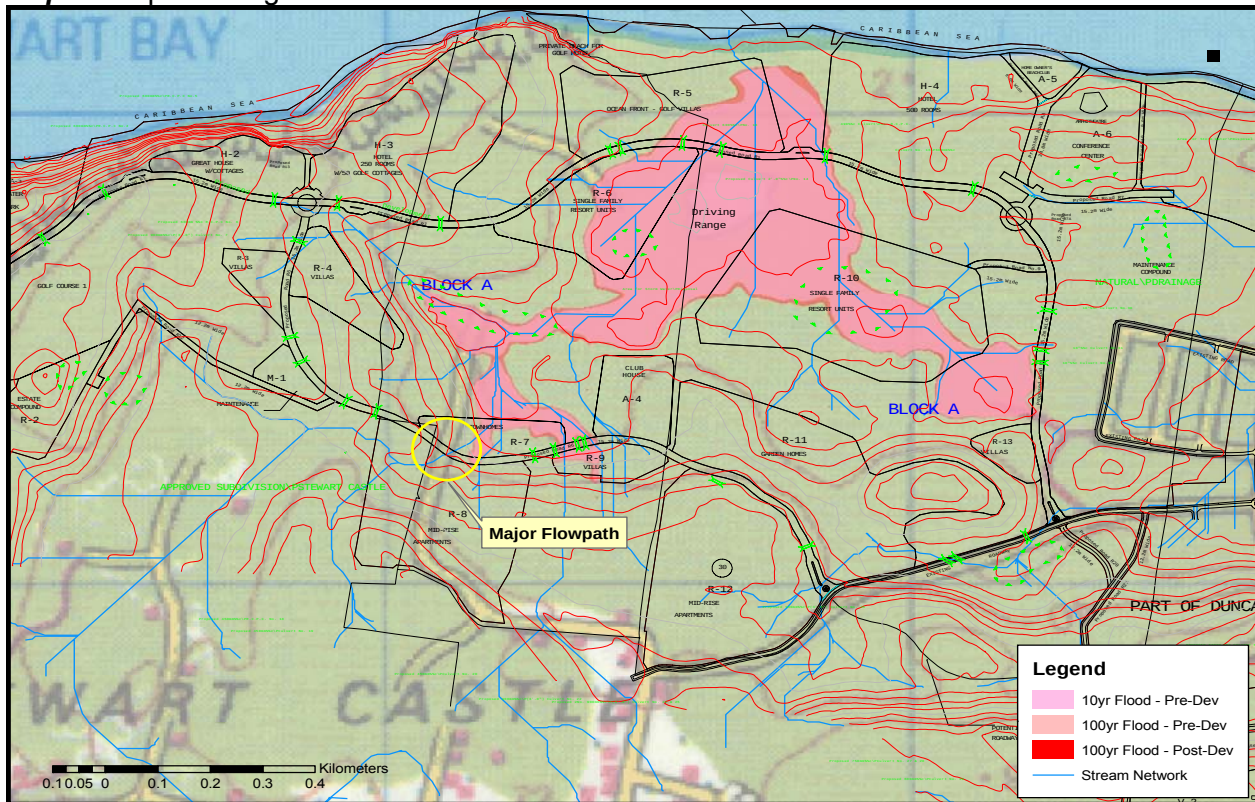
almost indistinguishable. This is due to the fact that the area constitutes a large depression whereby the floodwaters accumulate in the depression until it is filled. Accordingly the modeled floods have similar flood extents.

The filling of the depression is confirmed by the volumetric estimates from the hydrologic analysis (**Table 22**) where the volumes of runoff from all the floods modeled exceed the capacity of the depression estimated liberally at 360,000m³ (using the 5m contour with a surface area of 120,000m² and an a depth of 3m neglecting the slope). The volume of runoff for the smallest flood (10yr pre-development flood) was estimated at 415,600m³ (**Table 22**, reach segments JR30, Clermont and Ws_Park).

The average inundation depths at the 6 cross-sections shown in the map are presented in **Table 25**. In the large depression, the average inundation depth for the 100 yr post-development flood was 2.62m. This suggests that the average depth of 3m used to estimate the capacity of the depression was reasonable.

The proposal to construct a road across the depression is likely to exacerbate flooding south of the road provided adequate drainage is not in place. Any other encroachment in the area will also exacerbate flooding. The level of drainage required is dependent on the extent to which the area is to be drained. The proposed culverts are currently located at the top of the depression and would not allow significant draining of the depression. The proposed retention areas are unlikely to be able to control the volume of water associated with the floods modeled given that these areas are much smaller than the existing depressions which are themselves natural retention areas.

There is no provision for culverts on the drainage plan south of the depression where the proposed road crosses the major stream flowing into the depression (**Map 9**). This maybe an oversight on the drawing but needs mentioning as it is very important that proper and adequate conveyance is considered for this point the road could obstruct flow and result in flooding south of the road.

Map 9: Map showing the Intersection of Road and Stream without Culvert

Source: Drainage plan developed by Kevin Tucker Design Group

C. Basin 3

A computer analysis of the hydraulic conditions in *Basin 3* was not done as this basin is very small and does not require such elaborate modeling. The drainage requirements can be determined based on the estimated volume of runoff from the hydrological analysis (**Table 23**, Reach Segments Stewart Bay 2 and 3). The capacity of the retention basin can be determined based on the design flood and the amount of water to be or can be retained. Additional drainage should be put in place for floodwaters in excess of the capacity of the retention basin.

Overall, the impact of the development of the golf course on the flooding in the Silver Sands community is marginal when compared to the pre-development flood discharge with a likely increase in the average inundation depth of less than 0.1m. The culvert close to the intersection of the North Coast Highway and Silver Sands main road should be adequate to convey the flood discharge provided that it is not blocked.

The proposed drainage plan for Basin 2 seems inadequate however to deal with the runoffs associated with the full range of floods modeled (10 – 100 yr), considering that the

natural retention systems with expected larger capacity is already inadequate. These include the proposed retention basins and the culverts which may not be effective due to their elevations. Encroachment into the natural depressions in Basin 2 is likely to exacerbate flooding in the area also.

4.1.6 NOISE AND VIBRATION

Noise pollution can be defined as any unwanted sound, usually of anthropogenic origin. The impact can range from minor irritation to disruption of concentration, interference of social regimes to changes in physiology resulting in health impacts such as hearing loss.

METHODOLOGY

Baseline data for noise was obtained from a Strategic Environmental Assessment (SEA) that was recently conducted in the area. It was determined that these measurements were suitable for the environmental impact assessment and that in the most they represented the current conditions of the study site. This data was reviewed and used to predict the noise impact should the development proceed.

Recently the National Environment and Planning Agency (NEPA) released a review of international guidelines for noise as one of the steps to establishing a framework for Jamaican standards on noise. In this review India's noise standards were regarded as the most suitable for the Jamaican condition. These standards are reproduced from the review and are represented below. These were also compared to guidelines from the World Health Organization (WHO) and the European Commission (EC). These are presented in **Tables 26**, and **27** below respectively. Noise limits for various activities were also used in the comparison of the noise assessment results. These are shown in **Table 28** below.

Table 26 Table showing the selected framework for standards: (from India)

AREA ZONE	DAYTIME LIMITS (dBA)	NIGHTTIME LIMITS (dBA)
Industrial Area	75	70
Commercial Area	65	55
Residential Area	55	45
Silence Zone	50	40

Table 27: Table showing the Noise standards and Guidelines from The United States Environmental Protection Agency, the World Health Organisation and the European Commission

ORGANIZATION	INDUSTRIAL AREA	COMMERCIAL AREA	RESIDENTIAL AREA	SILENCE ZONE
	Day / Night	Day / Night	Day / Night	Day / Night
U.S.(E.P.A.)	70	60	55	45
W.H.O. & E.C.	65	55	55 / 45	45 / 35

Table 28: Table showing the Noise Limits for Various Automobiles

EQUIPMENT	NOISE LIMIT (dBA)
Small motorbike or scooter	80
Passenger Car	82
Small Bus or Commercial Vehicle	85
Medium Bus or Commercial Vehicle	89
Large Bus or Commercial Vehicle	91
Domestic Air Conditioner	68
Refrigerator	46
Domestic Generator	85
Compactors (rollers), Front Loaders, Concrete Mixers, Cranes (moveable)	75

4.1.6.1 PRESENT STATUS

Five (5) sites were chosen for the gathering of noise data. These were on the outskirts of Silver Sands near an intersection, inside the residential portion of Silver Sands, Duncans Hill, and two points around the community of Stewart Castle. The results from the SEA are displayed in **Table 29** below.

Table 29: Table showing the results of the noise assessment conducted in the area

LOCATION	GPS COORDINATES	AVERAGE dB(A)	MAXIMUM dB(A)	MINIMUM dB (A)
Silver Sands Intersection at Bus Stop	N 18 29 029 W 77 31 908	59	76	38
Silver Sands- Housing Scheme	N 18 28 059 W 77 32 262	54	81	39
On Stewart Castle Main Road	N 18 28 559 W 77 34 395	49	77	39
Stewart Castle Boundary with Highway	N 18 28 083 W 77 33 862	69	80	43
Duncans Hill	N 18 2 290 W 77 32 741	66	77	54

Source: TEMN, 2005

Silver Sands is a long-standing community of villas and cottages, many of which are available for rent by tourists who visit the area. It has a gated entrance and a common area where visitors can gather on the beach for vacation activities. It is not particularly close to the main road and since many of the visitors are foreigners on vacation, it is unlikely that the movement of traffic would be heavy. The average for this community was 54 dB (A) which is within the World Health Organisation's (WHO) guidelines for the maximum community noise at 50 - 55 dB (A), as well as the daytime limit of 54 dB (A) set by the Indian Central Pollution Control Board. Where the values were higher, the noise was attributed to nearby construction activities, as well as a garbage truck for the maintenance of the area. Since the construction activity was likely short to medium term, and the passage of the garbage truck likely to be at intervals throughout the week, the average was thought to be representative of the community.

Just on the outskirts of the community is an intersection with a bus stop. The average obtained at this site was 59 dB (A). This monitoring site was described as the main pick up area from persons travelling to and from Duncans, as well as a thoroughfare for private vehicles and vehicles servicing Jacob Taylor Beach and Silver Sands. Silver Sands is on the outskirts of the property earmarked for development.

The communities of Stewart Castle and Duncans Hill are residential communities that were adjacent to the highway. The main road in the community of Stewart Castle averaged 49 dB(A) which makes this a relatively quiet community. It was described as a sparsely populated area. However at the part of the community closer to the highway the average decibel level rises to 69. This is close to the 70 dB (A) which is the average for street-corner traffic. This is not only higher than the WHO guideline of 55 dB (A) but well above both the limits set for Residential and Commercial areas as set by the standards of the Central Pollution Control Board of India. In fact it approaches the night time limit for Industrial Areas. Traffic tends to be the most significant source of environmental noise and this appears to be the case for the portion of Stewart Castle closest to the highway.

Duncans Hill is a housing scheme that was described as being approximately 150 feet from a construction site associated with the North Coast Highway. The average noise reading of 66 dB (A) was quite high for a residential area. However it is quite likely that the movement

of heavy vehicles associated with this construction contributed significantly to these readings. This average however was below the guidelines for construction vehicles as well as those for Industrial Areas in the daytime.

4.1.7 LANDSCAPE AND AESTHETICS

METHODOLOGY

A walk through of the area was carried out to determine the landscape and aesthetic value of the site. The site was also viewed from various vantage points.

4.1.7.1 PRESENT STATUS

From all vantage points the area appears to be one which is undeveloped, un-landscaped area, which some persons may view as not aesthetically pleasing.

4.2 BIOLOGICAL ENVIRONMENT

4.2.1 TERRESTRIAL ENVIRONMENT

This section outlines the description of the biological environment, the methodologies involved and the results of the assessment. It is divided into two parts; the first outlines the results of the Floral Assessment and the second outlines the results of the Assessment of the Fauna observed in the area.

4.2.1.1 ASSESSMENT OF FLORA

METHODOLOGY

The assessment of the vegetation in the area was carried out in two (2) phases, a *Phase 1* Assessment and a *Phase 2* Assessment respectively. The *Phase 1* Assessment included a review of aerial images of the project area (Please see **Figure 10** below). These were used to delineate the vegetation types within the area of influence. This was followed by a “walk through” of the site to formulate a concept of the area, as well as to identify the particular habitats and vegetation types. This was also carried out to confirm the information gleaned from the aerial images. In addition, consultation was held with local residents and the developer.

An extensive vegetation study was conducted during the undertaking of the Strategic Environmental Assessment (SEA) for the Amaterra development in 2005. An ecological assessment of the area was also conducted in 1993 by the Trelawny Environmental Protection Association. This assessment was therefore undertaken to verify the information that was presented in these reports.

Based on the analysis from the *Phase 1* assessment and the information presented in the SEA, the project area was divided according to the habitat type identified as follows:

- A. **Type 1:** Dry Limestone Forest Zone
- B. **Type 2:** Mangrove/ Swamp Zone
- C. **Type 3:** The Beach Zone

All species observed during the assessment were identified in the field where possible, and photographs and samples were taken of all unknown species for later identification. Species that were of ecological and commercial value were also recorded during this exercise. A Semi-Quantitative Abundance Rating method was used to determine the abundance of all the species identified as shown in **Table 30** below.

Table 30: Table showing the Semi-Quantitative Abundance Rating Method

RATING	SYMBOL
Dominant	D
Abundant	A
Frequent	F
Occasional	O
Rare	R

Figure 8: Picture showing the aerial images of the Amaterra Development Area



Source: Google Earth (2007)

4.2.1.1.1 PRESENT STATUS

A. GENERAL DESCRIPTION DEVELOPMENT AREA

The part of the property earmarked for the development of the golf course relatively small constituting of only approximately 25 % of the entire development area. However, the area that will be impacted by this and future developments is considerably larger and therefore must be taken into account during the ecological survey.

The study area borders the shoreline and can therefore be considered predominantly coastal in its makeup. The site itself does however encompass several discrete habitats and vegetation types and mostly consists of dry limestone forests. To the centre of the property is a large non-flowing brackish pool, another distinctive habitat. To the north are marsh and swamp lands that come from tidal pools, as well as mangrove woodlands that border sandy and rocky shores. Near the coast there is distinctly coastal vegetation. Scrublands border the residential areas on the southern outskirts of the proposed development site.

B. CONSERVATION STATUS OF THE AREA

The analysis of aerial photographs of the area, the Protected Area Map of Jamaica (NEPA, 2005) shows that the area is not located within a protected or conservation area. No Tree Preservation Order has been declared for the area or has any of the wetland areas been declared as Ramsar sites.

C. DESCRIPTION OF THE VEGETATION ZONES

i. Dry Limestone Forest Zone

The Dry Limestone Forest vegetation type dominates most of the development area. Generally, the vegetation in this area can be described as being one of relatively low undisturbed forest consisting of moderate species diversity. The spatial distribution of the dominant species in this area is typified by a clumped distribution pattern, which has the characteristics of the presence of one plant of a species means there is a high probability of finding another of the same species close by (Barbour *et. al*, 1987). The inland areas consists mostly however of an undisturbed forest, largely consisting of native species. This

area appears to have a similar structure and functioning to a natural type (Morris and Therivel 2001).

On the outskirts of the property, bordering the residential areas the vegetation type is of a low canopy approximately eight (8) metres, consisting of species such as Wild Poponax (*Acacia tortuosa*) and other scrubland vegetation. As you move further into the forested areas the canopy height increases, and ranges from twelve (12) to twenty (20) meters. In this area species such as *Agave* sps., Red Birch (*Bursea simarouba*), Guango (*Samanea saman*) and Logwood (*Haematoxylum campechianum*) were observed. Abundant species in this area included the Ping – Wing (*Bromeliaceae* sp), Guinep (*Melicoccus bijugatus*) and Wild Mahogany (*Trichilia hirta*). As is typical of this forest type, vegetation was observed to be growing on bare rock with little soil cover, understory and minimal leaf litter.

Where soil cover increased, species diversity and density also increased. In these areas shrubs and herbs such as Devils Horeswhip (*Achyranthes indica*), Wild Rosemary (*Croton linearis*), Pepper rod (*Croton humilis*), Broomweed (*Sida acuta*) and *Lantana* sps were more prevalent. Quite a few fruit trees were also observed this included Star-Apple (*Chrysophyllum cainito*), Soursop (*Annona muricata*), Mango (*Mangifera indica*), and Tamarind (*Tamarindus indica*). This was perhaps due to the close proximity of the development site to residential areas.

Also observed in this area were a number of epiphytes including the Jamaican Purple Orchid (*Broughtonia sanguinea*) [this species is listed in and regulated under the Endangered Species Act of 2000, (See **Section 3.15**)]. Other epiphytes observed include *Ipomea* sps., and tank Bromeliads (*Hohenbergia* sp.).

ii. Mangrove/ Swamp Zone

To the north of the property, bordering the sandy shores is a wetland area consisting of a large open pool with vegetation consistent with mangrove swamps. The four (4) species of mangroves found in Jamaica were observed in this area. This includes the Black Mangrove (*Avicennia germinans*), the Red Mangrove (*Rhizophora mangle*), the White Mangrove (*Laguncularia racemosa*) and the Button Mangrove (*Conocarpus erectus*). The Black Mangroves were the most abundant species observed in this area.



Picture 1: Picture showing the Mangrove Forest Zone

iii. Beach Zone

The Beach Zone is located to the most northern region of the development area. The vegetation observed in this area is typical of coastal areas in Jamaica. Species observed included the Sea Grape (*Coccoloba uvifera*), Seaside Mahoe (*Thespeisa populnea*), *Sesuvium portulacastrum*, Beach Croton (*Croton punctatus*), Beach Morning Glory (*Ipomea brasiliensis*), Almond (*Terminalia catappa*) and Seashore Saltgrass (*Distichlis spicata*).

Picture 2: Picture showing the Beach Zone



Picture 3: Picture showing the Beach Zone



D. CONSERVATION STATUS OF SPECIES OBSERVED

i. Endemic Species

Out of the eighty-seven (87) species of plants observed throughout the development area, five (5) species are endemic to Jamaica including *Broughtonia sanguinea*, *Cactus triangularis*, *Cordia bullata*, *Thrinax parviflora*, and *Hernandia catapifolia* (Adams, 1972). The remaining species observed are introduced or native and are typical to species found in similar habitats islandwide.

ii. Rare Threatened or Endangered Species

One (1) of the plant species observed is classified as an endangered species and is protected by the Endangered Species Act (2000) and listed as a CITES Appendix II species [See **Sections 3.1.5** and **3.2.1** respectively]. No rare or threatened plant species were observed during the survey of the area.

iii. Invasive Alien Species

During the assessment four (4) invasive alien species were observed. These include *Prosopis juliflora*, *Leucaena leucocephala*, *Schinus terebinthifolius* and *Haematoxylum campechianum* (JACHM, 2007).

The complete list of plant species observed during the Floral Assessment is shown in **Appendix 6**.

4.2.1.2 ASSESSMENT OF FAUNA

Ecologically, terrestrial fauna is generally concerned with the macro fauna of a habitat. This is not to say that the microorganisms, which are always present, are any less important to the health of a particular habitat and that of the overall ecosystem. However the complexities of the interactions of these organisms with the biotic and abiotic factors within the macro environment, is not viewed as critical in most ecological studies of impact assessments. Therefore the approach taken in this part of the ecological study utilised a survey, where species are indicators to the overall health of the ecosystem.

This section of the report is divided into three (3) parts:

- o Assessment of Avifauna
- o Assessment of Butterflies
- o Assessment of Macro Fauna including other Insects, Reptiles, Gastropods and other Vertebrates

The Class Aves and the Class Insecta (Order Lepidoptera) were assessed separately because of the importance of these animals as indicator species, and the high level of endemism present on the island.

4.2.1.2.1 AVIFAUNA

Islands are often characterised by a very rich biodiversity, and Jamaica is no exception. The bird life in particular, is not only rich in the number of species present but also in the number of species unique (endemic) only to the island of Jamaica. Of all the Caribbean islands, Jamaica has the most endemic species of birds with 30 species; 2 of which are believed to be extinct.

METHODOLOGY

A point count sampling method was employed to assess the avifauna. In this method the observer stood at one point and counted all the birds seen and heard within six (6) minutes within an estimated fixed radius of 50 meters. In total four (4) points were counted, each approximately 150 meters apart. In addition, anecdotal notes were made of the birds observed while travelling between the points. Point counts were conducted on May 4 and 5 2007 starting at 6:30 am and 6:00 am respectively.

The abundance for the birds identified during the assessment was determined by the scale as shown in **Table 31** below.

Table 31: Table showing the abundance ratings for the Avifauna identified

ABUNDANCE	RATING
Common	Seen or heard in >50% of observation points in suitable habitat
Locally common	Detected in >50% of observation points but habitat type restricted in area
Fairly common	Seen or heard in 25% - 50% of observation points in suitable habitat
Uncommon	Seen or heard in <25% of observation points in suitable habitat
Rare	Not likely to be seen on every observation trip
Vagrant	A migrant that occurs less frequently than once every 10 years

4.2.1.2.1.1 PRESENT STATUS

The avifaunal assessment of the proposed development area revealed sixty-nine (69) species of birds representing twenty - two (22) families (See **Appendix 6**). Forty-seven (47) species of these birds are year round residents. The remaining twenty-two (22) species are migrants; which are divided into nineteen (19) non-breeding residents (winter migrants) and three (3) breeding residents (summer migrants). Of the total number of species observed, at least fourteen (14) species are associated with the coast and wetlands.

A. Endemic Species

More than fifty percent (50 %) of the extant endemic species were observed in the area. These are mostly common endemics such as the Jamaican Euphonia (*Euphonia jamaicensis*), Jamaican Vireo (*Vireo modestus*), White-chinned Thrush (*Turdus aurantius*) and the Red-billed Streamertail (*Trochilus polytmus*). While most of these endemics may be considered common birds, they are mostly less tolerant to high levels of disturbance compared to other non-endemic resident birds. Their presence therefore, hints towards a relatively good habitat type within the assessed area. The main indicator species in this respect are the Rufous-tailed Flycatcher (*Myiarchus validus*), Orangequit (*Euneornis campestris*), Yellow-shouldered Grassquit (*Loxipasser anoxanthus*), Jamaican Lizard Cuckoo (*Saurothera vetula*) and the Yellow-billed Parrot (*Amazona collaria*), to name a few.

The presence of the Yellow-billed Parrot (*Amazona collaria*) is of particular importance as this species is not only endemic, but also endangered and as such is given added protection under the Endangered Species (Protection, Conservation and Regulation of Trade) Act, 2000 [See **Section 3.1.5**] Careful observations and anecdotal notes suggest however that this species does not reside within this particular area, but instead visited the area to forage. During the assessment only one (1) pair of individuals was observed and this itself suggests that the area is not necessarily an important foraging area for this species. These individuals probably arrived from the Cockpit Country to the south.

B. Migrants

This area is important to a wide range of migrant birds. The dynamic structure of the area provides large expanses of low disturbance forests for forest birds, mangroves and ponds for wetland birds, and sandy and rocky shores for shore birds notably members of the Charadriidae and Scolopacidae families (**Appendix 6**). A total of twenty- two (22) migrant species were identified. This figure however could easily have been more, considering the fact that the assessments were done towards the end of the winter migrant season, where most of the winter migrants had already left the island and the summer migrants had just started to arrive.

C. Conservation Status of Species Observed

i. Endemic Species: Fifteen (15) species of birds identified are endemic to Jamaica.

ii. Rare, Threatened or Endangered Species: Only one (1) species that has been listed on the endangered species list (Endangered Species Act (2000)) was observed in the area, which is the Yellow- Billed Parrot (*Amazona collaria*). Only one (1) pair of the species was observed however and it was therefore concluded that this pair only visited the area to forage.

iii. Protected Species: All the bird species with the exception of the three (3) introduced species observed are protected under the Wild Life Protection Act (1945).

iv. Invasive Alien Species: No invasive alien species were observed during the assessment.

4.2.2.2 BUTTERFLIES

The Order Lepidoptera consists of butterflies and moths. These flying insects display a high level of endemism in Jamaica, as well as being reasonably good indicators of the health of the particular ecosystems in which they occur. Their role as pollinators performs an ecologically invaluable function and they may be second only to bees in this category. For these reasons they are discussed separately.

METHODOLOGY

The butterfly survey was undertaken over a two day period. The observations begun on the initial visit to the site where notes were made on the species observed with a view to

simple identification of species. On the second visit the time of observations were noted along with a designation of the abundance of the species using the DAFOR scale as shown in **Table 32** below.

Table 32: Table showing the Abundance Rating Method

RATING	SYMBOL
Dominant	D
Abundant	A
Frequent	F
Occasional	O
Rare	R

Field guides accompanied surveyors on the both days and digital cameras were used to capture images that could be scrutinized away from the field in order to confirm the identity of species. Two (2) surveyors were present in each of the survey days. Weather conditions were noted on survey days which ranged from partly cloudy to sunny and windy.

4.2.2.2.1 PRESENT STATUS

Butterflies were found in most of the habitat types identified throughout the development area. The numbers however were significantly reduced as one approached the beach. Despite the diversity of habitats, this was not reflected in the species richness or numbers of individuals. During the survey eleven (11) species were identified.

A. Endemic Species

Only one (1) species endemic to Jamaica was observed during the survey period. This was the *Mestra Dorcas*, commonly known as the Jamaican Mestra or simply the Dorcas. It was only occasionally observed and seen mostly in small bushes along pathways and roads that cut through the dry limestone forest. Although not frequently seen on the property it is known to be quite common in Jamaica.



Picture 4: Picture showing a *Mestra dorcas* butterfly observed within the development area

B. Other Species

The butterfly seen in the most habitats throughout the study area was the Buckeye. It is well known that a species of the Buckeye (*Junonia evarete*) favours mangrove and shoreline areas. The Buckeye was seen with great frequency around areas that were abundant with Black Mangroves (*Avicenna germinans*). One such habitat was only a few metres from the beach itself, bordering what is possibly a wetland of brackish water. Buckeyes were also noted on the grassy areas that grew in the sand and that led up to the beach. Buckeyes also seem to prefer areas of bare ground and several species were observed perched on small rocks and on stony pathways. They were seen with less frequency flying through the forests and there was the possibility that these Buckeyes were actually *Junonia genoveva* rather than *J. evarete*. It was difficult to get close enough to these butterflies to examine the differences that could distinguish the two (2) species. In the sightings list (See **Appendix 6**) both are listed to illustrate this uncertainty. Despite its range in the habitat the numbers of individuals noted were not as high as the Zebra (*Heliconius charitonius simulator*).

Picture 5: Picture showing a Buckeye (*Junonia evarete*) butterfly observed within the development area



The Zebra (*Heliconius charitonius simulator*) was the butterfly observed with the most frequency. Although its range was not as far as the Buckeye, it was seen in noticeably greater numbers. This was a fairly fast flying butterfly and one of the things that may have led to the appearance of greater abundance is that, rarely if ever was one individual seen. These butterflies were regularly seen flying together throughout the forest. Sometimes as many as four (4) or five (5) individuals were seen flying together or perched together.

Although they were never seen feeding, it is known that the Zebra has a preference for the passion fruit flower.

The White Peacock (*Anartia jatrophae jamaicensis*) is a common butterfly and was frequently seen in several habitats. It was seen mostly in the disturbed areas of the property including the outskirts of the residential areas and along the vehicular pathways. However it was the only other butterfly observed around the grassy areas by the seashore. Several species were seen around the large standing pond and the White Peacock was also noted around these areas. Although this species was seen in many diverse habitats it was not seen in numbers akin to the Zebra or Buckeye.



Picture 6: Picture showing a White Peacock (*Anartia jatrophae jamaicensis*) butterfly observed within the development area

The Tropical Fritillary (*Euptoieta hegesia hegesia*) was seen quite frequently around the large standing pool of water, but not regularly outside of this habitat. Several individuals were observed, apparently feeding on vegetation around the pond. No other species was as prevalent in this habitat but this dominance dropped off dramatically as one moved further away from the pond. With all the dragonflies present it is also possible that these fritillaries were part of their diet.

The Malachite (*Spiroeta stelenes stelenes*) was a rare sight during the survey period but notable. The Malachite can resemble the Zebra and with such large numbers of the latter it was quite possible but the malachite with its large size and distinct brown and green was distinct. The Malachite tends to prefer shaded, quieter portions of the forest and it was a bit surprising to see it along one of the more traversed pathways to the beachside of the property. The Malachite is also notable in its feeding habits. Although it does feed on nectar, it is also known to like rotting fruit and even some rotting animals, which is unusual for butterflies. None of those sources of food were noted where the butterfly was observed.

It is a butterfly that one may expect to say more in a moist limestone forest, closer to say the Cockpit Country.

The Maerula (*Anteos maerula maerula*) was noted on some of the few occasions that one could come close enough to reliably identify it. These butterflies tend to be quite high in their flight and their designation as rare may be due more to this fact than their true abundance.

The Checkered Skipper (*Pyrgus oileus*) was occasionally noted in the more sunny open areas of the study site. It was also noted with reasonable frequency along pathways and in the scrubland areas of the property.



Picture 7: Picture showing a Checkered Skipper (*Pyrgus oileus*) butterfly observed within the development area

Other butterfly species noted were the Cuban swallowtail (*Papilio andraemon*), which is a known pest to citrus trees. It was once listed as endangered and although its conservation status is no longer described as such, it should be given due consideration as management may be necessary.

The Jamaican Goatweed Butterfly (*Anaea troglodyte*) is a distinct butterfly. Only one individual was seen and was classified as rare. Occasionally almost Bond White high flying butterflies were seen and those were tentatively identified as the Jamaican Albatross.

C. Conservation Status of Species Observed

i. Endemic Species: One (1) species of butterflies was classified as endemic to Jamaica this included the *Mestra dorcias*.

ii. Rare, Threatened or Endangered Species: No rare threatened or endangered species was observed during the assessment.

iii. Protected Species: No protected species were observed during the assessment.

4.2.1.3 OTHER MACRO-FAUNA

The part of the property earmarked for the development of the golf course is relatively small. However the area that will be impacted by this and future developments is considerably larger and therefore must be taken into account during the faunal survey. The study area borders the shoreline and can therefore be considered predominantly coastal in its makeup but the site itself does encompass several discrete habitats and vegetation types. These include dry limestone forests, mangrove woodlands, marshlands, sandy and rocky shores as well as tidal and brackish pools with their respective vegetation profiles. The plants and animals found in these areas tend to display a reasonably high level of specification to their environment especially those that must tolerate the salt that comes from being in such close proximity to the sea.

METHODOLOGY

The assessment of the macrofauna barring avifauna and butterflies were conducted simultaneously with the assessment of the flora. Animals were divided into five (5) categories as follows:

- o Mammals
- o Reptiles
- o Gastropods
- o Insects
- o Crustaceans

Attempts were made to record the relative abundances of these species. In theory this would have been a good idea, however there were very few sessile species. Most of the species observed were swift flyers or very mobile species such as insects. Direct observation was therefore employed. This method involved following observed individuals of a given Order or Genus in order to estimate species abundance and observe interactivity with the habitat. This was done for successive species. Total counts are obviously an ideal

but this was unlikely except for large and or mostly sessile species. The species of Macrofauna identified is listed in **Appendix 6**.

4.2.2.3.1 PRESENT STATUS

A. Mammals

The largest animals noted on the visits to the site were goats (*Capra aegagrus*). These were found closer to the residential areas in the communities near the road that bordered the property, but were also seen foraging relatively close to the sea. These introduced species were generally allowed to range throughout the property but seemed to prefer the shrub lands on the edge of the dry limestone forest that covered much of the area surveyed. Goats are known to be less discriminate eaters and perhaps this is why they were the only herbivores seen grazing in the area.

Picture 8: Picture showing goats observed within the development area



In the surrounding areas the usual stray, domesticated dogs (*Canis familiaris*) were observed. Also observed in the communities were chickens (*Gallus gallus domesticus*). A single mongoose (*Herpestes auropunctatus*) was noted just outside the outskirts of the residential area.

B. Reptiles

One of the most common vertebrates in Jamaica is the Anoles lizard. It is widely distributed on the island from highly disturbed urban areas to forests and is even found in mountainous areas. Anoles lizards are small to medium sized iguanoid lizards that tend to be arboreal in their habitat and carnivorous, though mainly insectivorous. The study site found several individuals from various species of Anolis lizard. Most easily identified was *Anolis lineatopus*, as this species is generally found on the lower trunks of trees or on the ground and this makes it more accessible in the surveying process. It was found in abundance in the dry limestone forest on the trunks of several trees. Farther up the trees the identification process was a little more difficult. Several lizards were seen on the upper trunks, twigs and branches of trees as well as approaching the canopy. These were likely *Anolis opalinus* and *Anolis grahami* that were higher up on trees.

The Strategic Environmental Assessment (SEA) conducted in 2005 purported to the presence of the Jamaican Yellow Snake (*Epicrates subflavus*) in the area. During the assessment none of these species was observed, but due to the nature of the habitat it is highly likely that these species are present within the area. If this species is present, the population is likely being affected by the mongooses (*Herpestes auropunctatus*), a natural predator of snakes which has significantly reduced the population of these species islandwide.

C. Insects

This is a very large phylum of animals and is represented in almost every environment. The Order Lepidoptera is also included in this phyla are discussed separately in **Section 4.2.2.2**. The class of Odontata (which includes Dragonflies and Damselflies) was well represented in the development area, by large the large numbers of dragonflies observed. This may be explained by the large pond of standing water that bordered the limestone forest and whose northern-most edge was about 271 metres (0.17 miles) from the shoreline. It is known that the juvenile stage of Odontata is aquatic and this phase can last from several weeks to several years depending on the species. Several bright green individuals were observed around the dry limestone forested areas. This species was most likely *Erythemis simplicicollis*, known commonly as the green clearwing or eastern pond hawk. The green specimens were the female of the species. The male of the species tends

to be blue, although none of these were seen at the time of the survey. Another dragonfly with a somewhat pink abdomen was also seen in great abundance. It tended to fly high in this habitat and so was difficult to identify with any certainty, but the colour was quite distinct. It is possible that this was the Roseate Skimmer (*Orthemis ferruginea*) and this dragonfly is known to be quite successful in the Caribbean.

Picture 9: Picture showing a Dragonfly observed within the development area



Picture 10: Picture showing a Grasshopper observed within the development area



On the border of this pond, the dry limestone forest extends further in the interior of the property. At the base of several trees and among tangled vegetation several large duck ant nests were observed.

A few individual Orthopterans were noticed during the survey. These were large grasshoppers in all cases as no crickets were observed. These are large, herbivorous insects. Crickets tend to be nocturnal and it is quite likely that these insects were present at times when they would be missed by the survey.

The order Hymenoptera contains several social insects including ants, bees and wasps. Ant species are expected in habitats and quite a few were observed. Several bees were also observed during the survey. There were a large number of wasps observed at various intervals throughout the survey of the forest. Wasps prey on several insects and both in the wild and in agricultural settings are very important in the culling and control of nuisance and pest control.

Picture 11: Picture showing a hive of wasps observed within the development area



D. Gastropods

At several points during the survey large numbers of gastropod shells were seen in shaded areas and pockets. Many were intact but several were broken. There was a large diversity of shells and it is quite possible that these snails were captured by birds and taken to these spots in order to feed on them in seclusion. Jamaica does possess a high level of endemism in land snails and it is more than likely that several of the shells observed belonged to endemic species.

Several gastropods were found in the littoral zone of the rocky shores and on and around several almond trees that were on the rocky shore. The vast majority of snails observed near the seashore were in the littoral or supra-littoral zone. Some of these snails could therefore be described as marine or at the very least maritime.



Picture 12: Picture showing Gastropods observed within the development area

E. Crustaceans

As one moves closer to the shoreline the vegetation, as well as the fauna becomes more specific to the coastal environment. In some of the wetland areas closer to shore several hermit crabs were noted. Crabs are omnivores and so have a variety of food sources available. The species of crabs observed in the area were hermit crabs (*Coenobite clypeatus*). The crabs were relatively small, only a few centimetres in length and the wetlands probably provided a food source as well as a source of refuge from predation.



Picture 13: Picture showing a hermit crab observed within the development area

F. Nuisance Species

Nuisance species can be described as any animal, whether native or introduced that can have a negative impact ecologically, economically or otherwise. This definition of course is anthropogenic in its outlook. Some species will always be described as pests of one kind or another. Several nuisance species were observed during the assessment. These include mosquitoes, houseflies, and black and brown rats.

Mosquitoes at best are annoyances to mammals, humans and otherwise, and at worse are vectors for diseases such as malaria and dengue fever among many others. The health impact and related economic considerations are considerable to say the least.

The mongoose is an introduced, invasive species ecologically but it can also be a nuisance economically. To those who are raising chickens, mongoose can be very damaging creatures.

The housefly is a common Dipteran that is found wherever food and waste are generated and there are also vectors for several harmful diseases. Conversely lizards are actually quite useful in controlling nuisance species but they themselves are looked at as a nuisance by a majority of Jamaicans. These reptiles are regarded as repulsive and strenuous effort is made to keep them as far away from dwelling and working places as possible.

An inevitable result of human activity and improper storage and disposal of waste are an increase in rats. *Rattus rattus* and *Rattus norvegicus*, black and brown rats respectively are also vectors of disease and the fairly recent outbreak of Leptospirosis in Jamaica is a reminder of the health hazards posed by these vermin.

Butterflies are not necessarily thought of as pests but their larva are feeding stages in their life cycle and can cause great harm to agricultural pursuits. The Cuban Swallowtail which was seen on the property is noted as a pest of citrus trees during the larval phase. These species are all present, whether in the residential areas on the outskirts of the property or on the site itself and it is important that further development does not mean an ecological disturbance that means a significant increase in some of these species.

G. Conservation Status of Species Observed

i. Endemic Species: There is an extremely high level of endemism among Jamaican land snails however and it would not be presumptuous to expect that there are endemic species of land snails in the area. Two (2) species of reptiles identified are endemic to Jamaica. This includes *Anolis lineatopus* and the Jamaica Yellow Snake (*Epicrates subflavus*)

ii. Rare, Threatened or Endangered Species: One rare, endangered species, the Jamaican Yellow Snake has been observed within the development area and is protected under the Endangered Species Act (2000).

iii. Protected Species: The Jamaican Yellow Snake (*Epicrates subflavus*) is protected under the Wildlife Protection Act (1945).

iv. Invasive Alien Species: One species observed was identified as being an Invasive Alien Species that is the Indian Mongoose (*Herpestes auropunctatus*)

4.2.2 BIOLOGICAL ENVIRONMENT: MARINE ENVIRONMENT

METHODOLOGY

The site was surveyed initially along the coastline by land with special reference given to the site layout of the proposed development. Using satellite imagery, five (5) stations spanning the coastline were chosen to evaluate the coral and fish composition of the benthic environment. **Figure 9** below shows these sites. The GPS Coordinates for these five (5) stations are shown in the table below.

Table 33: Table showing the GPS Coordinates for the five (5) stations

STATION	GPS COORDINATES
1	18 29'37.26N, 077 34'38.03W
2	18 29'35.69N, 077 33'55.50W
3	18 29'38.67N, 077 33'16.03W
4	18 29'37.26N, 077 32'40.34W
5	18 29'44.40N, 077 32'10.46W

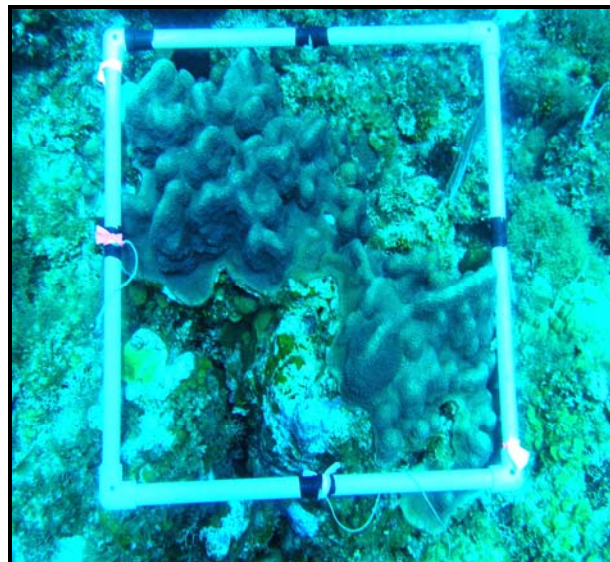
Fish populations were evaluated using the method development for use for the Atlantic and Gulf Rapid Reef Assessment (AGRRA). Thirty metres (30m) transects were laid at each station and fish were identified, counted and their size estimated along these transect. This is depicted in **Picture 14** below. In addition, a 10-minute roving dive was conducted at each station during which fish were identified and given a frequency rating as shown in **Table 34** below.

Table 34: Table showing the frequency rating used in the survey

FREQUENCY	OCCURRENCES
Single	1
Few	2 - 10
Many	11 - 100
Abundant	> 100

Figure 9: Aerial image showing Stations used in benthic reef survey and fish populations

Source: Google Earth (2007)

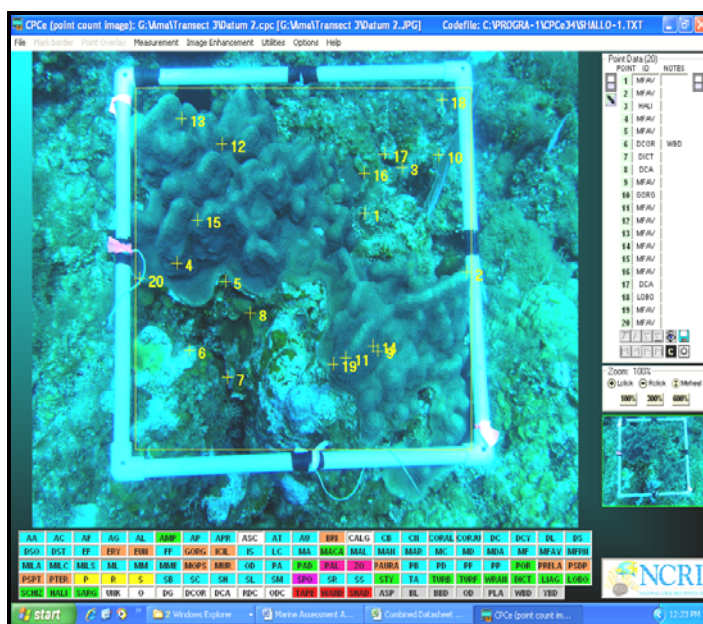
Picture 14: Picture showing the Fish survey along 30m transects using AGRRA method**Picture 15:** Picture showing the Raw digital image captured in the field

The coral populations were evaluated along the same thirty (30) metre transects similar to the fish survey. Digital Images were captured using a Nikon 4600 Digital Still Camera at 3m intervals 80cm above the substrate. A 60x60cm PVC quadrat was used as a guide for the

camera, and this was placed adjacent to the transect line at the 3m interval. This is shown in **Picture 15** above.

The images were then uploaded to a computer programme called Coral Point Count (CPC) with Excel Extensions (CPCe) developed by the National Coral Reef Institute of the United States. The field of view of each image for analysis was limited by the quadrat. Twenty (20) random points were then superimposed over the image and the coral and algal species covered by each point identified. See **Picture 16** below.

Picture 16: Analysis of Image using CPCe



The seagrass areas were evaluated using a combination of satellite imagery and snorkelling at the site to demark areas of major seagrass cover.

4.2.2.1 THE PRESENT STATUS: BENTHIC REEF COMMUNITY

The benthic reef community of the site is dominated by macroalgae (47%). The mean hard coral cover is reasonably high (28%). There is a low occurrence of coral disease. Sponges and Gorgonians are present in reasonable amounts. This is shown in **Figure 10** below.

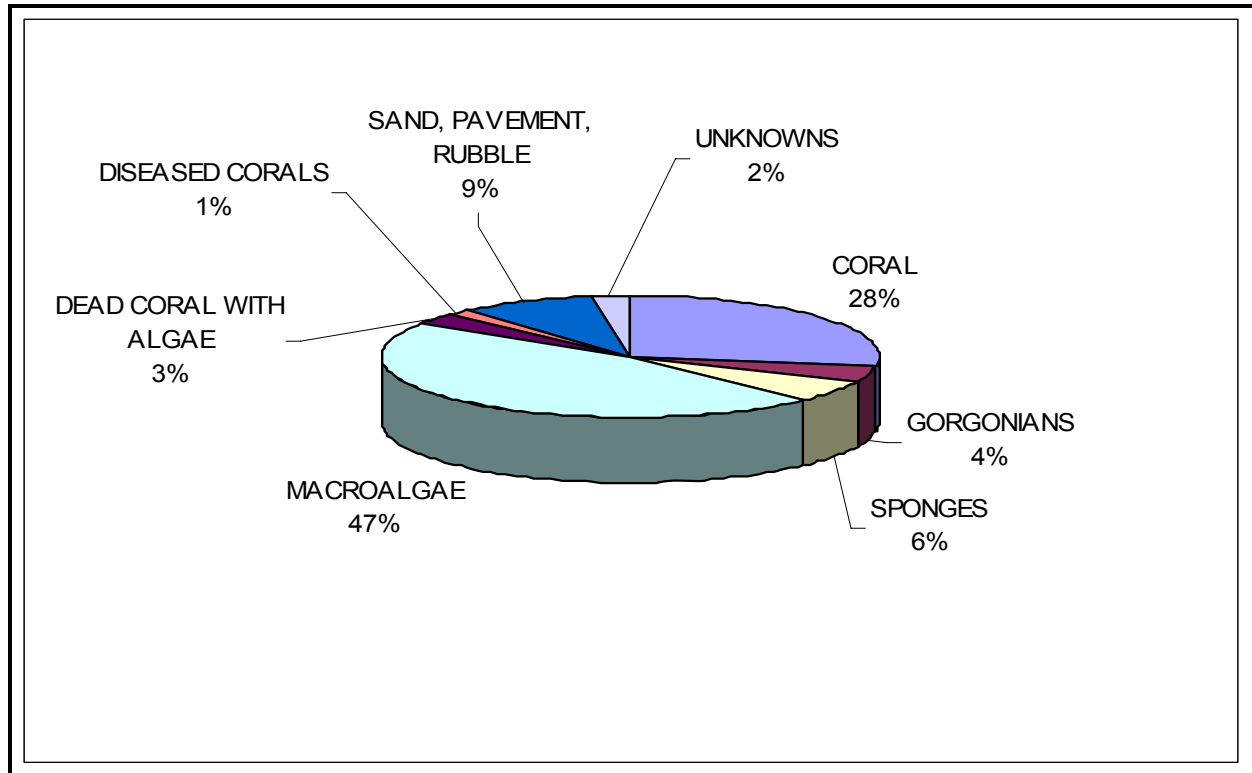
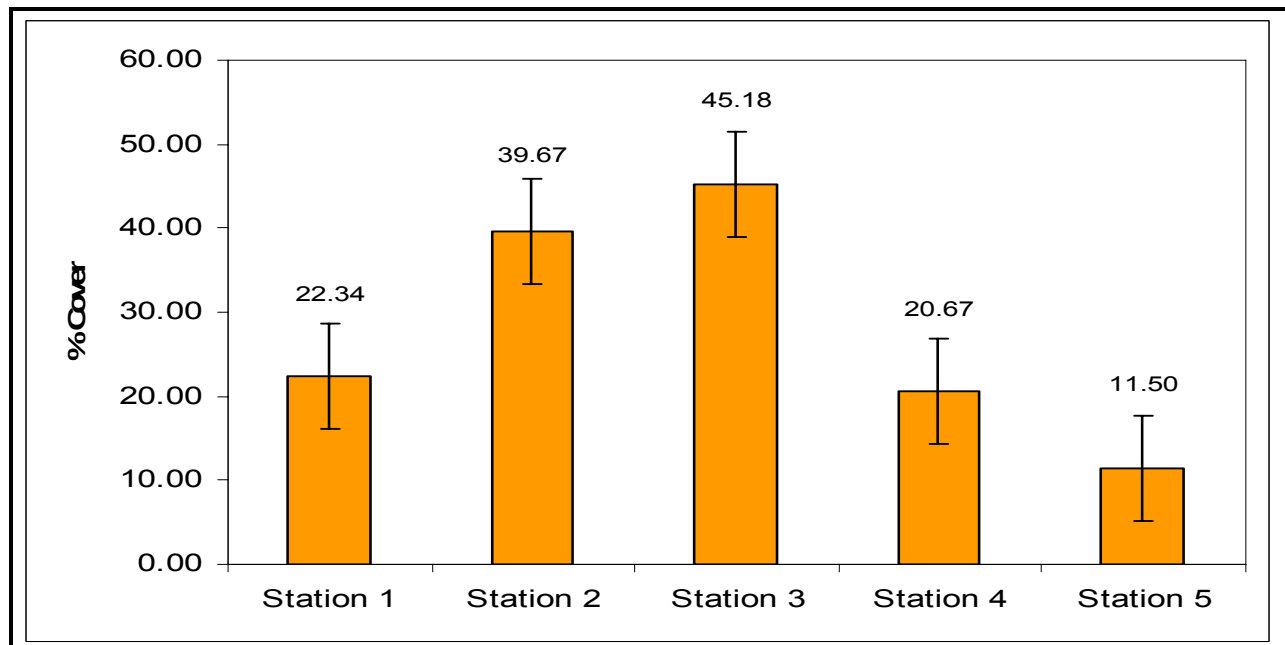
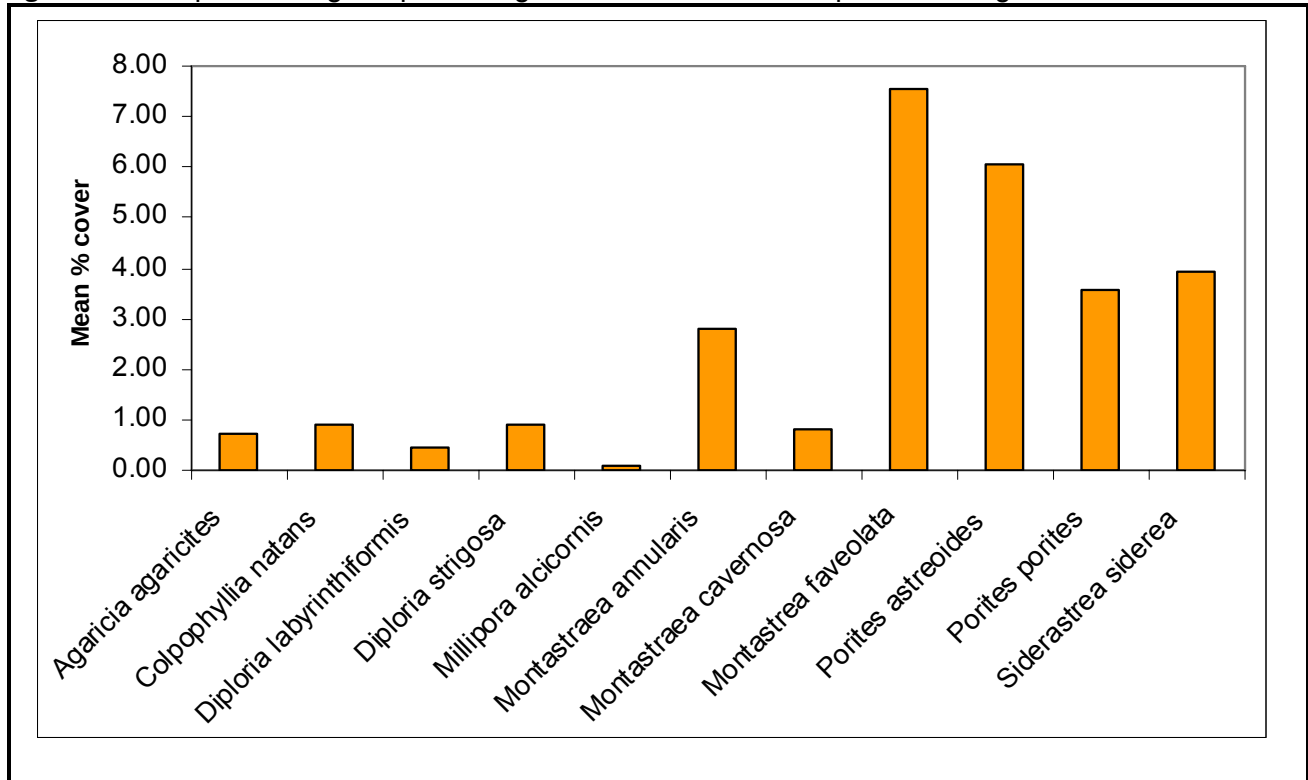
Figure 10: Pie Chart showing the mean Benthic Composition

Figure 11 below shows a comparison of the coral cover between stations at the site. *Station 3* shows the highest cover of 45.18% while *Station 2* showed a percentage cover of almost 40%. *Station 5* showed the lowest cover of 11.5% hard coral.

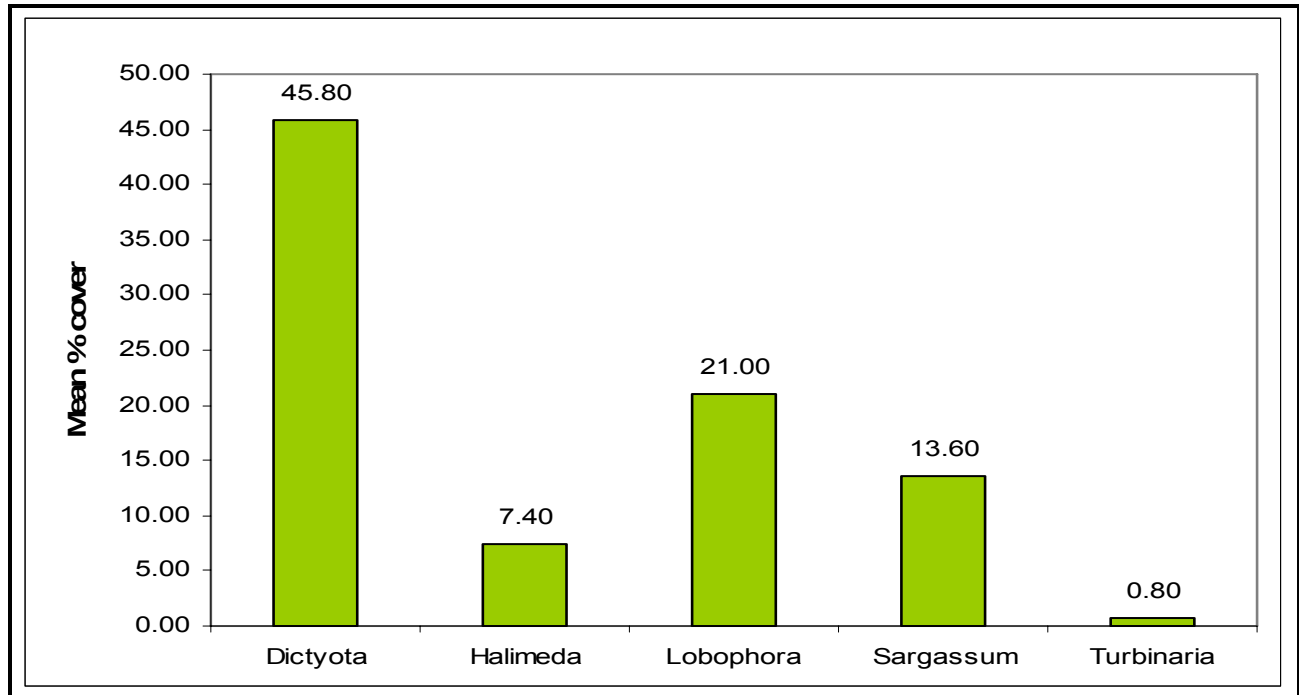
Figure 11: Graph showing the percentage hard coral cover among Stations

Eleven (11) coral species were observed in the transects laid. These are shown in **Figure 12** below. *Montastrea faveolata*, *Porites asteroides* and *Siderastrea siderea* showed the highest mean percentage cover throughout the site. *Porites porites* and *Montastrea annularis* also showed reasonable coverage throughout the site.

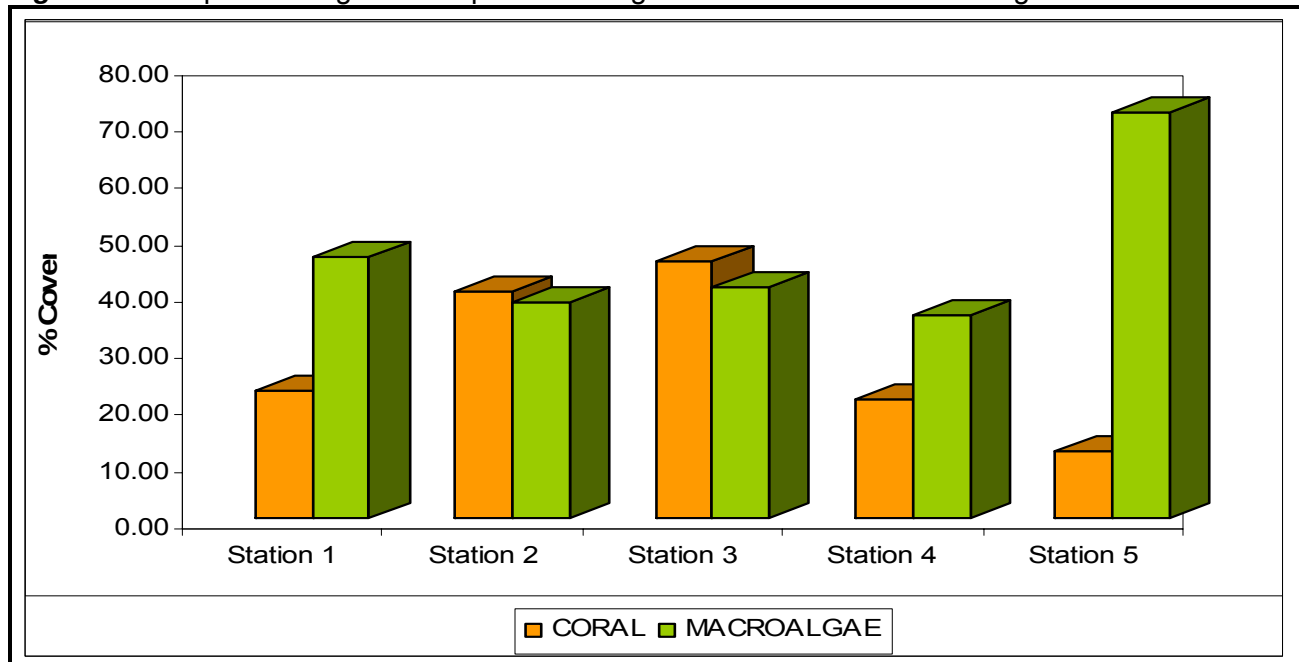
Figure 12: Graph showing the percentage mean cover of coral species throughout entire site



Five (5) species of macroalgae were observed during the assessment, three (3) species of which dominate the reef (See **Figure 13** below). These three (3) species include *Dictyota* sp., *Lobophora* sp. and *Sargassum* sp. Almost half (45.8%) of the total algal cover at the site was *Dictyota* sp.

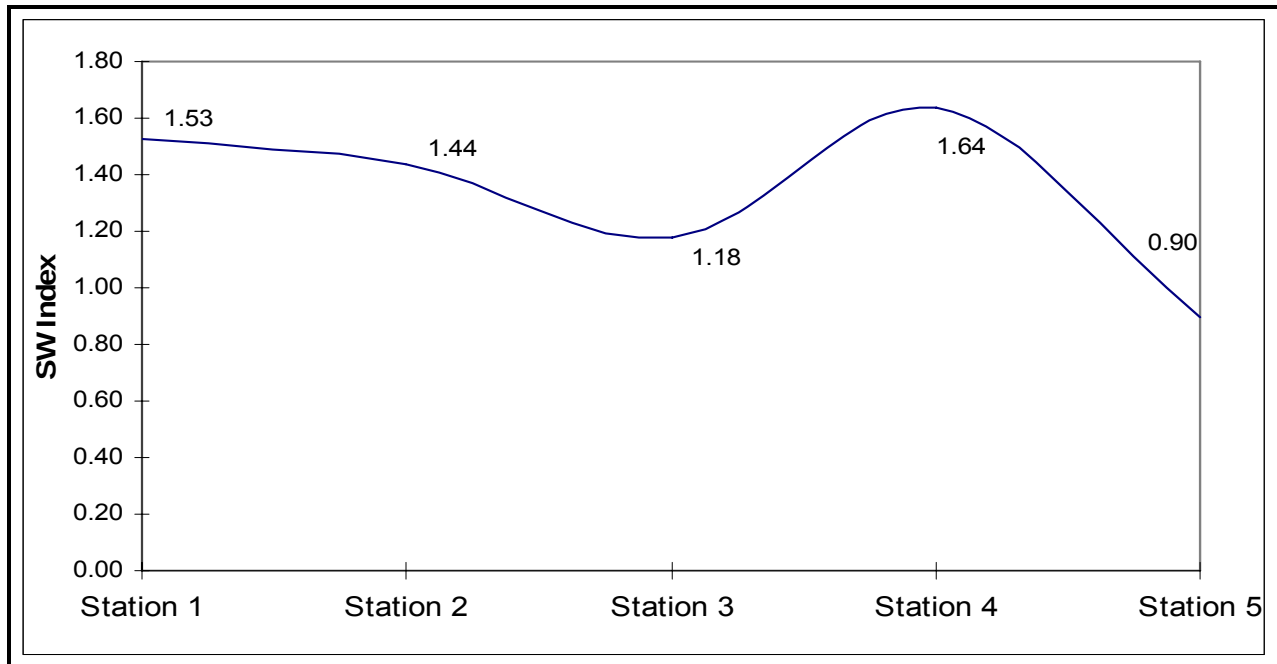
Figure 13: Graph showing the percentage mean cover of algal species throughout entire site

A comparison of the relative mean percentage cover across the stations revealed that hardcoral cover at *Stations 2* and *3* was greater than macroalgal cover. The other three (3) stations showed the converse situation, especially at *Station 5*, where macroalgae significantly dominated the substrate. See **Figure 14** below.

Figure 14: Graph showing the Comparison of algal cover vs coral cover throughout Stations

A comparison of the Shannon-Weaver Index for the benthic community across the various stations showed the highest diversity at *Station 4*. Of the five (5) stations, *Station 5* showed the lowest diversity index. This is shown in **Figure 15** below.

Figure 15: Graph showing the comparison of Shannon-Weaver Index across stations

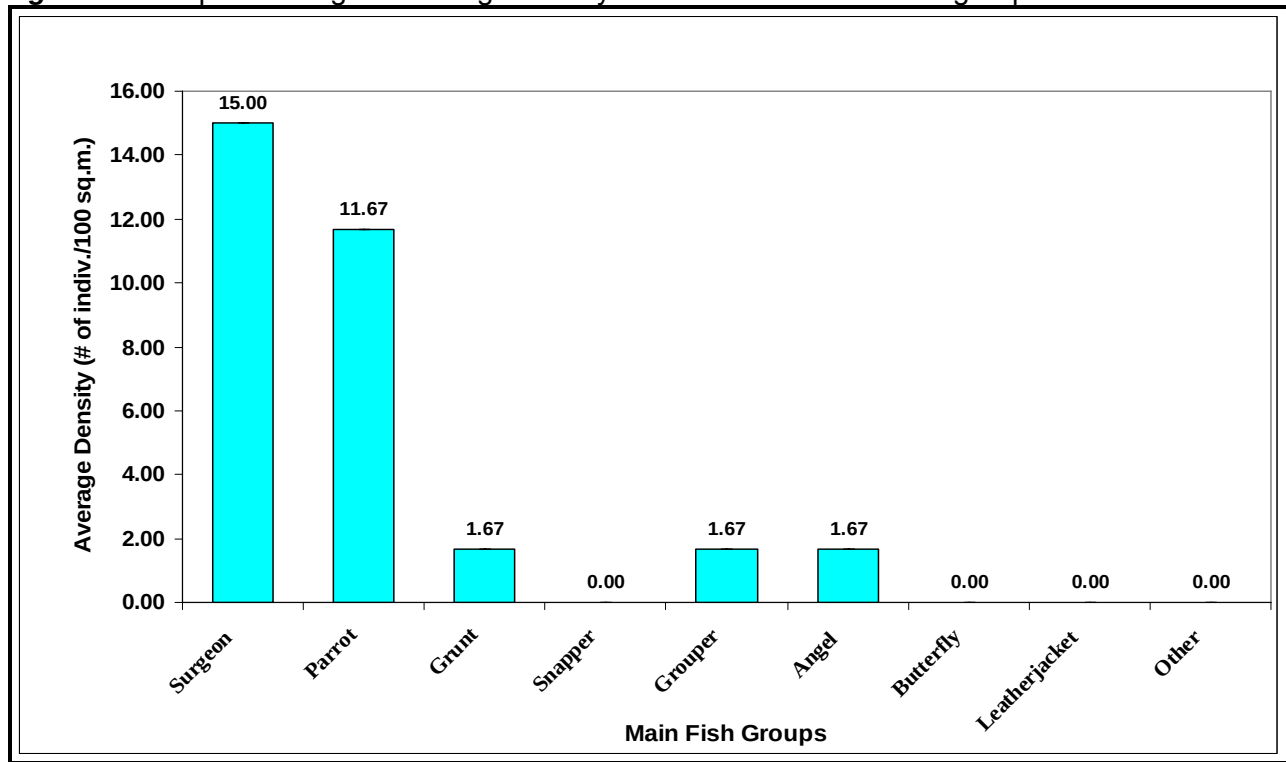


4.2.2.2 THE PRESENT STATUS: THE FISH COMMUNITY

A total of thirty-seven (37) species were observed during the five (5) 10- minute roving dive carried out at all five (5) stations. Of these species, seven (7) were single occurrences, twenty- three (23) were few, six (6) were many and one (1) was abundant. These species are listed in **Appendix 6**.

A. STATION 1

The fish community at *Station 1* was dominated by surgeonfishes and parrotfishes. Commercial species such as groupers and snappers showed low and zero densities at the site respectively. The average densities are quite low, with parrotfishes showing densities of only 15.00 individuals/100 m². This is shown in **Figure 16** below.

Figure 16: Graph showing the average density of individuals in main fish groups for Station 1

The biomass of the groups followed a similar trend as the density with the surgeonfishes and the parrotfishes contributing greatest to the community (**Figure 17**).

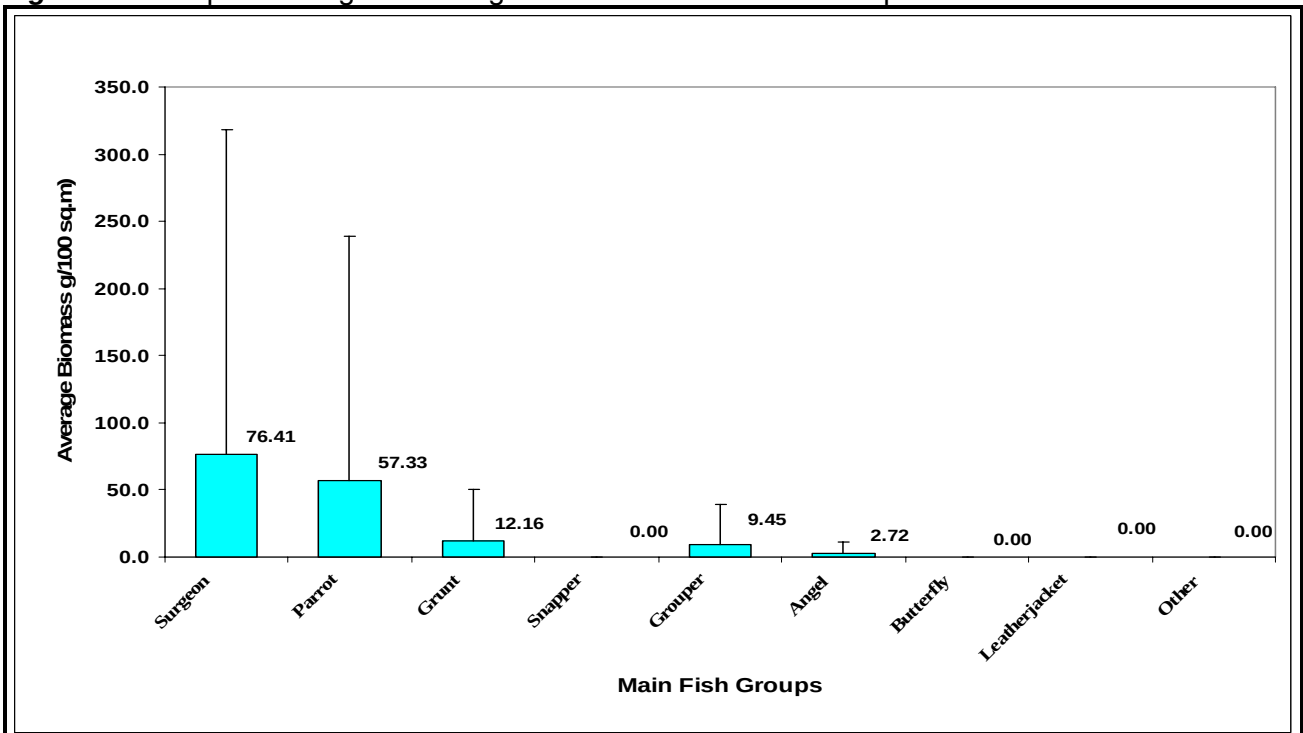
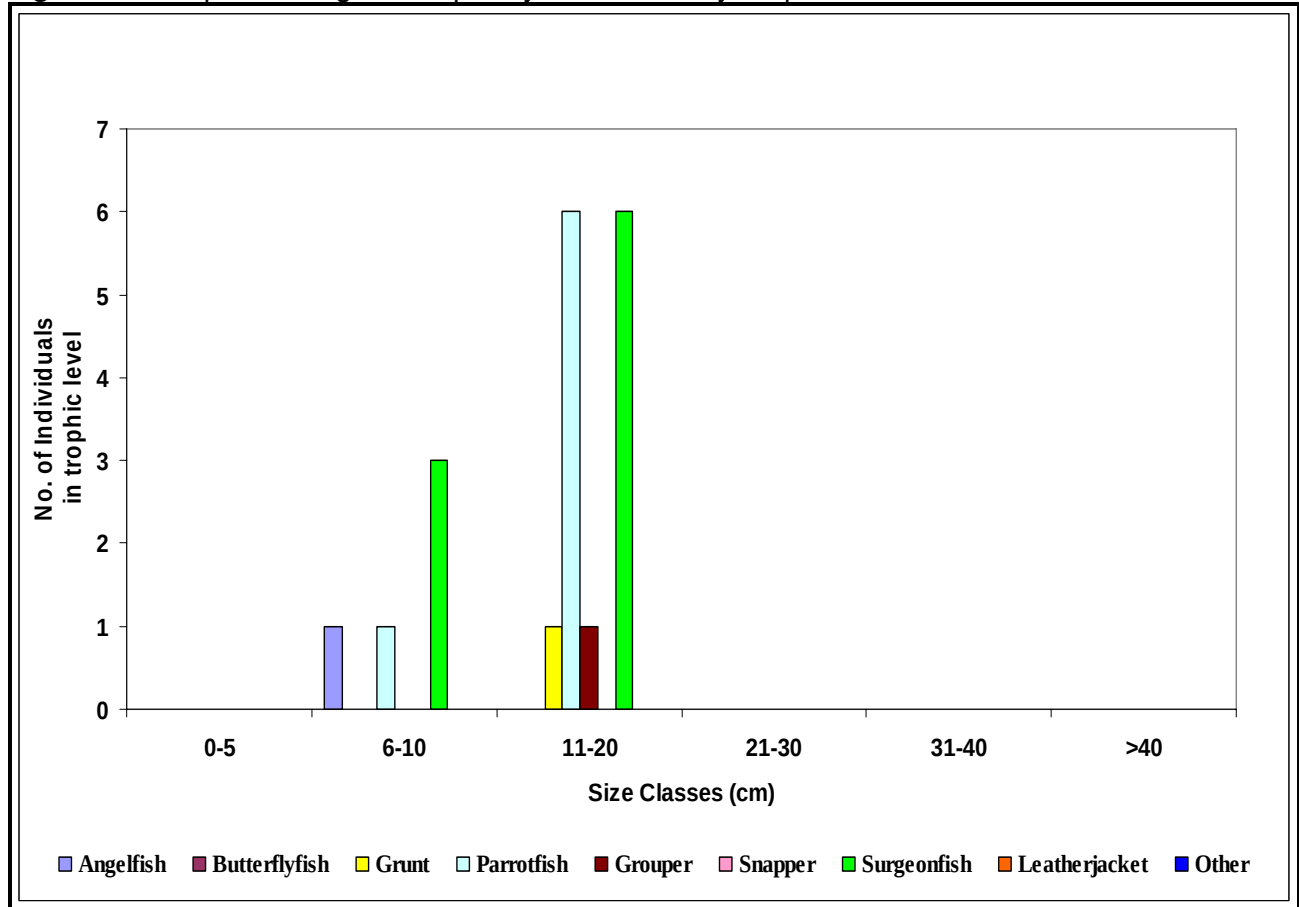
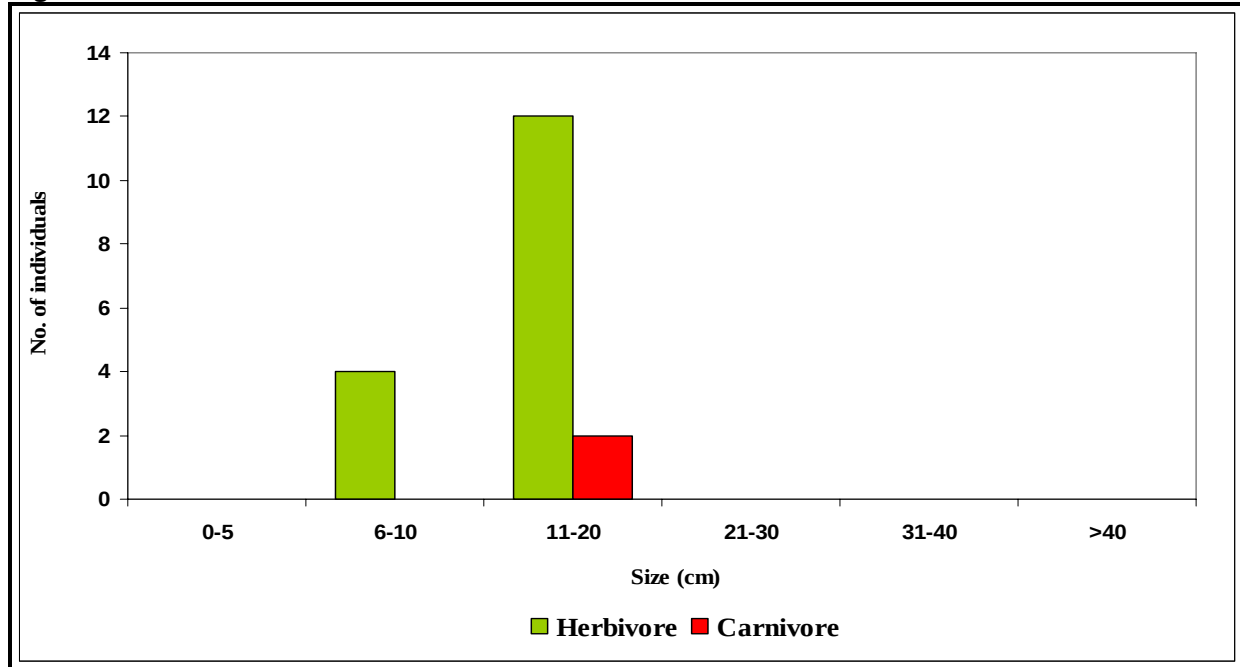
Figure 17: Graph showing the Average Biomass of Main Fish Groups for Station 1

Figure 18: Graph showing the frequency Distribution by Trophic Level for Station 1

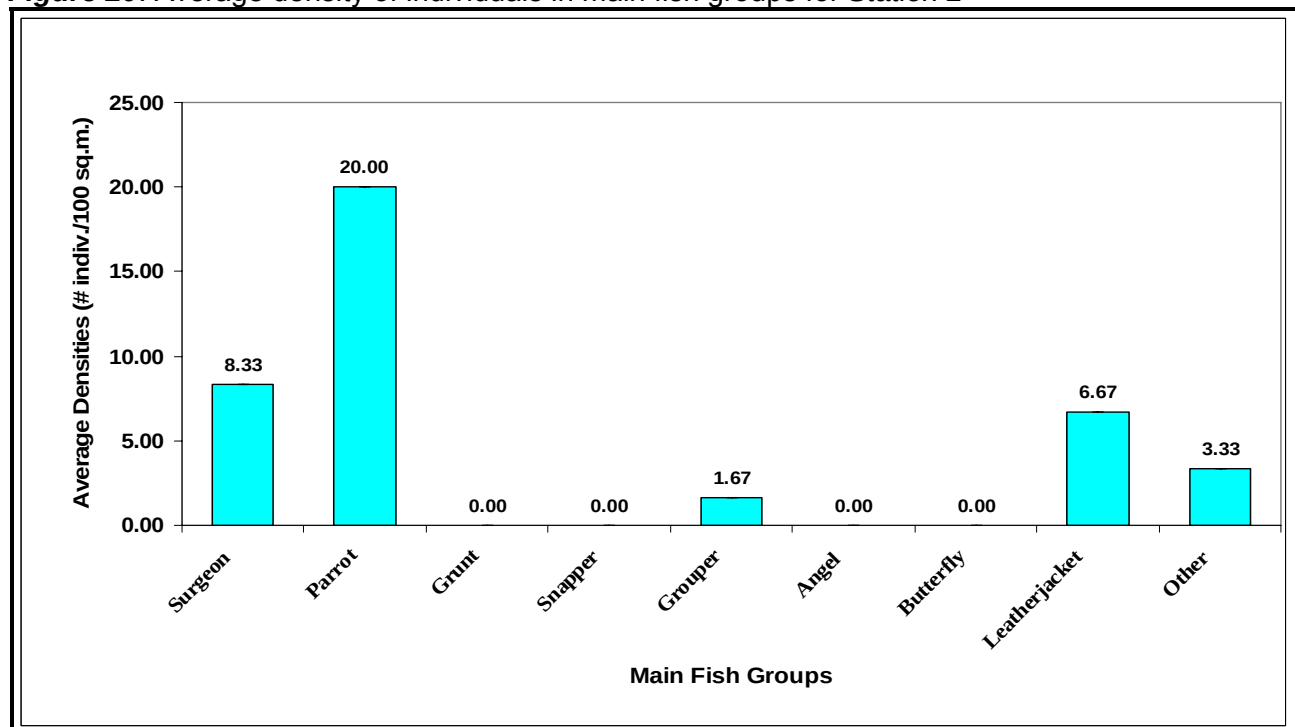
A comparison of the of the size classes within the trophic levels shows two size classes. Parrotfish and Surgeonfishes are represented in both classes with each showing a maximum of only six (6) individuals. All other groups, Angelfishes, Grunt and Grouper only show one (1) individual each (**Figure 18 above**).

Station 1 shows a dominance of herbivores versus carnivores with a ratio of 8:1 (**Figure 19 below**).

Figure 19: Number of Carnivores vs Herbivores for *Station 1*

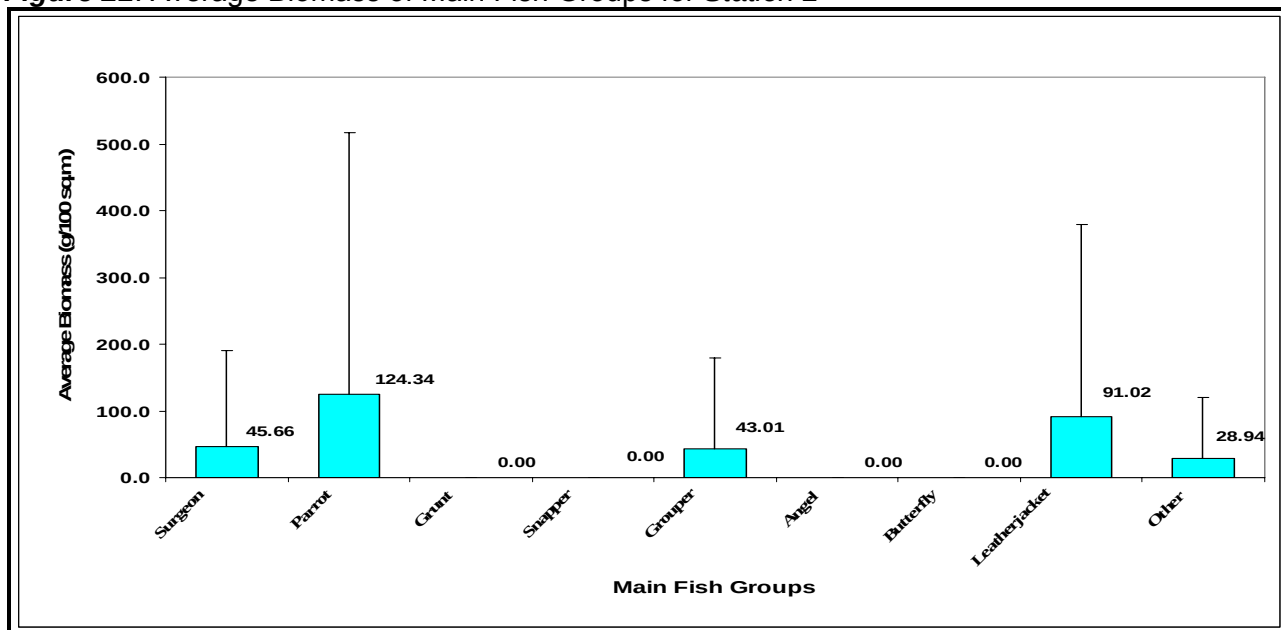
B. STATION 2

At *Station 2*, parrotfishes dominated the community followed by surgeonfishes. Though relatively low, parrotfishes showed the highest density with a value of 20 individuals/100 m² (*Figure 20* below).

Figure 20: Average density of individuals in main fish groups for *Station 2*

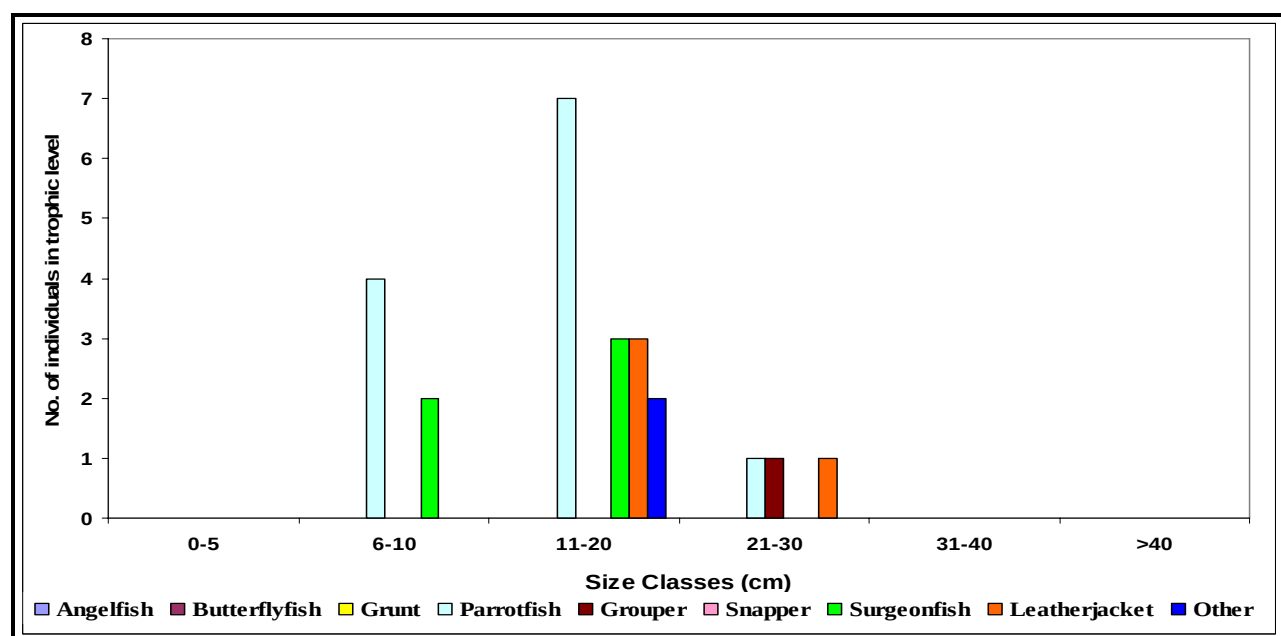
The biomass at this Station showed a slightly even spread of contributors with Parrotfishes and Leatherjackets accounting for the greatest biomass, while Surgeonfishes and Groupers following (**Figure 21** below).

Figure 21: Average Biomass of Main Fish Groups for Station 2



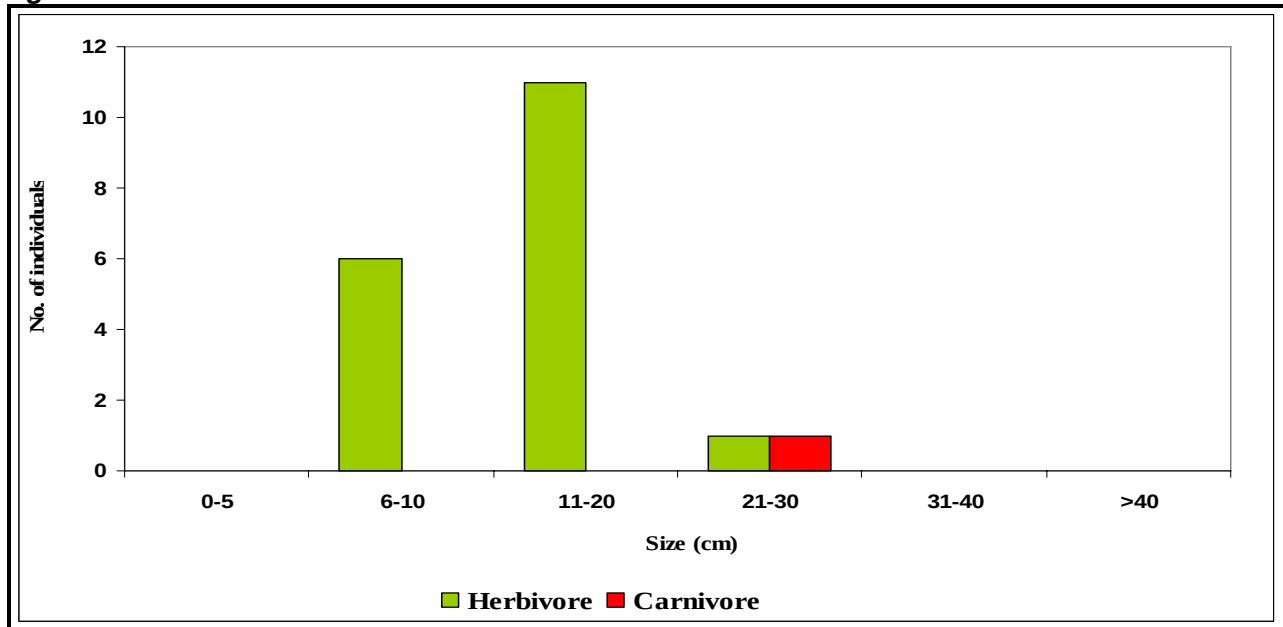
Parrotfishes showed up in all three size classes that were represented at this station. The dominant size class was 11-20cm length which showed approximately 60% of the individuals (**Figure 22** below).

Figure 22: Frequency Distribution by Trophic Level for Station 2



Station 2 showed herbivores in three (3) size classes and only one large carnivore (21-30cm). Herbivores were by far the dominant group at this station (**Figure 23** below).

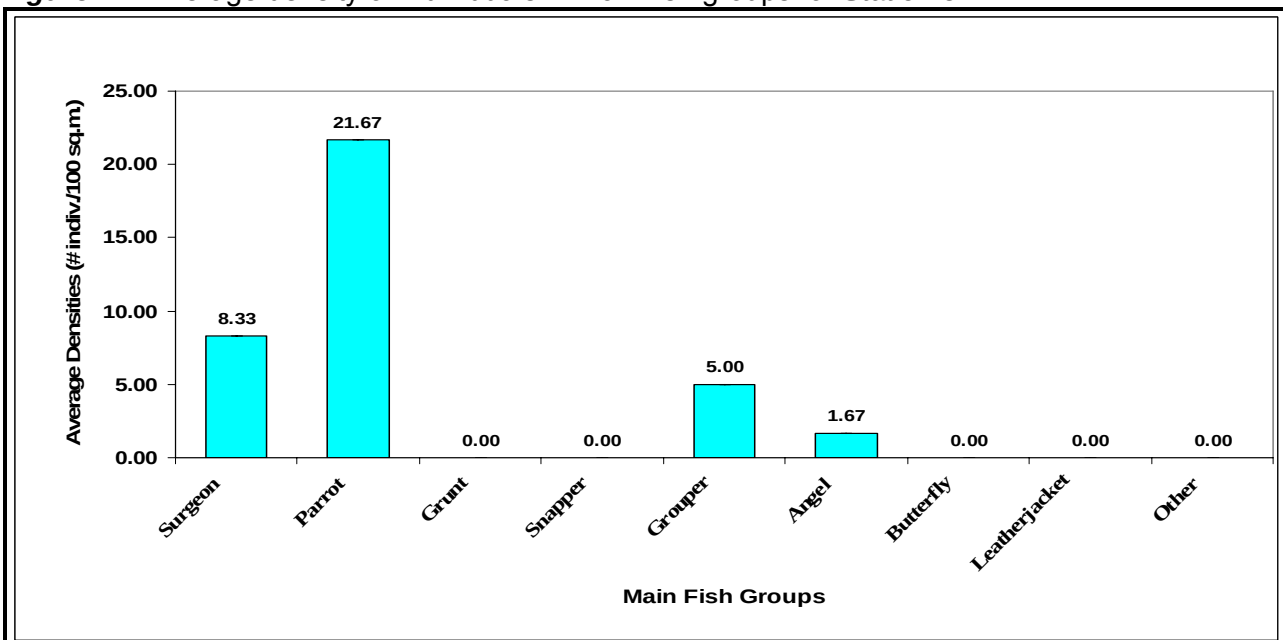
Figure 23: Number of Carnivores vs Herbivores for Station 2



C. STATION 3

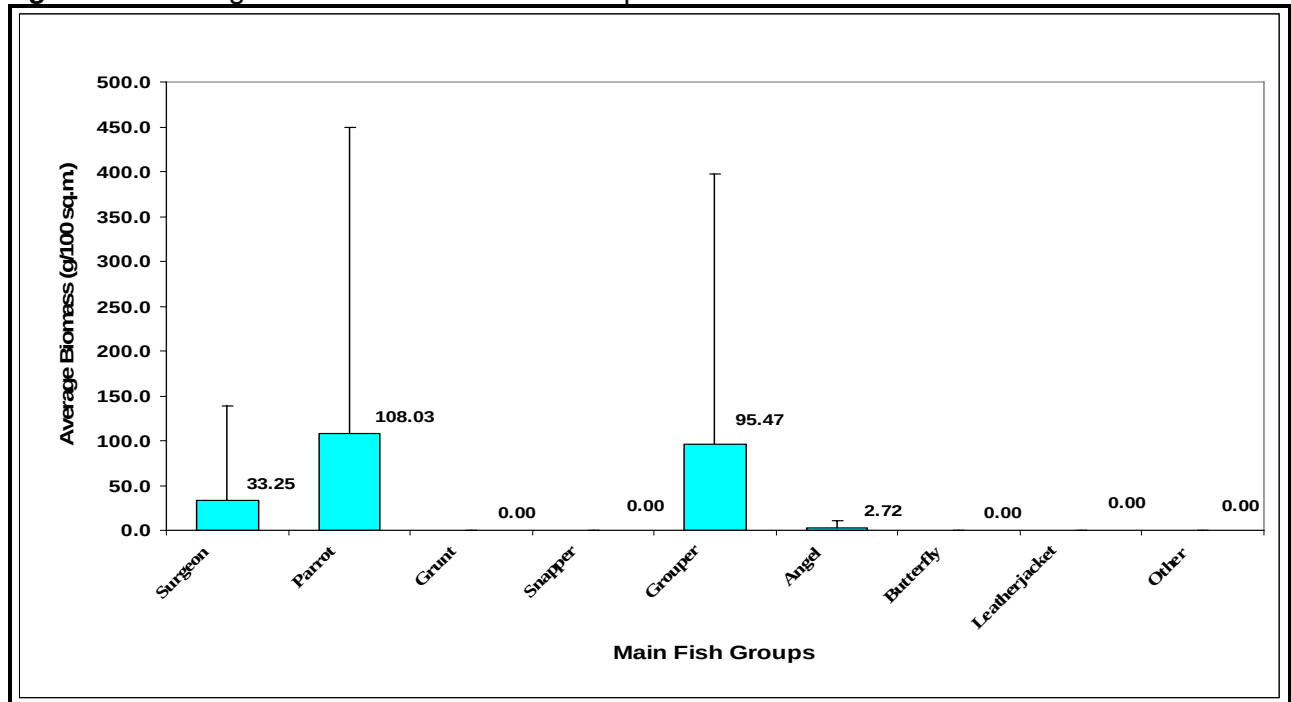
At Station 3, Parrotfishes dominated the community followed by Surgeonfishes, Groupers and Angelfishes. Though relatively low, Parrotfishes showed the highest density with a value of 21.67 individuals/100 m² (**Figure 24** below).

Figure 24: Average density of individuals in main fish groups for Station 3



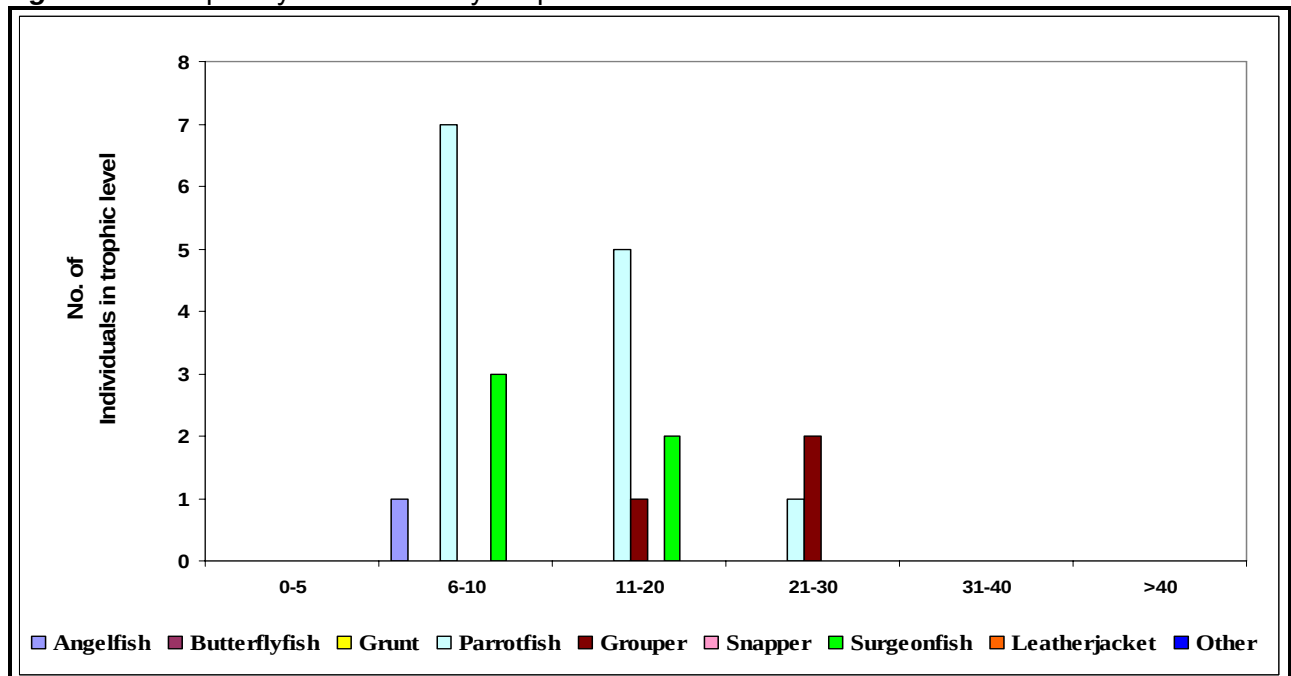
Groupers, though the density was low, contributed as significantly to the biomass at this station as the parrotfishes (**Figure 25** below).

Figure 25: Average Biomass of Main Fish Groups for Station 3



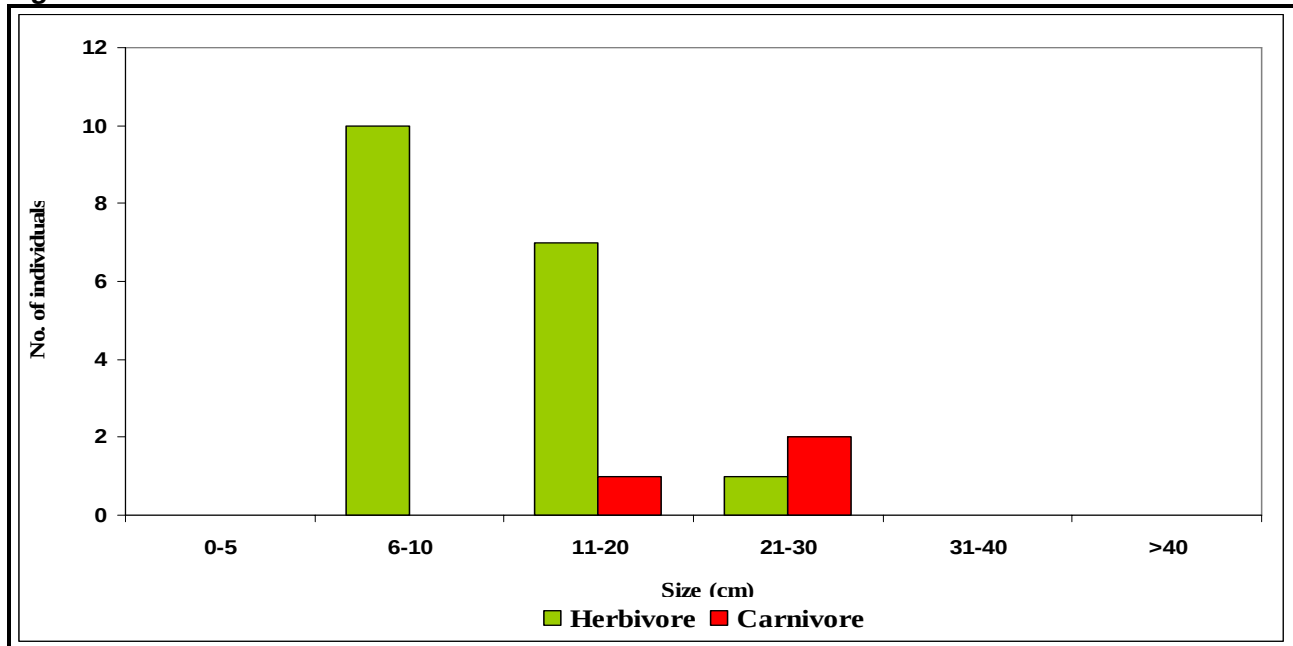
Parrotfishes showed up in all three (3) size classes represented at this station while Groupers and Surgeonfishes showed up in two of the classes (**Figure 26** below).

Figure 26: Frequency Distribution by Trophic Level for Station 3



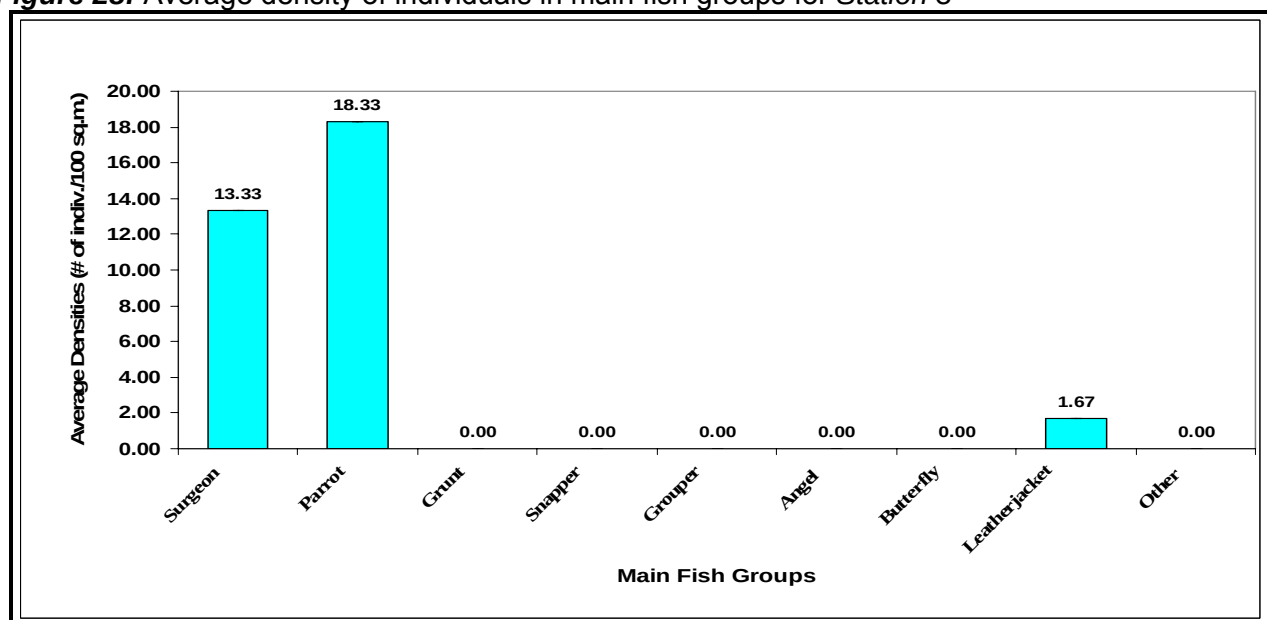
Though herbivores dominate at this station, there was one larger carnivore (21-30cm) than herbivore. The majority of the fish at this station were small herbivores (**Figure 27**).

Figure 27: Number of Carnivores vs Herbivores for Station 3



Only three (3) of the main fish groups showed up at this station; they were Parrotfishes, Surgeonfishes and Leatherjackets in order of dominance. The densities were very low overall, with the dominant Parrotfishes only showing a density of 18.33 individuals/m² (**Figure 28** below).

Figure 28: Average density of individuals in main fish groups for Station 3



D. STATION 4

Surgeonfishes accounted for the greatest contribution to the biomass at this station followed closely by Parrotfishes (**Figure 29** below).

The majority of the fish population fell in the 11-20cm size class and this class was dominated by Surgeonfishes. Parrotfishes were the only representatives in the 6-10 and the 21-30 size classes (**Figure 30** below).

Figure 29: Average Biomass of Main Fish Groups for Station 4

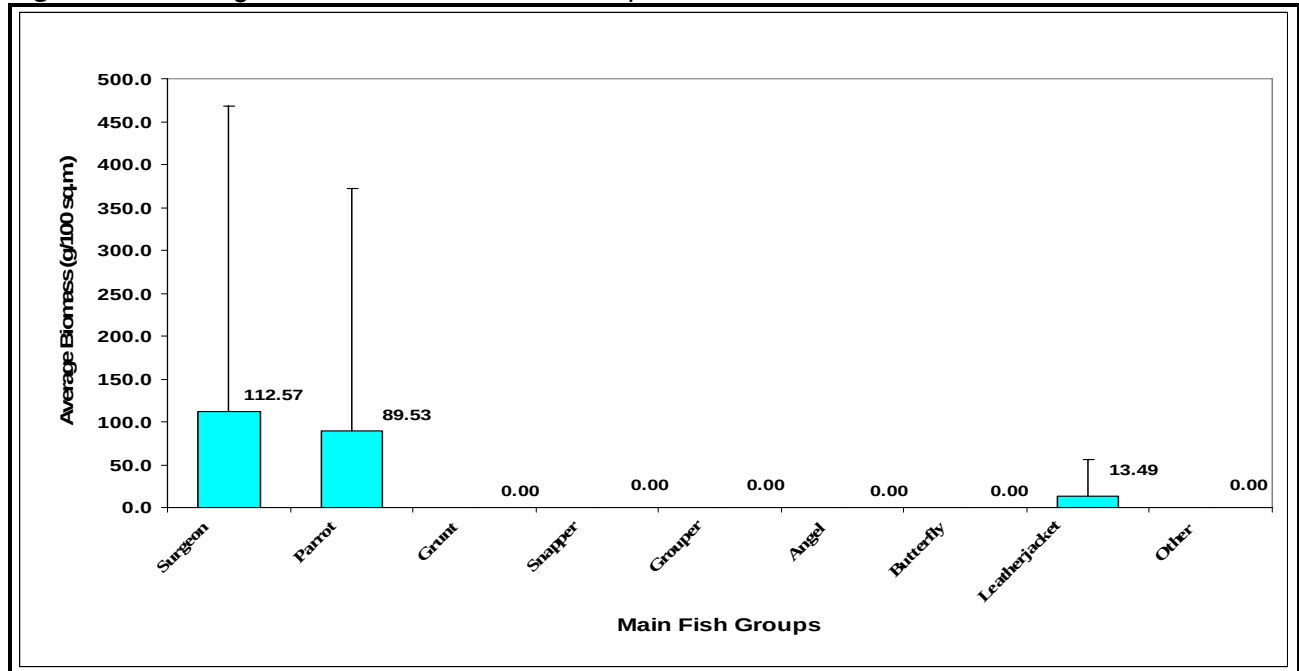
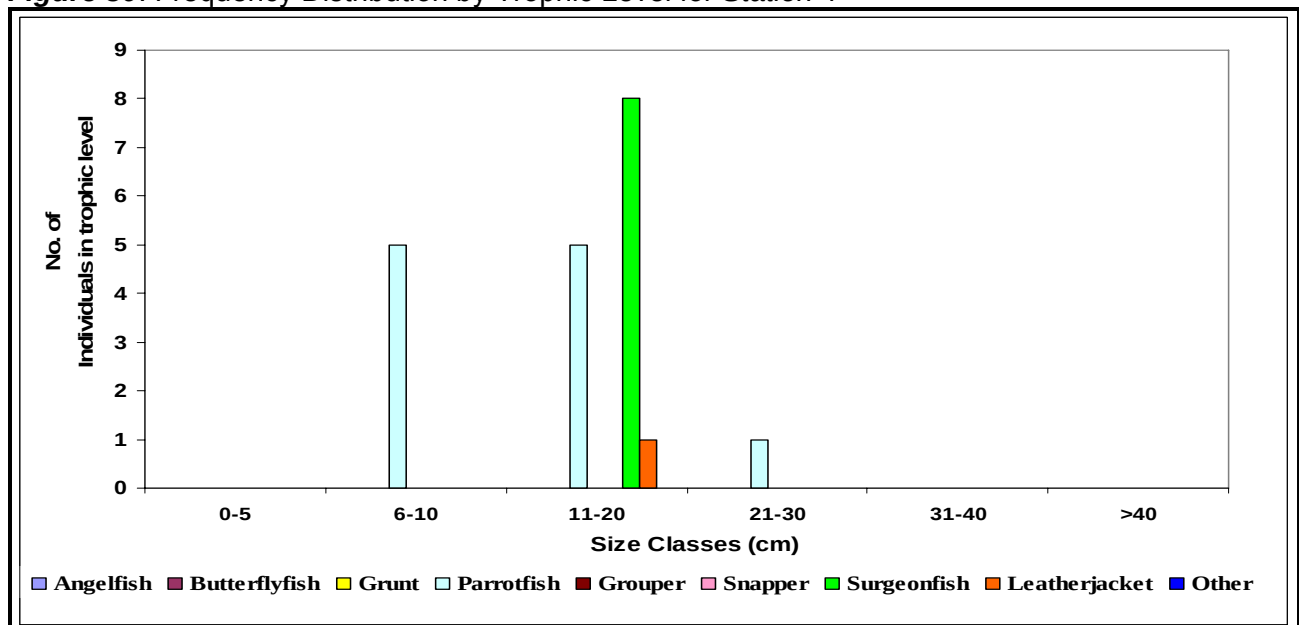
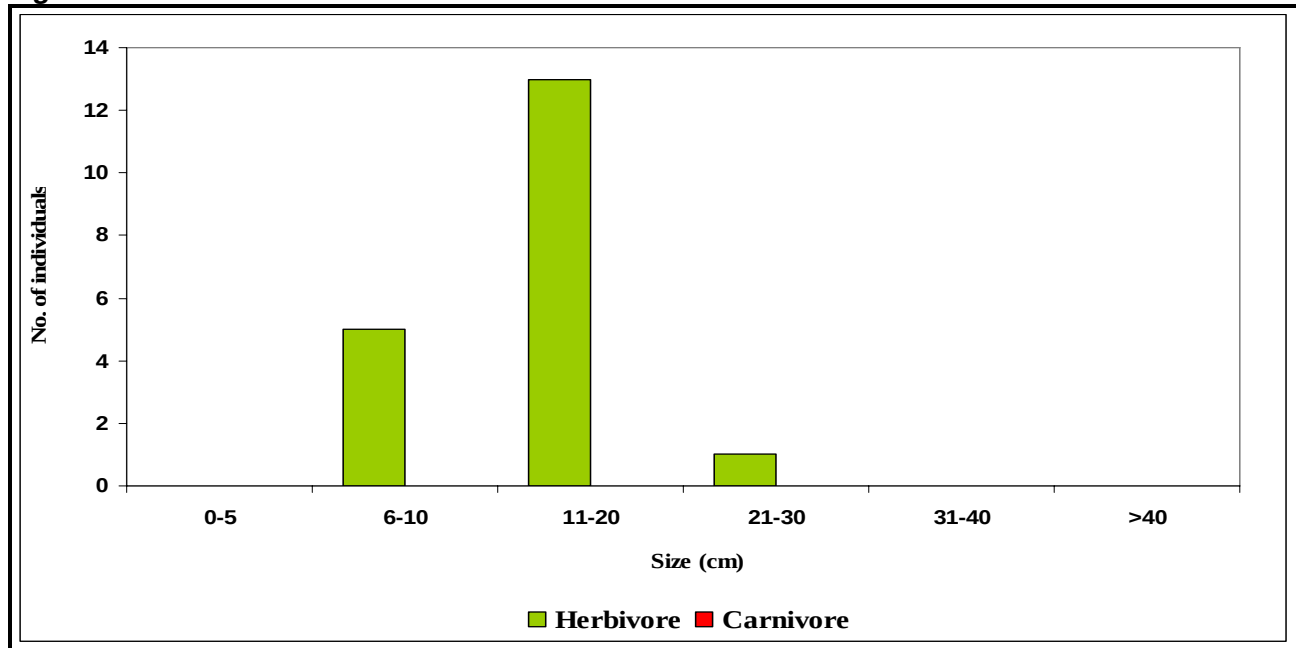


Figure 30: Frequency Distribution by Trophic Level for Station 4



At *Station 4*, there were no carnivores seen in the survey along the transect (**Figure 31** below).

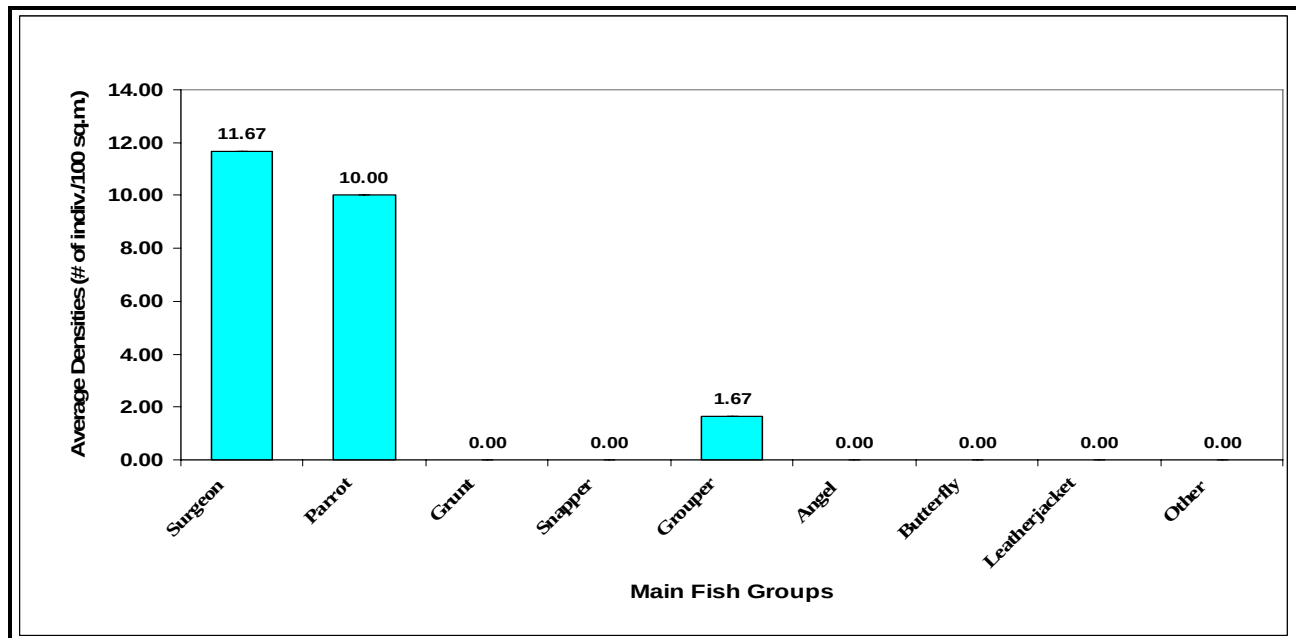
Figure 31: Number of Carnivores vs Herbivores for *Station 4*



E. STATION 5

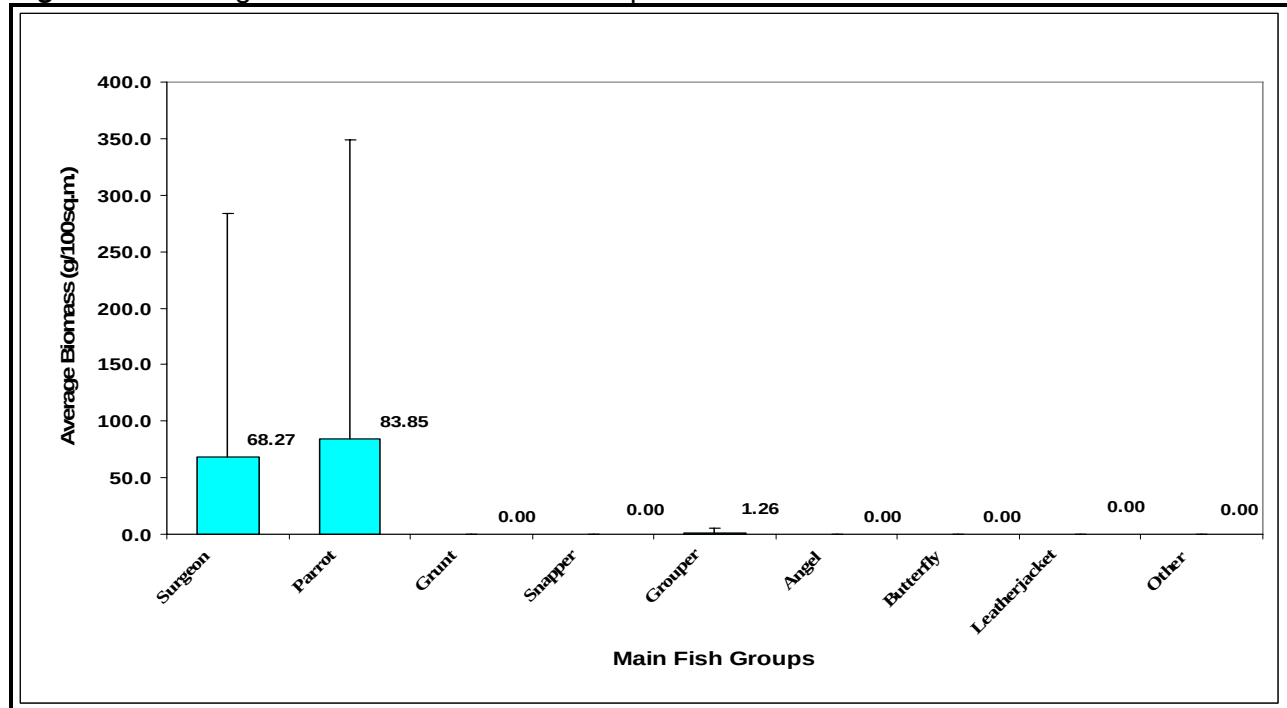
At *Station 5*, the Surgeonfishes and Parrotfishes dominated the fish community at this station though the densities were quite low (**Figure 32** below).

Figure 32: Average density of individuals in main fish groups for *Station 5*



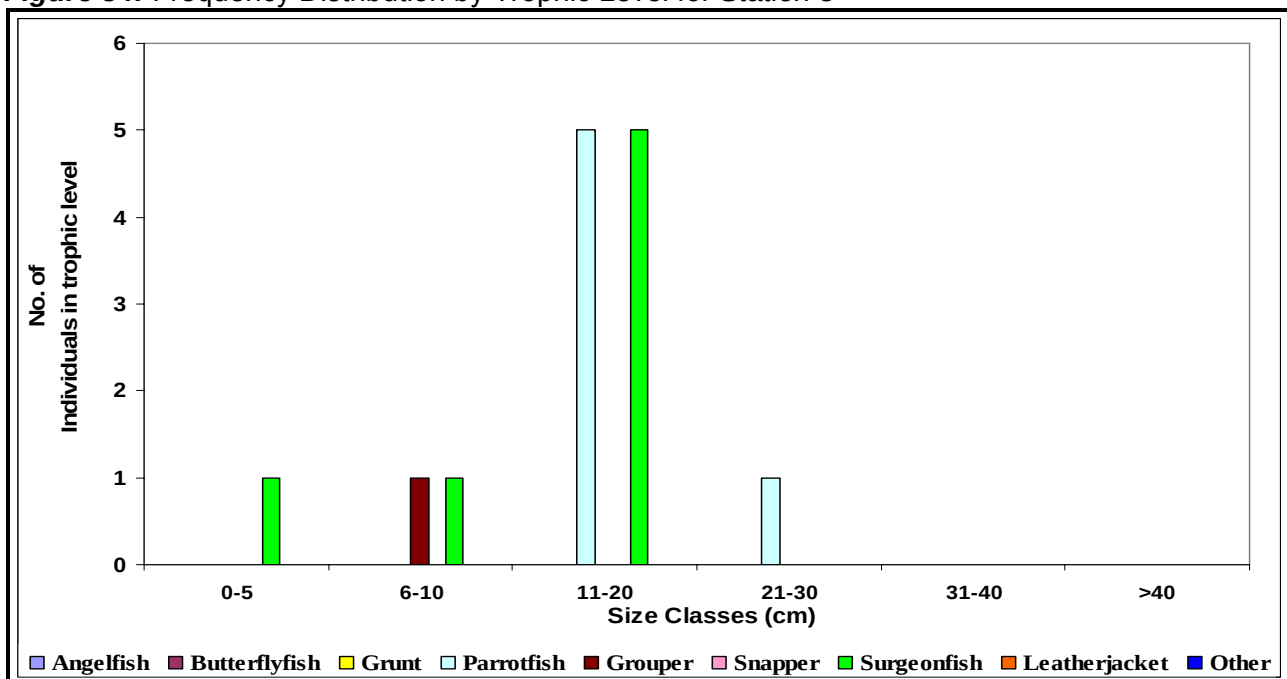
Parrotfishes accounted for the greatest contribution towards the biomass (**Figure 33** below).

Figure 33: Average Biomass of Main Fish Groups for Station 5



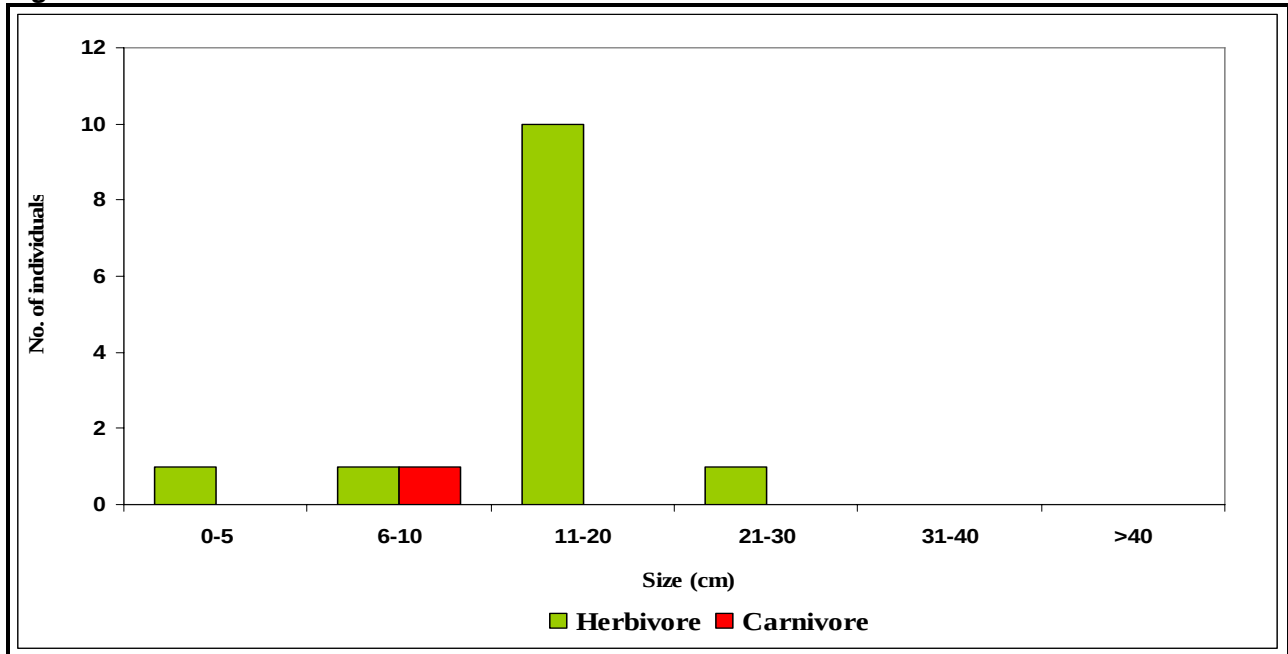
Surgeonfishes were the dominant group at this station and showed up in 75% of the size classes represented (**Figure 34** below).

Figure 34: Frequency Distribution by Trophic Level for Station 5



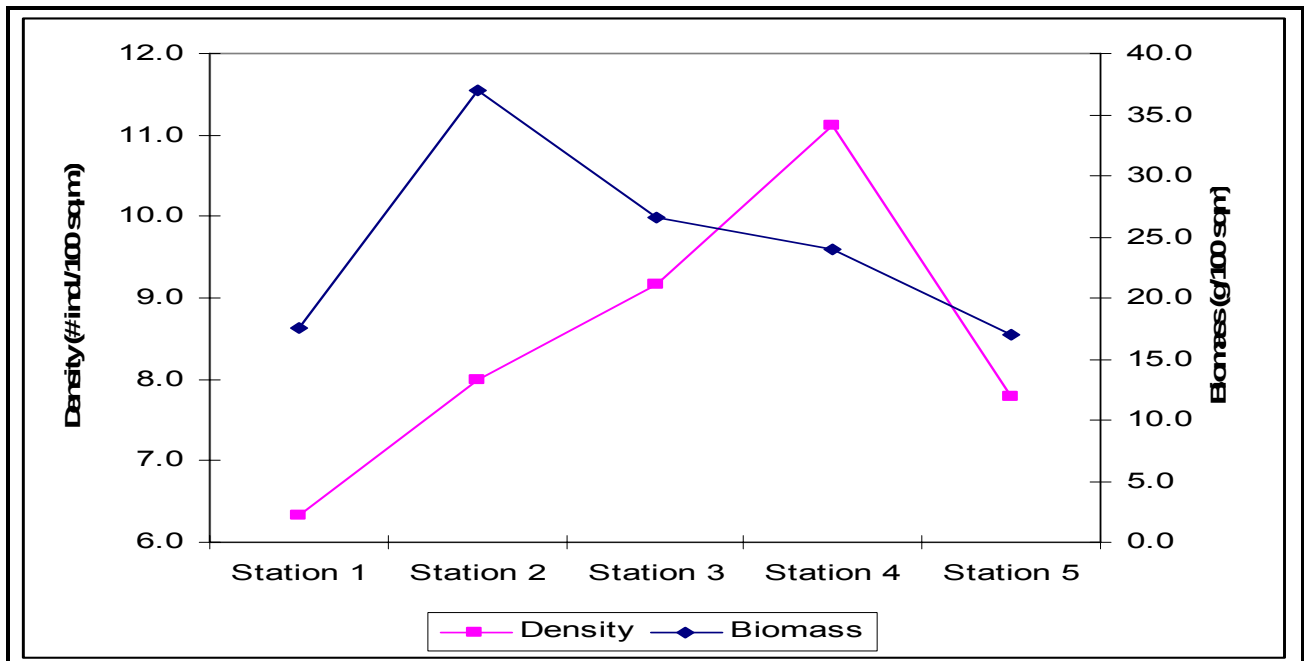
At Station 5, only one small carnivore showed up in the survey. The station was dominated by herbivores in all size classes (**Figure 35** below).

Figure 35: Number of Carnivores vs Herbivores for Station 5



On comparison of the mean density and mean biomass among all five (5) stations (**Figure 36** below), though Station 4 shows the highest density, the biomass is relatively low as the species do not contribute much to the biomass to the type of species. Station 5 shows the lowest density and biomass among all stations.

Figure 36: Comparison of Mean Density and Biomass of Fish Populations among stations



4.2.2.3 THE PRESENT STATUS: SEAGRASS BEDS

There are two (2) major seagrass areas found at the site. These beds are dominated by *Thalassia testudinum* (Turtle Grass). Seagrass Bed 1 is located at latitude 18° 29'25.63"N, longitude 77°34'05.00W while Seagrass Beds 2 is located at latitude 18° 29'32.72"N, longitude 77°32'43.61W. These are depicted in **Figure 37** below.

Figure 37: Aerial image showing the location of the seagrass beds observed off-shore the development area



Source: Google Earth (2007)

4.2.2.4 THE PRESENT STATUS: SEA TURTLES

It is quite probable that some of the sandy beaches located along the coast of the development site are used as nesting sites for Sea Turtles namely the Loggerhead turtle, the Hawksbill Sea turtle, the Leather back turtle and the Green Sea Turtle. Although no turtles were observed during this assessment, the sandy substrate needed for egg laying and nest building, proximity to seagrass beds and the low intrusion by human disturbances in some areas along the coast, makes it an ideal nesting location for these species. The

areas where they may more than likely be found if they use the area for nesting are shown in the aerial image below.

Figure 38: Aerial image showing the possible location of Turtle nesting sites along the coast of the development area



Source: Google Earth (2007)

The marine community off the coastline of the proposed site for the development shows varied degrees of biodiversity. Overall, the site shows noteworthy hard coral cover. The highest coral cover of 45% observed at *Station 3* and the 39% coral cover at *Station 2* are of special mention. These stations also demonstrated higher coral cover than macroalgal cover, which is unique among reefs of the north coast. These stations are found in areas with no development occurring on the land immediately adjacent to the station.

The health and diversity of the reef system varied between stations. There was a general decrease in the coral population and an increase in the macroalgal cover from more pristine areas towards the more developed areas approaching the eastern end of the site. The reefs trended from a coral-dominated community towards a more algal-dominated reef from west to east of the site. The hard coral community of reef-building corals and the

structure of the reef system offers reasonable protection from wave energy from impacting the coastline.

The site supports a thriving fishing community, with the majority of fishing done by fish pots and net fishing. The result of the fishing activity is the reduction of large carnivores and commercially important species such as groupers and snappers. Small herbivores dominate the site.

The seagrass communities are fairly healthy and well-developed. These areas appear to be resilient communities.

4.3 ECOLOGICAL FUNCTIONS OF THE STUDY AREA

4.3.1 ECOLOGICAL GRADIENTS AND INTERACTIONS

4.3.1.1 TERRESTRIAL ENVIRONMENT

The study area represents a complex, mostly undisturbed ecosystem with a variety of communities with specific habitats and niches. Although there were no obvious ecotones between adjacent communities, the area can be described as mosaics of intergrading communities, with moderate species diversity within each (Morris and Therivel, 2001). This was evident in all the three (3) zones observed in the development area. Each had some difference in flora and fauna species composition.

These three (3) zones are interdependent of each other. The Mangrove swamp areas provide barriers that help protect the inland forested areas from the effects of tropical storms and hurricanes. They also play an important role in preserving soil and ground water quality by reducing the intrusion of salt water to inland areas. Their extensive root systems trap sediments and extend the land outwards protecting the shore from wave action. These species also provide a natural filtration mechanism which filters sediments and pollutants that wash from land – based activities, protecting the marine environment. The marine environment consists of important seagrass beds and coral reefs. These seagrass beds help to maintain water clarity, reduce beach erosion and sedimentation on reefs, as well as promote recruitment of marine species. The coral reefs observed are very important because they protect coasts from strong currents and waves by slowing down the water before it gets to the shore.

Throughout the development area important animal/animal and animal/plant interactions were also. Whether it was symbiosis, mutualism and predation, these were all evident in the project area. Some examples of these interactions observed are outlined below.

Dragonflies are insectivorous and play an important ecological role. They feed on bees, butterflies and mosquitoes and are known to feed on other dragonflies. They control the population of several pest and nuisance insects. The nymph stage is also predaceous, and feeds on invertebrates in the water and even tiny fish and tadpoles. With the presence of several wetlands in the area and the standing body of water in which the nymphs thrive, mosquitoes probably about in the area, and the presences of butterflies and bees must provide the bulk of food for these insects.

Duck ants are a tropical termite that tend to favour certain trees such as mangroves but will form huge nests at the base of many species of plant. There are major detritivores that are responsible for recycling of nutrients back into the environment, and aid in soil formation. In the case of the forest where these insects were found the soil is quite shallow and falls in pockets where the limestone is porous. It makes the action of these insects particularly important.

Crickets also form an important food source for birds, lizards and perhaps even dragonflies during the smaller nymph phases.

Hermit crabs use gastropod shells as their homes and although there were many empty shells to be found not all of these were whole. This however illustrates the interdependence of species in a given ecosystem and how the loss of one species can negatively impact on another.

4.3.2.2 MARINE ENVIRONMENT

This interdependency is also observed in the marine environment. Where the seagrass beds located offshore have played a very important role in maintaining water clarity, reducing beach erosion and sedimentation on reefs, as well as promoting recruitment of marine species.

4.3.2 INDICATOR SPECIES

4.3.2.1 TERRESTRIAL ENVIRONMENT

Some plant and animal species can be used as indicators of the general health of an ecosystem. Common indicators include the presence of invasive alien species, the level of endemism and the species diversity observed in a particular area.

The vegetation composition of the area shows a moderate level of species diversity. The vegetation observed is typical of that found in most Dry Limestone areas islandwide. Although the area displays moderate species diversity, the level of endemism in vegetation types was relatively low. No rare, endangered or protected plant species were observed and therefore the area cannot be considered to be of high ecological importance. The rate of the observance of invasive alien species was also low. This is indicative of the low level of disturbance that the area has been exposed to over the years. It is possible that the difficult terrain throughout the development area has served as a factor that has protected it from intrusion.

Faunal composition is also a very good indicator of the overall health of an ecosystem. The presence of species such as Dragonflies, Butterflies and Birds are all indicative of the ecological health of the development area. The diversity observed among butterflies is fairly moderate with only one (1) endemic species being observed. The level of diversity and endemism among bird species observed however hints towards a relatively good habitat type for these animals as sixty-nine (69) different species were identified, fourteen (14) of which are endemic to Jamaica. The main indicator species in this respect are the Rufous-tailed Flycatcher (*Myiarchus validus*), Orangequit (*Euneornis campestris*), Yellow-shouldered Grassquit (*Loxipasser anoxanthus*), Jamaican Lizard Cuckoo (*Saurothera vetula*) and the Yellow-billed Parrot (*Amazona collaria*), to name a few.

4.3.2.2 MARINE ENVIRONMENT

Similarly, the results of the marine assessment are also indicative of the general health of the area. This is evidenced in the coral assessment results shown at Station 2 and Station 3 of the marine assessment. At these stations the coral cover ranged from 39 % to 45 %

respectively and are higher than the macroalgal cover which is oppositely true for most reefs along the north coast.

4.3.3 FACTORS INFLUENCING THE ECOLOGY OF THE STUDY AREA

4.3.3.1 TERRESTRIAL ENVIRONMENT

The ecology observed within the development area has been influenced by specific factors including the physical attributes of the study area (climate, soil and geology) and to a lesser extent anthropogenic activity. The rainfall levels experienced in this area are not very high as compared to the rest of the island, with the area receiving a low of 42 mm in July and a high of 178 mm in December. The temperatures experienced in this area tend to be higher than other areas as well, reaching as high as 31 degrees Celsius in the summer months. In addition to the climate, the geology of the area has also influenced the plant diversity. As typical of a karst environment, the soil composition in the area is not very thick and some plants were seen growing on bare rock. Plant diversity in the Beach Zone is also low as plants became more exposed to salt spray. Despite these factors, the plants in the area have shown a series of adaptations to their environment. Within the forested areas trees have long branched root systems that take advantage of the little soil composition within the rock crevices. Plants in this area have also shown xerophytic characteristics, which enable them to survive in periods of drought. This adaptability is also observed in plant species that are found within the beach zone and wetland areas having adaptations such as increased succulence, salt glands and breathing roots which enable them to survive in that particular habitat. The area has remained relatively undisturbed due to the difficult terrain of the area.

Anthropogenic influences have also affected the ecology of the area. The most obvious human impact has been the removal of vegetation, which took place during the process of identifying the centre lines for the golf course design. Succession has begun to take its course in these areas, where evidence of regeneration by primary species in these plots was observed. The level of regeneration was greater in areas that had a greater soil cover.

Other disturbances to the area include the harvesting of wood from the forest, which is used in the manufacture of mostly fish pots by fisher folk in the area. Feral animals such as goats also roam the property and were seen grazing on the vegetation.

The presence of discarded empty shotgun cartridges within the wetlands, and the presence of duck species suggest that this sight may also be an area of illegal duck hunting activities. Truly enough, the surrounding forests were exploited legally during the Annual Game Bird Shooting Season by the Trelawny Gun Club. These shooting rights were however removed by the developer some time ago.



Picture 17: Picture showing the spent shells observed during the reconnaissance visit to the development area

4.3.3.2 MARINE ENVIRONMENT

The marine community, off the coastline of the proposed site for the development shows varied degrees of biodiversity. This has been mainly influenced by the impacts of intense fishing activities and coastal impacts from developed areas. The direct correlation with decrease in health of the ecosystem and human activity was observed in during the assessment, where areas along the coastline adjacent to developed areas had a higher percentage of algal cover, than undeveloped areas.

5.0 DESCRIPTION OF THE SOCIO - ECONOMIC SETTING

The socio-economic conditions of the area will be discussed in this section. The conditions looked at will be examined in terms of micro (local) and macro (national) levels.

METHODOLOGY

The assessment of the Socio-economic setting of the study area involved the collection of primary and secondary data and the review of socio-economic data presented in past reports.

For the purpose of this evaluation, local conditions focused on those on the site itself and those within a 2 km radius from the site while those on a national level focused on the island-wide conditions. Informal discussions were also held with residents in these communities during the month of July 2007.

The gathering of quantitative and qualitative data are equally important when gauging the perceptions of stakeholders ranging from the existing conditions of their communities to what impacts they believe any development may have on their quality of life. One of the primary research tools used to glean information on the public perception of the project from the existing residents within the communities was a questionnaire or structured interview (See **Appendix 7**).

The questionnaire used had a mixed format of closed and open questions. Where necessary the answers were limited to facilitate easier answers on the part of participants. Some questions were semi-structured to allow the respondents to expand on their previous answers or to give more personal input to the answers. In cases where the expressed opinion of the participant was most appropriate the question posed tended to be open allowing full expression. A total of fifty (50) questionnaires were administered within the study area.

5.1 SOCIAL STRUCTURE

5.1.1 COMMUNITY STRUCTURE

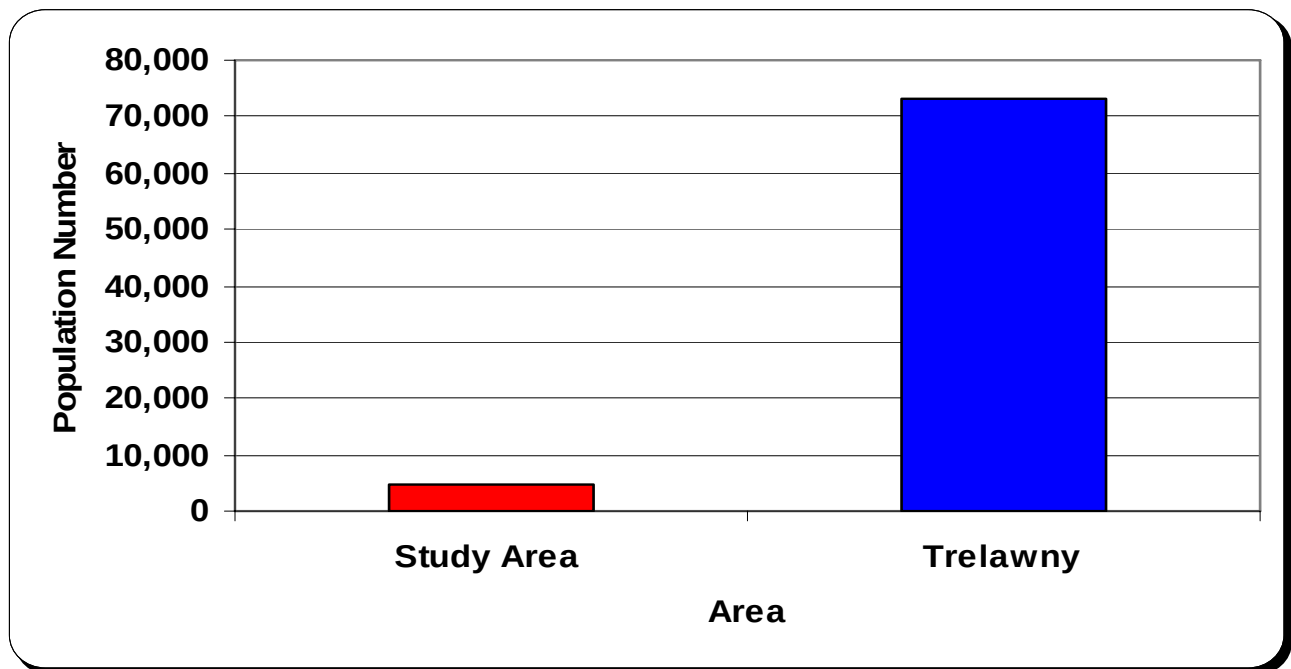
Several residential communities are within 2 km of the development site. These include the communities of Kettering, Carey Park, Duncans, Sterling Castle, Spicy Hill, Shawsmith Prospect, Crawle and Simpson. The major township of Duncans is located approximately 1.5 km from the development site.

5.1.2 DEMOGRAPHY

5.1.2.1 POPULATION

Census data shows that the population in the study area is approximately 4,613. The population in these communities represents 6 % of the population of the parish of Trelawny which is 73,066.

Figure 39: Graph showing the comparison of the study area to the parish of Trelawny



Source: STATIN (2001)

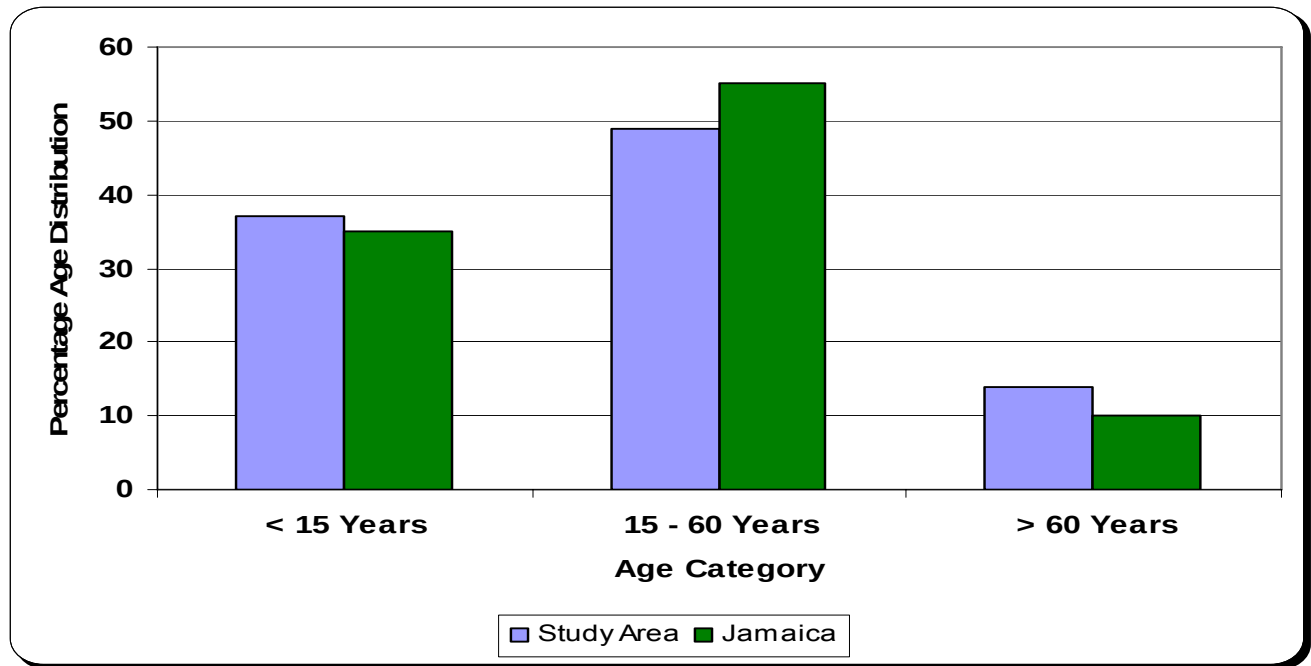
5.1.2.2 GENDER RATIO

The total female population of the study area is 2,308 and the total male population is 2,305 which is roughly a 50:50 ratio of males compared to females.

5.1.2.3 AGE VARIANCE

The 2001 census data from the Statistical Institute of Jamaica (STATIN) shows that approximately 37% of the population of the study area is less than 15 years of age. This is higher than the national figure of 35%. In contrast to this approximately 14 % of the population of the study area is over the age of 60. This shows somewhat less agreement with the national figure of 10.2%. See **Figure 40** below.

Figure 40: Graph showing the age distribution for the Study Area compared to Jamaica



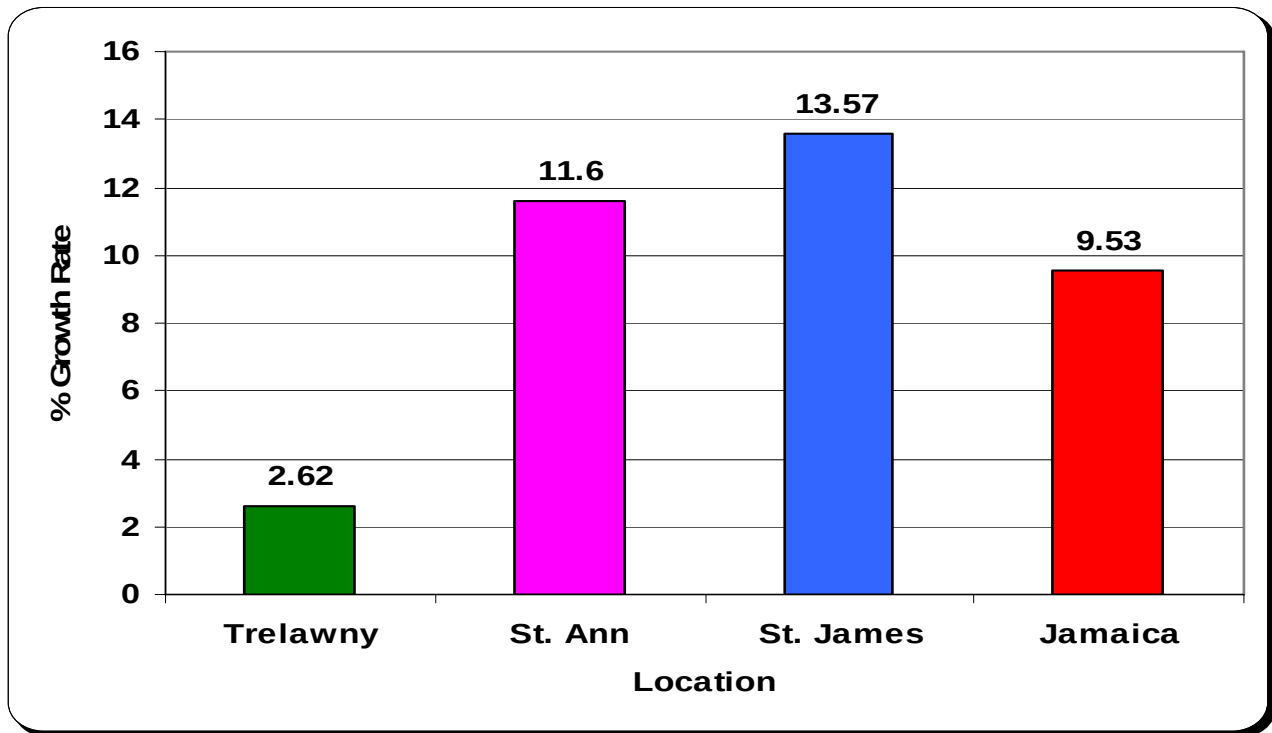
Source: STATIN (2001)

5.1.2.4 POPULATION GROWTH

The growth of the population in the parish of Trelawny has shown an increase of approximately 2.6 % between 1991 and 2001 and it is likely that the development area has shown a similar growth rate in the same period. This rate is very marginal when compared to the island's average population growth rate of 9.5 %, or the growth rates of adjacent parishes St. Ann and St. James which are 11.6 % and 13. 57 % respectively, within the same time period. Presently, there is no evidence of overcrowding in the area. The low rates observed may be attributed to the very little economic activity and development within the parish. Because of this there was no attraction for the migration of persons into this

area and more likely movement of residents to resort towns such as Ocho Rios and Montego Bay in search of employment.

Figure 41: Graph showing the comparison of Population Growth rates between Trelawny, St. Ann, St. James and Jamaica



Source: STATIN (2001)

5.1.3 COMMUNITY COHESION

Within the study area the churches are central areas for community members to interact. Only one (1) community centre is located within the study area, which is in Spicy Hill. No recreational parks or playing areas are located in the study area. The lack of these facilities was a concern expressed by residents polled. It was hoped that the developers would demarcate an area within the development of the golf course or adjust the development plans to incorporate an area where youth could learn to play golf and other recreational type activities.

5.2 ECONOMIC STRUCTURE

5.2.1 EMPLOYMENT AND INCOME GENERATION

Data from the Strategic Environmental Assessment (SEA) shows that a wide range of economic activities are evident within the area through self-employment and small businesses. These services range from grocery shops, restaurants and bars. Commercial fishing is also another major economic activity concentrated at the Jacobs Taylor Fishing Beach which borders the property. This is a very vibrant fishing cooperative known as the “Friendly Society Fisherman’s Cooperative” which has over thirty-five active (35) members.

According to the Development Order for Trelawny, the area has been zoned for resort type activities. The tourism intensive activities in the area include the Silver Sands and Duncans Bay resorts.

The only employment data that could be garnered for the study area came from the answers to the interviews of residents. The employment rate within the study area was over 35 % for persons who were employed full-time and 50 % for persons who were either self employed or employed part-time. These jobs ranged from, teachers, fishermen, taxi operators, construction workers, caterers, craft vendors, drivers, domestic workers, farmers and shopkeepers *inter alia*. 15 % of the population said they had no means of employment.

5.3 INFRASTRUCTURE

5.3.1 ROAD NETWORK

The Amaterra Development’s main access is via the Duncans to Coral Spring main road which is a part of the newly upgraded North Coast highway. The road conditions within some of the surrounding communities are in a deplorable condition however. Within the development area the roads are unpaved parochial thoroughfares.

5.3.2 UTILITIES

5.3.2.1 ELECTRICITY

All the residents in close proximity to the development site have access to electricity or have electricity in their homes.

5.3.2.2 WATER AVAILABILITY

Approximately 54 % of the respondents in the socio-economic assessment had access to piped water in their homes. The remaining population said they accessed water from standpipes and catchments in the area. The main source of water supply in the area is by the National Water Commission (NWC). The developer has embarked on an initiative to increase the water supply in the area and has therefore gone into an agreement with the NWC to upgrade the water supply system to a tune of US\$ 7. 8 Million.

5.3.2.1 TELECOMMUNICATION SERVICES

Fixed line services provided by Cable and Wireless Jamaica Ltd. are available in the communities within the study area. Most residents in the area said they also relied on cellular service (Digicel, Cable and Wireless and Miphone) for their means of telephone communication.

5.4 WASTE MANAGEMENT

5.4.1 SOLID WASTE

Based on interviews with residents and the National Solid Waste Management Authority's (NSWMA) Garbage Collection Schedule (2007), garbage is collected in the area by the Western Parks and Markets Waste Management Ltd. at least once per week. This is disposed of at the solid waste disposal site located at Grange Farm on the Daniel Town Road which is operated by the NSWMA.

5.4.2 SEWAGE DISPOSAL

Most of the residents interviewed had indoor plumbing suitable for piped water in their homes with toilet facilities. This sewage is disposed of in individual absorption pits.

5.5 SOCIAL SERVICES

5.5.1 HEALTH SERVICES

The major hospital in Trelawny is the Falmouth Hospital. This is situated some thirteen kilometres (13) kilometres away from the study area. Within the town of Duncans located about 1.5 km from the study area is a Type III Health centre and two (2) private doctors' offices. A health centre has been proposed within the Amaterra Resort Development.

5.5.2 EMERGENCY SERVICES

5.5.2.1 FIRE SERVICES

The closest Fire Station to the study area is the Falmouth Fire Station, which is located approximately 13 km from the project site and serves the entire parish of Trelawny. The developer intends to include a Fire Station within the remainder of the Amaterra Development Plans.

5.5.2.1 POLICE STATIONS

Three (3) police stations are in close proximity to the development site. The closest of the three (3) is the Duncans police station, located about 2 km away. The other two (2) are located in Rio Bueno approximately 7 km and in Clarks Town, which is approximately 6.6 km from the development site. Crime and violence is not perceived as a major issue in the area.

5.5.3 TRANSPORTATION

Most of the residents within the study area travel by taxi or minibus. The completion of the North Coast Highway has played a role in the improvement of the transportation services that the residents in the area depend on.

5.6 AREAS OF HISTORICAL AND CULTURAL SIGNIFICANCE

Within the development area Stewart Castle has been declared a National Heritage Site by the National Heritage Trust of Jamaica. This site is an important monument as a Taino Midden was found on the property. Excavations done within the property has offered

valuable insights into the dietary habits of the Tainos that once resided in the area (JNHT, 2007). The Amaterra developers plan to manage the site as a tourist attraction through a long-term lease with the Jamaica National Heritage Trust.

5.7 COMMUNITY'S PERCEPTION & KNOWLEDGE OF THE PROJECT

5.7.1. COMMUNITY'S AWARENESS OF THE PROJECT

More than eighty percent (80%) of the respondents to the survey were aware of the proposed Amaterra development. However, less than thirty percent (30 %) of these respondents were aware that a golf course was included in the development plans. Most knew of the hotels proposed however.

5.7.2 USE OF THE DEVELOPMENT AREA BY THE COMMUNITY

Interviewees were asked if they used the property in any way. Approximately forty percent (40 %) of those interviewed said they utilised the property for docking of boats and equipment by fisherfolk or the harvesting of wood for charcoal burning and the construction of fish traps.

5.7.3 GENERAL PERCEPTION OF THE DEVELOPMENT

The general perception of the development of the golf course was positive. The basis of these positive responses was due to the anticipation of primary and secondary income generation activities that would arise from the development. Most of the persons polled were excited that new jobs would be created in the area through direct employment during the construction and operation phases. Indirect income earners were expected through the provision of goods and services such as craft items and the increase in demand from the fishing activities. Overall improvements to the communities around the development area were also anticipated by the residents. This included an improvement to the really bad road conditions that currently exists in the area. It was felt that the proposed golf course would raise the standard of living in these communities.

Although most residents had favourable responses to the development of the golf course, concerns were raised of the impact that the development would have on the environment. These concerns were mostly raised by fisher-folk who fished offshore of the property. The concerns raised were particularly with respect to the damage to the reefs and therefore reduction in catch by the use of chemicals to be used for the maintenance of the golf course.

Only one (1) of the residents, a fisherman interviewed said that they did not want the development, due to the potential for the reduction of the income through the potential damage to the reef that the golf course could have.

6.0 ANALYSIS OF ALTERNATIVES

The alternatives with respect to the project from the Environmental and Socio-Economic perspectives are discussed in this section. This includes a discussion on the project activity alternatives and the project design alternatives.

6.1 PROJECT ACTIVITY ALTERNATIVES

6.1.1 THE 'NO ACTION' ALTERNATIVE

From an environmental perspective, the removal of the golf course may be the best option. Without the development, the area would remain a relatively undisturbed area providing a habitat for the varied flora and fauna presently observed. This area will continue to be impacted, although minimally, by anthropogenic and natural factors.

From a socio-economic perspective the “no action” alternative may not be the best alternative as the numerous benefits to be gained from the development both locally and nationally would not be realised and the resources in the area would continue to be under-utilised.

6.1.2 THE PROPOSED PROJECT ALTERNATIVE

The development area for the proposed golf course will see some changes to its environmental attributes (physical and biological). Ecologically there will be loss of habitat and species diversity in the area. While not discounting the value of the ecology that persists in the area, the loss to be incurred will be significant but not major as the species diversity in the area is not very high. Drainage patterns, groundwater, surface water and soil quality may also be affected.

From a Socio-Economic perspective the proposed golf course development would contribute significantly to a partial national, regional and local income generation. In addition numerous jobs would be created by the development either directly or indirectly as well as community growth and development for the surrounding communities.

6.1.3 UTILISATION FOR AGRICULTURE ALTERNATIVE

The area for the proposed development according to the Development Order for Trelawny, the area is zoned for resort-type activity. The large expanses of property available for development in this area could make it suitable for intense agricultural activity.

From an environmental perspective agriculture would present similar negative impacts to the development of a golf course through the similar wholesale clearing of vegetation which would mean a loss of habitats for species currently occupying the development area. The impacts associated with the use of chemicals for the maintenance of these agricultural activities would also be similar and so would be the impacts associated with the strain on water resources that this type of activity would present. Characteristics of the area such as climate, poor soil cover, saline intrusion and topography would however make this practise unsuitable.

From a socio-economic perspective considerable revenue could be gained from agriculture through the supply of produce locally and for export if the area was suitable for this practise. The returns due to the characteristics of the area would however be marginal, as there would have to be a significant input of resources to make this alternative successful.

6.1.4 UTILISATION FOR MINING AND QUARRYING ALTERNATIVE

Mining is another alternative for land-use in the development area. Land-use information shows that the site consists mainly of limestone scrub forest with limited opportunity for mining and quarrying however. The area is also not located within areas zoned for Bauxite and Conservation under the Development Order for Trelawny (TEMN, 2005).

6.1.5 HOUSING & RESORT DEVELOPMENT ALTERNATIVE

The alteration of the Amaterra Development plan design to strictly housing and resort development may not be the best option from an environmental perspective. This type of development would mean an increase in the amount of vegetation that would be cleared within the development area. Due to security reasons and aesthetics the amount of green belts and buffer areas that are proposed within the golf course design may be removed.

The amount of houses and resort type activities would also increase in an effort to offset the loss of income that would be associated with the removal of the golf course from the development plan. Aesthetically this may not be best option either, as whilst there may be landscaping involved in the development, this cannot compare to the aesthetic appeal that would be afforded by the development of the golf course. This intensive concretisation of the area would also have effects on the drainage patterns, the soil and to a lesser extent the climate of the area.

From a socio-economic perspective the increase in the residences, villas and hotels in the development, could mean an increase in the income earnings for the developers, as well as the increase in job creation and income generation for the surrounding communities as compared to the projections for the golf course.

6.2 PROJECT DESIGN, SCALE AND IMPLEMENTATION ALTERNATIVES

6.2.1 NINE (9) HOLE GOLF COURSE ALTERNATIVE

The alteration of the plan to include a nine (9) hole golf course rather than an eighteen (18) hole golf course may see both positive and negative impacts on the environment. The design of a smaller golf course would mean that the level of clearing of vegetation, this would also mean that the amount of chemicals used on the golf course would be reduced, the level of change to the drainage patterns would decrease and the impacts to soil and underground water quality would also be reduced. Despite these initial obvious reductions of impact, the final impacts may be more negative than if a larger golf course was developed. A smaller golf course would mean that the areas for buffer zones and green areas would also be reduced as the developer may alter the development plans to increase the amount of houses, villas and hotels within the development plans to offset the economic losses that developing a smaller golf course would have. This concretisation would itself have its own major negative environmental impacts.

From a socio-economic perspective, whilst the development of a nine (9) hole golf course would still have some socio-economic benefits, its benefits would be marginal to those that

the proposed championship eighteen (18) hole golf course would have. Due to the smaller size, the development may not receive the amount of visitors expected to the area due to the inability to host championship games at the site. A smaller golf course would also mean that the amount of direct employment anticipated for the development in both the construction and operation phases would also decrease. This would also affect the indirect employment and income generation associated with the project.

6.3 THE CHOSEN ALTERNATIVE

Whilst the golf course itself may have major negative impacts on the environment, of all the alternatives presented, the development of the eighteen-hole golf course seems to be the most desirable. This proposal presents an opportunity for the retention of natural vegetation within the area as buffer areas will be incorporated in the golf course design and vegetation that currently exists will be maintained for 'rough areas', which would still provide a habitat for fauna in the area.

From a socio-economic perspective the development of the eighteen (18) hole golf course will have the most social and economic benefits locally and nationally.

7.0 ENVIRONMENTAL IMPACT ASSESSMENT

This section outlines the methodology used for predicting the impacts of the project and the identification of subsequent mitigation measures recommended for each impact identified. The cost for each mitigation measure has been quantified and is presented in the **Table I** in the Executive Summary found in the first section of the report.

METHODOLOGY

An environmental impact identification matrix was developed which covered the main potential impacts (positive, negative, major, minor, long and short term and any cumulative or synergistic impacts) of the project. The matrix lists impact types under broad headings with more detailed project specific impact categories. These impacts are divided into the Site Preparation and Construction Phases and Operation Phase of the development. This is shown in **Appendix 8**. It is assumed that mitigation measures will be implemented for all aspects of the development including the sod farm and the golf course.

7.1 PHYSICAL IMPACTS

7.1.1 CLIMATE

A. SITE PREPARATION AND CONSTRUCTION PHASES

Climate research has shown that the large-scale removal of vegetation may have adverse effects on cloud formation and precipitation, through their impact on the processes of evaporation and convection. In addition, vegetated areas have been proven to act as carbon sinks for greenhouse gases which are produced from car exhaust and other industrial type activities. The site preparation activities involved in the development of the golf course and other features of the golf course design includes the clearing of a significant amount of vegetation (approximately 85 hectares). This stage will also see the increase in vehicular traffic in the area. Exhaust from vehicles contains greenhouse gases which contribute to global warming. This may have a minor negative short-term impact on the climate of the area.

Considering all these factors, this stage of the development may therefore have a minor negative long term impact on the climate of the area. The effects of this may be evident in the decline in rainfall levels, increase in temperature and an increase in humidity, as the area becomes more influenced by the prevailing sea breeze. The significance of these changes may not be noticeable in the short-term, but may become more evident over time as more vegetation in the area is cleared for the remaining activities in the development plan as well as for the other development activities that have been slated for the area.

Mitigation Measures:

- o Maintain all mature trees (trees greater than 25 cm) throughout the development;
- o Remove only vegetation that is absolutely necessary for the construction of the golf course;
- o Ensure that buffer areas and green belts are incorporated in the golf course design;
- o Clear vegetation only after 90 % of sod has been established at the sod farm ;
- o All raw materials must be sourced as close as possible to the construction site thus reducing the emissions from vehicular traffic;
- o Recruit staff from the surrounding communities to decrease the travelling distance thus reducing emissions from vehicular traffic;
- o Ensure that all vehicles involved in the transport of construction material and staff, and machinery involved in the construction is properly maintained and serviced; and
- o Machines must not be left idling for unnecessary periods of time; this will save fuel and reduce emissions.

B. OPERATION PHASE

This stage of the development may have a positive impact on the climatic conditions in the area. Once natural vegetation in the area has been cleared, these areas will be re-vegetated with turf and other vegetation in the 'rough' areas of the golf course. This may serve to offset some of the impacts on climatic factors that may be associated with the development. Studies have shown that turf grass can absorb ozone and carbon dioxide which may be a major factor in the stability of the climatic conditions in the area. The

positive effects of the golf course on the climate in the area can be enhanced through the implementation of the mitigation measures outlined below.

Mitigation Measures:

- o Ensure that all machinery and vehicles used in the maintenance of the golf course are regularly maintained.
- o Implement a traffic system that involves appropriate signals and signs to ensure the smooth flow of traffic must be implemented. This will reduce the idling of vehicles that may occur and therefore reduce the emissions in the area.
- o Ensure that buffer areas and green belts that are incorporated in the golf design are delineated by containment measures such as fencing so as to prevent the impact of secondary opportunistic clearance in the area as a result of increased accessibility created by the development;

7.1.2 AIR QUALITY

NO₂ and SO₂ can cause adverse health effects, through both acute and chronic exposure. Chronic exposure may result in increased incidences of respiratory illnesses in the exposed population.

A. SITE PREPARATION AND CONSTRUCTION PHASES

It is expected that during these phases of development that there may be some changes in the air quality.

Vegetation clearing for site preparation, storage of raw materials and spoilage, and preparation of access roads are all expected to liberate dust and other forms of particulate matter, which currently is within the set limits for PM. While most of the dust generated is likely to settle a short distance from these sources, smaller particles may be transported across a wider area. The magnitude of dispersion will be influenced by the local meteorological conditions. Since the area is coastal, it is expected that the level of dispersion will be greater relative to inland areas, as wind speeds tend to be higher in coastal areas. The fugitive dust has the impact of being a nuisance as well as fine particulates ($\leq 10_{\mu m}$ measured as PM₁₀) may cause respiratory distress or illness (asthma,

bronchitis etc.). The dust generated from the site preparation and construction activities is likely to have a major negative long-term local environmental impact. The cumulative effects of this will be increased if the other development for the area occurs simultaneously with this proposed development, thus exacerbating the impacts to the air quality in the area.

Movement of heavy construction vehicles and the increase in traffic may cause an increase of local greenhouse gas emissions including NO₂ and SO₂. It is also expected that construction of roads will cause the on-site release of noxious fumes due to the processing of asphalt. Short and long term exposure to NO₂ and SO₂ may result in the development of both acute and chronic respiratory illness. Chronic exposure may result in increased incidences of respiratory illnesses in the exposed population. The impacts although negative, may be short term, and not significant.

Mitigation Measures:

- o The clearing of vegetation must be carried out on a phased basis. Vegetation should not be cleared in the area for the golf course until sod has reached ninety percent (90 %) grow-in at the sod farm. Vegetation should only be cleared from areas that have been designated to be included in the golf course design.
- o Ensure that all material (sand and aggregate) stockpiled on the site to be used in construction activities are regularly sprayed to reduce the effects of wind whipping.
- o Ensure that all trucks carrying aggregate and sand are covered during delivery to the site.
- o Care must be taken in the unloading construction materials (aggregate, sand and cement) to prevent spillage. If a spill occurs, this should be cleaned up as soon as possible thereafter.
- o Extra care must be taken to reduce dust in periods when wind speed are greatest and the rainfall amounts are lowest which is between June and July, e.g. This will involve extra wetting of the construction area to suppress dust particles.
- o Retain a buffer area of trees and other vegetation especially to the most northern section of the property (the coast) and generally around the perimeter of the development site which will serve as a natural windbreaks which may reduce the

level of dispersion of dust particles generated during this phases of the development.

- o All staff employed at the construction site must be provided with dust masks and be asked to use them.
- o All raw materials must be sourced as close as possible to the construction site thus reducing the emissions from vehicular traffic.
- o All waste must be transported off-site for processing, not burnt or stored for any longer than is absolutely necessary.
- o Recruit staff from the surrounding communities to decrease the travelling distance thus reducing emissions from vehicular traffic.
- o Ensure that all vehicles involved in the transport of construction material and staff, and machinery involved in the construction is properly maintained and serviced.
- o Machines must not be left idling for unnecessary periods of time; this will save fuel and reduce emissions.
- o Where possible, the use of the machinery must be scheduled to have most use when the residents are not in the area.
- o Perform road repair and construction at times that persons are expected to be at work and school, as this produces noxious gases.

B. OPERATION PHASE

The operation of the golf course will mean an increase in vehicular traffic to the area causing an increase in Carbon Monoxide and the Oxides of Sulphur and Nitrogen in the area. The levels produced by these activities however are not expected to be high however and therefore the impact is minor long-term negative. The operation of the golf course will however use copious amounts of chemicals (pesticides and fertilizers etc.) during the maintenance of the course. Once applied to turf, pesticides can undergo a process known as volatilization, which is the process by which a liquid or solid evaporates into the atmosphere as a gas. It is known that this is a significant pathway for the transfer of some pesticides. Environmental factors such as high temperatures, low relative humidity and air movement all contribute to the increase in volatilization. This impact however will be negative, minor and temporary as these pesticides soon become diluted in water droplets and returned to the soil surface, which of course has other associated impacts which will be discussed further in this report.

Mitigation Measures:

- o Ensure that all machinery and vehicles used in the maintenance of the golf course are regularly maintained ;
- o Implement a traffic system that involves appropriate signals and signs to ensure the smooth flow of traffic must be implemented. This will reduce the idling of vehicles that may occur and therefore reduce the emissions in the area;
- o As far as possible use the most 'environmentally friendly pesticides'. In an effort to reduce the level of volatilization that may occur, select and use pesticides that have low vapour pressures and high water solubility;
- o Irrigate after the application of pesticides to reduce the level of volatilization.

7.1.3 WATER QUALITY & QUANTITY**7.1.3.1 WATER QUALITY****A. SITE PREPARATION AND CONSTRUCTION PHASES**

The activities involved in these phases of the development may cause a major negative long-term impact on the surface (terrestrial and marine) and ground water quality within the development area. This will be as a result of many of the activities which are slated to take place in these phases which includes the possible storage of hazardous substances on the site such as diesel and motor oil for the operation of machinery and stand-by generators, and the storage of raw material for the construction of buildings and roads *inter alia*.

The clearing of the vegetation within the development area may also have a synergistic negative long term impact on the water quality in the area as well. The removal of vegetation will increase the runoff and therefore sedimentation will increase in these areas as well. The mitigation of this occurrence is particularly important, as the levels of Total Suspended Solids (TSS) at one (1) of the sample sites within the pond were approximately 30 mg/l, a value which is considered high.

Inappropriate treatment of sewage during this phase of the development may also have a negative impact on the surface and ground water quality in areas where Total Coliform and Faecal Coliform measurements exceed guidelines

Although there may be negative impacts to the groundwater quality in the area, this will not be significant as groundwater is not abstracted for potable use within the development area.

Mitigation Measures:

- o If diesel and motor oil are to be stored on site, ensure that they are properly contained in a bunded area (With capacity to contain 1½ times the amount of substances stored). This area must be situated away from all water bodies and signs indicating the storage of these substances erected.
- o Provide workers at the development site with chemical toilets during this phase of the development. A reasonable ratio would be eight (8) workers per toilet.
- o Store all raw materials away from the vicinity of water bodies located on the property and away from the coastal areas to avoid contamination in these areas.
- o General refuse generated during these phases of the development must be stockpiled in one central area of the development site, away from existing water bodies and collected, transported and disposed of appropriately at the designated disposal site.
- o Clearance of vegetation must be avoided in periods of heavy rainfall (between October and December) to reduce the impact of runoff.
- o Avoid clearance of vegetation when periods of wind speed are highest (June to July).
- o Vegetation should not be cleared until sod has reached a 90 % grow-in at the sod farm.
- o Install siltation traps within the drainage design to collect silt and sediments ensuring that they do not end up in adjacent aquatic areas.
- o Conduct periodical water quality monitoring to ensure that standards are maintained.

b. OPERATION PHASE

This phase of the development may have the most negative, long term impact on the surface water (marine and terrestrial) quality if not properly monitored and managed and is potentially irreversible. This impact on the water quality will be from several sources within this phase of the development. This phase of the development may also have a negative

impact on the groundwater quality in the area; this impact will not be significant however, as groundwater is not abstracted for potable use in the area.

Nutrient loading in spite of the judicious use of fertilizers in turf maintenance and the use of nutrient – rich recycled water for irrigation of the course, may have a long-term major irreversible negative impact on surface water quality, both in the terrestrial and marine environments. Whilst some of the nutrients will be used up during the growing cycle of the turf grass and rough areas along the golf course, significant loading may occur to the water bodies and the marine environment through the processes of leaching and run-off. These nutrients may affect the pH, temperature and the deoxygenation of water bodies in this area. The result of this eutrophication is enhanced plant growth in these areas. This surge in plant growth can increase turbidity and hence light attenuation in water and also exacerbates the deoxygenation of these areas. It is thought that anoxic conditions may lead to the release of phosphate from bottom sediments and hence allow the eutrophication to become self perpetuating, irregardless of future inputs into these water bodies (Morris and Therivel, 2000).

Other chemicals, namely pesticides will be used in the maintenance of the golf course as well which may also have a major long-term, negative impact on the surface waters in the area through the processes of leaching and run-off as well. These chemicals may affect the pH of theses environments. In addition, the process of volatilization which has been described in the previous section may occur. This process occurs when pesticides and other chemicals with a high vapour pressure are applied to turfs. These chemicals are transferred to the gaseous state and then it becomes ‘diluted’ in water droplets which is highly susceptible to long-range transport from the application site and may be transferred back to the soil (EPA, 2007), where it may affect groundwater quality . Data collected however shows that the ground water quality in the area is not suitable for potable use. Therefore the impact on groundwater although negative, will be minor.

The operation of the clubhouse and maintenance area may also affect the surface water quality in the area. The construction of these areas may increase the level of run-off that may contain heavy metals, faecal bacteria, organic and inorganic chemicals, household cleaning residues and grease and oils that may have a negative impact on adjacent man-made and natural surface water features in the area. Oils and grease for example

deoxygenate water as they are broken down and can cover the surface of the water inhibiting oxygen diffusion and may directly form a coat on aquatic plants and animals causing injury or even death. These activities may also affect groundwater quality in the area as well. Leaks and spills in the maintenance area and the improper sewage treatment and waste disposal from the Clubhouse may also have a major negative impact on the surface and ground water qualities in the area.

Mitigation Measures:

- o Ensure that all areas of the golf course are lined with geotextile material to prevent the contamination of ground water in the area ;
- o Maintain a vegetation buffer around natural and marine environments to reduce the nutrient loading to these waterways.
- o Develop and implement a comprehensive Nutrient Management Programme for the maintenance of course. Golf course maintenance staff should be trained in these best practices.
- o Fertilizer applications should be based on the results of regular soil testing to avoid over application of nutrients.
- o Use as far as possible slow-release fertilizers to reduce the potential of leaching and run-off into water bodies. The application of these fertilizers must be timed to minimize the leaching from soil by rainfall or irrigation.
- o Irrigate after fertilization to reduce volatilization;
- o Monitor irrigation of the turf especially in periods of high levels of rainfall which is typically October – December);
- o Ensure that all machinery and vehicles used in the maintenance of the golf course are regularly maintained and that maintenance of these vehicles is always conducted in the stipulated area. All grease and oil from this area must be collected in an oil/water separator and properly disposed of by a licensed waste disposal company.
- o Incorporate constructed wetland features within the water features within the golf course, such as reed beds, these if properly designed and maintained can remove or manage the nutrient loading to these water features . This will provide natural filtration features for fertilizers and pesticides used in golf course maintenance, as

well as assisting with the decrease in the rate of eutrophication within these ponds ;

- o Apply practices and use products that reduce the potential for contamination of ground water and surface water which includes the physical removal of weeds, use of slow-release products and choosing the most 'environmentally friendly products available
- o The use of fertilizer can be adjusted to consider natural sources of nitrogen. Grass clippings can be recycled throughout the entire golf course. It is estimated that these clippings can provide approximately 0.45 kg/ 100 m² of Nitrogen per year. Where these clippings are not used, they must be properly collected, stored and disposed of. Rainfall can also provide natural source of Nitrogen which is estimated to be approximately 0.09 – 0.22 kg / 100 m² /year.
- o Establish 'no-spray' zones and buffer areas particularly around areas where there are water features and other surface waters. Staff should be trained to identify and operate with care in these areas; Native species, especially those with deep rooting systems should be planted in these areas as a natural means of ground water attenuation;
- o Prevent the contamination of ground water by the designation of a maintenance area for the maintenance of vehicles and other equipment to be used for the upkeep of the turf. This area should be paved with an impervious material and all run-offs from this area channelled and collected in a catchment area, after which it can be properly disposed;
- o Ensure that all chemicals are properly stored in a specific location. All chemicals stored in this area must be properly labelled. The area where chemicals will be stored and handled must be constructed with an impermeable surface. This area should also be bunded with the capacity to contain 1½ times the amount of substances stored
- o Monitor surface water quality to help with the regulation of nutrient loading
- o Employ more environmentally-sensitive turf management techniques within ten (10) metres of all wetlands, water bodies to eliminate or minimize nutrient and chemical inputs
- o Take weather into consideration when applying pesticides
- o When applying pesticides employ spot-treatment to affected areas

- o For holes closest to the shoreline raise the mowing height to slow and filter runoff
- o Reduce the recommended rate of application in out-play areas;
- o Determine pest thresholds and apply pesticides only when threshold has been exceeded
- o Use slow release fertilisers and employ spoon-feeding application of these fertilizers
- o Locate chemical storage and handling areas as far as possible from water course. Ideally a vegetative buffer should be incorporated in the design of the golf course between the storage area and water courses.
- o Care should be taken not to apply more fertilizer than is needed since there may be a growth surge in response to the nutrients which can lead to increased thatch production and predisposition to increased insect and or disease activity.
- o Monitor the Chloride level in irrigation water as this may suppress the uptake of Nitrogen in Seashore Paspalum.
- o Ensure that there is proper storage and disposal of waste generated at the clubhouse
- o Conduct regular water quality monitoring of the sewage treatment facilities, water courses to ensure that these are in keeping with the prescribed water quality standards
- o Ensure that there is proper blending of irrigation water with fresh water from run-off, this water must be tested regularly and fertilizers and pesticides adjusted accordingly to consider the input from this source.
- o Purchase and store only the amount of pesticide needed for the immediate future.
- o In the event of a spill, ensure that this cleaned up immediately.
- o Follow recommended mowing schedules and technique to maintain a healthy pest-resistant turf, and therefore reduce the amount of pesticides required.
- o Develop and follow an Integrated Pest Management Policy. This policy should include the times for treating pests and other turf problems. This should also include recommendations for mowing time, and also indicate how to use non-chemical options for pest control.

7.1.3.1 WATER QUANTITY

A. SITE PREPARATION AND CONSTRUCTION PHASES

The water consumption in these phases of the development will be minimal when compared to the rate of consumption in the operation phase. Water will be used for the construction of buildings and roadways, as well as for domestic use among labourers employed to the site. There is currently a problem of water availability in the study area. Other development has been proposed for the area and these will further increase the strain on the current water availability. An upgrading programme has been negotiated between the developer and the National Water Commission (NWC). Without this upgrade however these activities may have a major negative short-term impact on the current water supply in the area. This upgrade of the may have a positive impact on the current water shortage in the area.

Mitigation Measures:

- o As far as possible ensure that water is conserved during these phases of the development;
- o If the upgrading works proposed are not implement prior to the start of these activities , the developer should identify other sources of water to be used in this stage of the development; and
- o Ensure that the community benefits from the upgrading works to the water supply proposed.

b. OPERATION PHASE

Approximately 2,514 m³ of water will be required for daily operations of the golf course. This will have a major negative long-term impact on the current water supply in the area. If this water supply is not upgraded it will place a significant strain on the water supply in the area.

Mitigation Measures:

- o Ensure that the water supply is upgraded as proposed (See **Appendix 5**) before the commissioning of the golf course takes place; If this does not occur the developer should identify other sources of water for this phase of the development;
- o Irrigation systems must be regularly checked to ensure there is proper water distribution in all areas;
- o Install a filtration system within the irrigation ponds to ensure that nozzles do not become blocked with suspended solids which can reduce irrigation efficiency and uniformity;
- o Incorporate evapotranspiration rates and weather data into the daily irrigation decisions; and
- o Reduce the level of irrigation on all unused or minimally used areas of the property.

7.1.4 SOILS AND GEOLOGY**A. SITE PREPARATION AND CONSTRUCTION PHASES**

The activities involved in the site preparation and construction phase of the development may have a major negative short-term impact on soil and geology of the project site. This is due to the removal of vegetation from the area which will leave considerable areas of soil exposed to the elements, which may result in soil erosion. This is particular area of concern since the soil cover in the area is already poor.

Heavy machinery will be traversing the site due to the construction activities this may lead to soil compaction and erosion of the soil.

Hazardous substances such as diesel used for the operation of machinery and stand-by generators, may be stored on the property. This may have a significant negative long-term impact on soil quality in the area.

Mitigation Measures:

- o Only remove vegetation from areas for the golf course construction ;
- o Only remove vegetation after sod has completed 90 % grow-in;
- o Install appropriate drainage systems to direct water away from slopes;

- o Avoid as far as possible the traversing of bare soil by vehicles to reduce soil compaction;
- o Designate a main access route for heavy machinery;
- o Avoid Site Preparation in period when wind velocities are highest which is between June and July;
- o Avoid Site Preparation and Construction activities in periods of heavy rainfall, when soil is saturated which are typically between the months of October and December;
- o Areas storing hazardous substances such as diesel must be properly contained in a bunded area (With capacity to contain 1 ½ times the amount of substances stored. This area must be situated away from project activities and signs indicating the storage of these substances erected. Care must be taken when handling these hazardous substances to avoid spills.
- o In the event of a spill the contaminated soil must be removed and disposed of at a licensed landfill.
- o Ensure that general refuse is collected regularly and is transported and disposed of appropriately at the designated disposal site.

B. OPERATION PHASE

The use of chemicals for the maintenance of the turf and the use of effluent for the irrigation of the turf may affect soil quality, by changing the soil's chemistry through changes in pH *inter alia*. This environmental impact may be long-term, major, irreversible and negative. Soil compaction during the rolling of tees and greens may also affect the natural infiltration of soil and therefore run-off may be affected.

Mitigation Measures:

- o Develop and implement a comprehensive Nutrient Management Programme for the maintenance of course. Golf course maintenance staff should be trained in these best practices.
- o Irrigate after fertilization to reduce volatilization;
- o Apply practices and use products that reduce the potential for contamination of soils including the physical removal of weeds, use of slow-release products and choosing the most 'environmentally friendly products available

- o Establish 'no-spray' zones within the development area. Staff should be trained to identify these areas;
- o Prevent the contamination of soils by the designation of a maintenance area for the maintenance of vehicles and other equipment to be used for the upkeep of the turf. This area should be lined with an impervious material and all run-offs from this area channelled and collected in a catchment area, after which it can be properly disposed;
- o Ensure that all chemicals are properly stored in a specific location. All chemicals stored in this area must be properly labelled. The area where chemicals will be stored and handled must be constructed with an impermeable surface. This area should also be bunded with the capacity to contain 1½ times the amount of substances stored
- o Reduce the recommended rate of application of fertilizers in out-play areas
- o Use slow release fertilisers and employ spoon-feeding application of these fertilizers
- o Purchase and store only the amount of pesticide needed for the immediate future.
- o In the event of a spill, ensure that this cleaned up immediately.
- o Follow recommended mowing technique to maintain a healthy pest-resistant turf, and therefore reduce the amount of pesticides required.
- o Develop and follow an Integrated Pest Management Guidelines this should outline the times when treating pests and other turf problems will be most effective and environmentally sound. This could include like recommendations for mowing time, and also should include the results from the investigation of non-chemical options for pest control.
- o Seashore Paspalum is tolerant to salts therefore rock salt may be used to control weeds, which would reduce the amount of herbicide that may be needed.

7.1.5 HYDROGEOLOGY

A. SITE PREPARATION AND CONSTRUCTION PHASES

These phases of the development may have a minor short-term negative impact on the hydrology of the area. Heavy equipment used in these phases of the development can

cause soil compaction and therefore result in increased surface runoff, which changes the natural internal drainage capacity.

Mitigation Measures:

- o Designate a main access route for heavy machinery;
- o Utilise impervious material for areas that require paving, such as parking lots to increase run-off. Parking lots may be designed to accommodate the average number of parking spaces. Additional parking spaces can be covered with gravel to reduce the amount of run-off from this area.
- o Ensure that the drainage plan proposed is implemented as stipulated on the plan.
- o Phase the clearing of vegetation on slopes.
- o Additional drainage may be put in place to convey the flood discharge to the sea and the retention areas used primarily to retain water for irrigation and smaller flood discharges.
- o The provision of a system of culverts should be considered at the intersection of the major flowpath leading to the large depression and the proposed road south of the depression in Basin 2.

B. OPERATION PHASE

The Operation Phase of the development is likely to have a minor negative, long-term impact on the hydrology of the area. This is however not significant as runoff levels predicted are marginal.

Mitigation Measure:

- o Ensure that all drains and culverts collecting water within the site are regularly cleaned and maintained.

7.1.6 NOISE & VIBRATION**A. SITE PREPARATION AND CONSTRUCTION PHASES**

The site preparation and construction phases of the development may likely have the most negative impact to the ambient noise and vibration in the development area. A number of

measures may be undertaken by the developer/s to reduce the impact of noise on the existing and potential residents as well as the workers involved in the project. This is temporary, however, and the aim at this point is to make the increase in noise as small as possible until this phase is complete.

The cumulative impact of the construction activities occurring simultaneously with the other proposed developments for the area may increase the noise and vibration levels in the area significantly.

Mitigation Measures:

- o Access roads should be cut that are exclusively used for the transportation of workers, goods and materials. These roads should be sited in such a way that the noise from this movement affects as few of the existing residents as possible.
- o Where possible silenced machinery and instruments should be employed to reduce the impact of noise on the existing residents and workers.
- o Machinery, vehicles and instruments that emit high levels of noise should be used on a phased basis to reduce the overall impact. These pieces of equipment such as drills, graders and cement mixers should also be used when the least number of residents can be expected to be affected, for example during periods where most residents are at work or school.
- o Workers, especially those working with machinery, vehicles and instruments that emit high levels of noise should be supplied with ear plugs and ear muffs to reduce the risk of hearing impairment. Prolonged exposure to this impact should be reduced where possible.
- o Temporary barriers such as earth berms, zinc fencing and sound dampening fencing such as acoustic screens should be employed to reduce the impact of noise to the existing residents;
- o Ensure that construction activities for the development of the golf course and the other developments proposed for the area are staggered to decrease the levels of noise and vibration in the area;
- o Construction hours should be limited to the hours of 8:00 a.m. and 6:00 p.m. daily.

- o The delivery of raw materials must be limited to 8:00 a.m. and 6:00 p.m.

B. OPERATION PHASE

The Operation Phase of a Golf Course is not expected to cause a major negative impact. Although it will be operated as a commercial facility it is likely that the noise limits should be akin to residential areas.

Mitigation Measures:

- o Ensure that there is proper traffic signage and signals where necessary or appropriate to effect the free and safe movement of traffic and there reduce the noise caused by traffic build-up.
- o Ensure that the golf course adheres to its opening hours which are between 6:00 a.m. and 8:00 p.m. daily.
- o Ensure that deliveries to the golf course are made between 8:00 a.m. and 5:00 p.m. daily.
- o Ensure that maintenance works on the golf course occurs between the hours of 8:00 a.m. and 5:00 p.m. daily.

7.1.7 LANDSCAPE AND AESTHETICS

A. SITE PREPARATION AND CONSTRUCTION PHASES

The site as it currently exists has not been landscaped and many may find it not aesthetically pleasing, this will be further exacerbated by the removal of vegetation during these phases of the development. This impact however will be a minor short-term negative impact.

Mitigation Measures:

- o Remove as little vegetation throughout the site as possible.
- o Conduct vegetation clearance on a phased basis and only after sod has achieved a 90 % grow in at the sod farm.
- o Re-vegetate cleared areas as soon as possible.
- o Retain vegetation screens from the mail vantage point along the highway to reduce the visual effect of this stage of the development.

- o Ensure that local building materials and muted colours are used to reduce the visual impacts of the development and the landscaping to hide it or blend in with the local environment. The developer is encouraged to mimic the Georgian style of construction, which the nearby town of Falmouth boasts.

B. OPERATION PHASE

The development of a golf course and the landscaping that accompanies this golf course may provide pleasant scenery from the main vantage points. This development may therefore have a major positive long-term on the aesthetics of the area.

Mitigation Measure:

- o Ensure that the golf course and the buildings incorporated within its designs are regularly maintained.

7.2 BIOLOGICAL IMPACTS: TERRESTRIAL ENVIRONMENT

7.2.1 FLORA

A. SITE PREPARATION AND CONSTRUCTION PHASES

The construction of the golf course will result in the removal of approximately eighty nine (89) hectares of the three hundred and forty four (344) hectares of natural vegetation in the area. The development may have a major, long-term, irreversible negative impact on the floral composition of the area. The main area to be impacted will be the dry limestone forested zone as holes 1- 14 and 17- 18, as well as the Clubhouse, Maintenance area and sod farm will be constructed in this area (See **Appendix 2**). This area shows a medium species diversity with only five (5) species being classified as endemics and one endangered/CITES classified species. No rare or threatened species were observed. This shows that from an ecological stand-point the area is not one of very high ecological importance. The vegetation within the Mangrove Zone will not be cleared for the construction of the golf course. The developer may however clear the area for aesthetical purposes, an activity which requires an environmental permit from the National Environment and Planning Agency (NEPA) [See **Section 3.1.1.2**]. This mangrove area is

not very extensive, but its ecological function should not be understated (this was already discussed in **Section 4.2.1.1.3.**)

The construction of holes 15 and 16 may have a direct impact on the Beach Zone as these areas will be cleared to facilitate construction. This zone also plays a very important ecological function as was discussed in **Section 4.2.1.1.3.**

The main impacts of the clearing of the vegetation may however be secondary and will affect the species that depend on the area for survival through habitat loss, fragmentation and the impacts of edge effects. This will be further discussed in the sections below.

The impacts of the clearance of vegetation will also have synergistic negative impacts on water (marine and terrestrial) and soil quality in the area however. This will be through the increase in run-off, soil erosion and siltation.

Mitigation Measures:

- o Only clear vegetation that is absolutely necessary for the construction activities; this vegetation should be cleared only after there has been 90 % grow-in of the sod at the sod farm;
- o Retain all mature trees (> 25 cm diameter at breast height (DBH)) during this phase of the development;
- o Perform translocation of important plant species such as the endemic orchids. The developer can make arrangements with either of the two (2) orchid sanctuaries in Jamaica which are the Schwallenburg Orchid Sanctuary located in St. Ann or the Martins Hill Orchid Sanctuary located in Manchester to accept these species. Both sanctuaries are operated by the West Indies Alumina Company (WINDALCO) Ltd. A nursery should be established for the propagation of native species which should be reintroduced into the golf course landscape design.
- o Avoid the use of Invasive Alien Species in the landscaping activities (A list of these Invasive Alien Species are shown in **Appendix 6**)
- o Determine access roads which are to be used by machinery used in the construction and site clearance phase of the development to avoid the unnecessary trampling of vegetation that will be maintained within the development area.

- o Ensure that 'green belts' which have been proposed for the golf course design are large as possible as small patches may not be able to support viable populations of some species and these small patches tend to be more susceptible to edge effect. In possible position these green belts in adjacent to existing vegetated areas. In addition species richness tends to increase with area, which would be the desired outcome of the incorporation of green belts.

B. OPERATION PHASE

Much of the area will remain vegetated after the construction after the golf course and its auxiliary components have been constructed. The activities involved in the maintenance of the golf course may have a major negative long-term irreversible impact on the remaining vegetation of the area. These main impacts may be associated with the use of chemicals to be used in the maintenance of the course which may have direct (use of herbicides for turf maintenance) and indirect impacts (alteration of soil chemistry and water quality). The machinery used in maintenance activities may also affect this vegetation.

Mitigation Measures:

- o Physically delimit the remaining neighbouring forests by some means of fencing which will reduce the impact of secondary opportunistic clearance in the area as a result of increased accessibility created by the development;
- o Develop and implement a comprehensive Nutrient Management Programme for the maintenance of course. Golf course maintenance staff should be trained in these best practices;
- o Establish and maintain 'no-spray' zones throughout the golf course
- o If the Mangrove Zones are to be maintained limit the fertilizer application in areas namely Holes 17 and 16;
- o Use slow release fertilizers throughout the golf course; and
- o Utilise as far as possible the most 'environmentally friendly' chemicals for the maintenance of the turf.

7.2.2 FAUNA

7.2.2.1 AVIFAUNA

A. SITE PREPARATION AND CONSTRUCTION PHASES

The area represents a fairly good habitat for bird species. This is indicated by the presence of fifteen (15) endemic bird species observed within the area. Within the development area there are three (3) main habitat types present within the proposed development area: low level disturbance forests; wetlands and; sandy and rocky shores. Each habitat types support its own unique population of birds adopted for the specific conditions of these habitats. It is safe to assume that each habitat type will be impacted to different degrees by the proposed development and as such, the habitat most heavily impacted, the forested area will have the most adverse effects on the birds of that habitat. It is important to note that all three (3) habitat types are linked and the presence of one facilitates the presence of the other and vice versa which has a direct impact on the bird species in each habitat. In effect, if the surrounding forests around the mangroves and ponds are removed the wetland birds will be indirectly affected by the exposure although the wetlands itself will not be disturbed. The avifauna diversity observed in the area is high and therefore the area represents a very good bird habitat.

Therefore, the loss of vegetation within this phase of the development may result in a direct loss of avifauna diversity and abundance within the affected habitat and an indirect loss within the neighbouring habitats. With the presence of the remaining two hundred and fifty five (255) hectares of forested area, the impact although negative will be minor long term and irreversible. This extent of this impact will however be enhanced in the long term with the development of the remainder of the Amaterra area, as well as the development of contiguous sites for other resort developments slated for the area.

Mitigation Measures:

- o Maintain all mature trees (trees > 25 cm) within the development;
- o Only remove vegetation that is necessary for the construction of the golf course;
- o Reduce edge effect and habitat loss by physically delimit the remaining neighbouring forests by some means of fencing which will reduce the impact of

secondary opportunistic clearance in the area as a result of increased accessibility created by the development;

- o Incorporate as much local plants found within the area into the final landscaping of the property;
- o Birds tend to be most active during the early morning and late evening. Construction activities must therefore be limited to the hours of 8:00 a.m. and 6:00 p.m.
- o The developer may encourage birds to utilise rough areas as habitats by installing nest boxes and birdhouse within these areas.
- o The developer should incorporate trees that are used by bird species for foraging to attract bird species to the area.

B. OPERATION PHASE

With the completion of the golf course, the area is expected to have rough areas that have project bringing landscaping additions such as ornamental trees as well as flowers. There will also be copious amount of vegetation remaining throughout the property in the short-term which will be able to support the avifauna of the area. The use of chemicals in the maintenance of the turf may have an indirect impact on these bird species, whose diets consist mostly of fruits and insects. These food sources may become contaminated with the chemicals that will be used in the maintenance of the golf course. The development of the golf course will therefore have a major negative impact on the avifauna of the area. This impact will be enhanced with the completion of the other aspects of the Amaterra development plans however, through habitat loss.

Mitigation Measure:

- o Establish 'no-spray' zones throughout the golf course, especially in the remaining vegetated areas of the golf course to reduce the effect of pesticides on the remaining fauna within these vegetated areas.

7.2.2.2 BUTTERFLIES

A. SITE PREPARATION AND CONSTRUCTION PHASES

Site preparation will involve the clearing of vegetation and the resultant destruction of habitat for these insects. This will obviously have a major negative impact initially. Some of the butterflies are known to survive in disturbed areas and so their population may flourish; these are referred to as generalist species. Unlike these generalist species it is likely specialist species will be lost from the area unless the trees and plants that form part of their life cycle are retained. Butterflies generally lay eggs on the underside of leaves which will then form the food source for caterpillars; removal of favoured trees will result in the interruption of the life cycle. Furthermore, along with bees, butterflies are important pollinators which aids in plant reproduction.

In the short-term sufficient habitat will be maintained for these species, with the completion of the Amaterra development however habitat loss will have an enhanced impact on these species. The species diversity in the area is however not high and only one (1) endemic species was observed in the development area, no rare threatened or endangered species were observed. The area is therefore not of very high ecological importance with respect to species diversity among butterflies and hence the environmental impact during this phase will be minor, negative and long term.

Mitigation Measures:

- o Plant native shrubs and herbs throughout the development such as *Lantana sps.* to encourage the butterflies to remain in the area.
- o Incorporate green belts within the golf course design to ensure that butterfly species remain in the area.

B. OPERATION PHASE

This phase of the development may have major negative impact on these species. Through the use of insecticides and other chemicals for the control of pest which may affect the turf. Butterflies as mentioned above rely on vegetation in various stages of their life cycle. While developers will not be intentionally seeking to destroy the butterflies in the

area, they may be inadvertently affected by the judicious use of pesticides to maintain the turf.. The use of insecticides to control pests that may affect the turf may have impact on these species.

Mitigation Measure:

- o Establish 'no-spray' zones throughout the golf course, especially in the remaining vegetated areas of the golf course.

7.2.2.3 OTHER MACROFAUNA

A. SITE PREPARATION AND CONSTRUCTION PHASES

The proposal to construct an eighteen (18) hole golf course is of particular concern not only the avifauna and butterflies, but to all animal species within the area. The secondary impact of the removal of vegetation which may result in habitat loss and fragmentation may have the most impact on these species. The conversion of large areas into grass land, apart from the obvious loss in vegetation cover there is the “edge effect” this creates to the neighbouring remaining forest. The relative humidity of the area will change as it becomes more influenced by the prevailing sea breeze. This is of great significance as it affects mainly the lower class animals such as the insects which form a very important link in the food chain.

For the larger species such as the goats that were observed on the site, the loss of vegetation and the development of the area would mean that the owners of these goats would have to find a new source of food for these animals. Considering however, that goats are found in the most disturbed of environments and are known to forage on various types of food it is not anticipated that the development will have a major impact on these animals. Perhaps, it may have a minor economic impact on the owners depending on the level of effort required to find new sources of food.

Reptiles including do not enjoy a favourable reputation in Jamaica although as predators they are ecologically important. Several insects are known to be pest species and lizards help to control insect population. The loss of the vegetation due to clearing for the development would likely result in a significant decrease in the numbers of lizards and potentially an increase in several insect populations. Several species of lizard have

adapted to highly disturbed environments and do continue a largely arboreal existence in residential areas once there are sizeable trees and plants. Even walls have replaced trees in some cases though the impact can still be expected to be major. Snakes, like their lizard relatives also play an important ecological role. The introduction of the Indian mongoose (*Herpestes auropunctatus*), an alien invasive species (CHM, 2007), to control rat species has significantly reduced the population of Yellow Snakes (*Epicrates subflavus*) in Jamaica and as such these species are protected by the Wildlife Protection Act (1945) and the Endangered Species Act (2000) [See **Sections 3.1.4 and 3.1.5** respectively]. Although none of these species were observed during the survey, these species may be present however and if observed during this phase of the development, these species should be handled as outlined in the mitigation measures section below.

Some species of dragonfly are known to exist in highly disturbed areas, once there is access to sources of water for the nymphs to survive. Generally however this may not be the case for this development unless water traps incorporated in the golf course can also be used and suitable habitat and food sources remain for the imago.

Mitigation Measures:

- o Where possible introduce site clearing on a phased basis to allow species the opportunity to relocate to suitable nearby habitats and to reduce the shock to the various habitats that may be disturbed.
- o During site preparation and construction phases, the spoilage and waste should be removed, relocated or stored in a manner that does not allow for the disturbance of surrounding habitats or the species that remain.
- o Where Yellow Snake species are observed, these should be captured and translocated to a nearby Wildlife Sanctuary. The developer may contract the services of the Seven Oaks Wildlife Sanctuary in Runaway Bay for their assistance in these translocation activities.

B. OPERATION PHASE

The judicious use of chemicals in this phase of the development may have a long-term major negative impact on these groups of animals, especially affecting the food web in the area. Goats who may continue to forage in the uncleared areas of the golf course may

consume vegetation that has been affected with pesticides used in the maintenance of the turf, insects may also consume affected vegetation which may result in their mortality and the mortality of their predators such as lizards.

Mitigation Measures:

- o Establish no spray zones within the golf course. Staff must be trained to identify these areas;
- o Apply practices and use products such as the physical removal of weeds, use of slow-release products and choosing the most 'environmentally friendly products available;
- o When applying pesticides employ spot-treatment to affected areas
- o Follow recommended mowing schedules and technique to maintain a healthy pest-resistant turf, and therefore reduce the amount of pesticides required.
- o Develop and follow an Integrated Pest Management Policy. This policy should the times for treating pests and other turf problems. This could also include recommendations for mowing time, and also indicate how to use non-chemical options for pest control such as rock salt.
- o The reservation of green spaces and buffer zones through out the development that are uninterrupted by aspects of the development may be used for a "passive" habitat creation. Areas of the site can be replanted with plant species that may encourage the return of associated animal species.

7.3 BIOLOGICAL IMPACTS: MARINE ENVIRONMENT**A. SITE PREPARATION AND CONSTRUCTION PHASES**

The marine environment during these phases of the development may be mostly be affected by secondary impacts of vegetation clearance. The removal of this vegetation will increase soil exposure and hence the increase in wind-whipping of soil. The area does not have a high soil cover however, but this wind whipping may also affect the construction material that will be stored on site. Run-off from heavy showers on cleared land may also increase the impact to the marine environment. This can increase the Total Suspended Solids (TSS) in the marine environment. Increased sedimentation resulting from land clearing and constructing of buildings may result in smothering of coral polyps and damage

to reefs which may have a major negative impact on marine species. The storage of hazardous substances such as diesel and other substances to be used in the construction phase of the development may have a negative impact should they enter the marine environment.

The beach zone area of the development is also an ideal nesting site for sea turtles, although none were observed during the assessment. For hatchling sea turtles, artificial light is a killer. Instinct drives them from their nests on beaches towards the brightest horizon, ideally the waterline on an undeveloped coast. Security lights may be installed around the development site during these phases of the development. These lights may disorient nesting, egg-laden female turtles and lure newly-hatched baby turtles towards artificial light sources (National Geographic, 2003).

Mitigation Measures:

- o If diesel and motor oil are to be stored on site, ensure that they are properly contained in a bunded area (With capacity to contain 1½ times the amount of substances stored). This area must be situated away from all water bodies and signs indicating the storage of these substances erected;
- o Provide workers at the development site with chemical toilets during this phase of the development. A reasonable ratio would be eight (8) workers per toilet;
- o Store all raw materials away from the vicinity of water bodies located on the property and away from the coastal areas to avoid contamination in these areas;
- o General refuse generated during these phases of the development must be stockpiled in one central area of the development site, away from existing water bodies and collected, transported and disposed of appropriately at the designated disposal site;
- o Clearance of vegetation must be avoided in periods of heavy rainfall (between October and December) to reduce the impact of runoff;
- o Avoid clearance of vegetation when periods of wind speed are highest (June to July);
- o Vegetation should not be cleared until sod has reached a 90 % grow-in at the sod farm; and
- o Conduct periodical water quality monitoring to ensure that standards are maintained.

- o Ensure that all development is located at least 30M from the high water mark.
- o Ensure that artificial lighting does not directly illuminate the beach area. If lights are to be used in this area they should be low pressure sodium lights that are no higher than 4 m above the ground.

B. OPERATION PHASE

In aquatic environments nutrients such as Nitrogen and Phosphorus can stimulate the growth of aquatic plants such as algae and seaweed, a process known as eutrophication. In some instances these algal blooms can harm or even kill fish, shell fish and other animals by using up the Dissolved Oxygen (DO) in the water that these species rely on. Aquatic organisms begin to be put under stress as DO levels in water drop below 5.0 mg/l. Oxygen levels that remain below 1-2 mg/l for a few hours can result in large fish kills. *[DO levels in the marine environment are well above the United States Environmental Protection Agency's (EPA) standards, which hint good water quality in the marine environment]*. Excessive algal growth may also cloud the water, effectively blocking sunlight from reaching submerged aquatic vegetation (SAV), such as seagrasses which provides prime nursery and spawning habitat for juvenile finfish and shellfish which may affect the entire food web in this ecosystem. The use of effluent for irrigation purposes may also cause an increase in Faecal and Total Coliform in the aquatic environments, which can be harmful to organisms.

The beach zone area of the development is also an ideal nesting site for sea turtles, although none were observed during the assessment. For hatchling sea turtles, artificial light is a killer. Instinct drives them from their nests on beaches towards the brightest horizon, ideally the waterline on an undeveloped coast. These lights may disorient nesting, egg-laden female turtles and lure newly-hatched baby turtles towards artificial light sources (National Geographic, 2003).

Mitigation Measures:

- o Maintain wetlands along the coast around all waterways (man-made, natural and marine environments) to reduce the nutrient loading to these waterways. Ensure that all machinery and vehicles used in the maintenance of the golf course are

regularly maintained. Fertilizer applications should be based on the results of regular soil testing.

- o Use as far as possible slow-release Nitrogen to reduce the potential of leaching and run-off into water bodies.
- o Develop and implement a comprehensive Nutrient Management Programme for the maintenance of course. Golf course maintenance staff should be trained in these best practices.
- o The application of fertilizer must be timed to minimize leaching from rainfall or irrigation;
- o Irrigate after fertilization to reduce volatilization;
- o Reduce irrigation in periods of high levels of rainfall which is typically between the months of October and December;
- o Apply practices and use products that reduce the potential for contamination of ground water and surface water which includes the physical removal of weeds, use of slow-release products and choosing the most 'environmentally friendly products available
- o Establish 'no-spray' zones and buffer areas particularly around areas where there are water features and other surface waters. Staff should be trained to identify these areas;
- o Ensure that all chemicals are properly stored in a specific location. All chemicals stored in this area must be properly labelled. The area where chemicals will be stored and handled must be constructed with an impermeable surface. This area should also be bunded with the capacity to contain 1½ times the amount of substances stored
- o Employ more environmentally-sensitive turf management techniques within ten (10) metres of all wetlands, water bodies to eliminate or minimize nutrient and chemical inputs
- o In order to reduce the amount of Nitrogen needed grass clippings will be recycled throughout the entire golf course. It is estimated that this will provide approximately 0.45 kg/ 100 m² /year. Where they are not used, they must be properly collected and stored and disposed of properly. Rainfall can also provide natural source of Nitrogen which is estimated to be approximately 0.09 – 0.22 kg / 100 m² /year. The

use of fertilizer can therefore be adjusted to consider these other sources of nitrogen.

- o Take weather into account for the application of pesticides;
- o When applying pesticides as far as possible employ spot-treatment;
- o For holes closest to the shoreline raise the mowing height to slow and filter runoff
- o Reduce the recommended rate of application in out-play areas;
- o Determine pest thresholds and apply pesticides only when threshold has been exceeded;
- o Use slow release fertilisers and employ spoon-feeding application of these fertilizers;
- o Locate chemical storage and handling areas as far as possible from water course. Ideally a vegetative buffer should be incorporated in the design of the golf course between the storage area and water courses;
- o Care should be taken not to apply more fertilizer than is needed since there may be a growth surge in response to the nutrients which can lead to increased thatch production and predisposition to increased insect and or disease activity;
- o Monitor the Chloride level in irrigation water as this may suppress the uptake of Nitrogen in Seashore Paspalum.
- o Ensure that there is proper storage and disposal of waste generated at the clubhouse
- o Conduct regular water quality monitoring of the sewage treatment facilities, water courses to ensure that these are in keeping with the prescribed water quality standards (See **Section 11.1.3**)
- o Ensure that there is proper blending of irrigation water with fresh water from run-off
- o Purchase and store only the amount of pesticide needed for the immediate future.
- o In the event of a spill, ensure that this cleaned up immediately.
- o Follow recommended mowing technique to maintain a healthy pest-resistant turf, and therefore reduce the amount of pesticides required.
- o Develop and follow an Integrated Pest Management Guidelines this should outline the times when treating pests and other turf problems will be most effective and environmentally sound. This could include like recommendations for mowing time, and also could include the results from the investigation of non-chemical options for pest control.

- o Monitor the water quality in the wells that will provide water for irrigation of the golf course to ensure that the levels of saline intrusion are not exceeded. These wells should be secured from public domain so that persons do not utilise the water in these wells for potable use.
- o Ensure that artificial lighting does not directly illuminate the beach area. If lights are to be used in this area they should be low pressure sodium lights that are no higher than 4 m above the ground.

8.0 SOCIO - ECONOMIC IMPACT ASSESSMENT

This section outlines the methodology used for predicting the socio-economic impacts of the project and the identification of subsequent mitigation measures recommended for each impact identified. The cost for each mitigation measure has been quantified and is presented in the **Table II** in the Executive Summary found in the first section of the report.

METHODOLOGY

A socio-economic impact identification matrix was developed which covered the main potential impacts (positive, negative, major, minor, long and short term and any cumulative or synergistic impacts) of the project. The matrix lists impact types under broad headings with more detailed project specific impact categories. These impacts are divided into the Site Preparation, construction and operation phases of the project. See **Appendix 8** for the Socio-Economic Impact Identification Matrix.

8.1 SOCIAL STRUCTURE

8.1.1 DEMOGRAPHY

A. SITE PREPARATION AND CONSTRUCTION PHASES

The inflow of workers who choose to reside in the community during these phases of the development may not have any impact on the demography of the area. The numbers of workers anticipated to be employed in these phases is estimated at x workers who will be directly employed in these phases. This number of workers will not necessarily have an impact on demography on a community which currently shows no evidence of overcrowding. To ensure that this is not impacted the developer should employ the mitigation measure outlined below.

Mitigation Measure:

- o As far as possible employ persons from the surrounding communities during this phase of the development to reduce the numbers of persons that will migrate to the area seeking employment.

B. OPERATION PHASE

The changes in the demography of the area is not likely to increase due to the operation of phase of the golf course as it is anticipated that this phase of the development will employ approximately forty (40) persons. There is currently no evidence of overcrowding in around the development area and therefore there will be minimal variations on its demography.

These population growth rates in the area are not expected to be consistent in the future however, as there has been a significant increase in the number of approved and proposed development for the parish of Trelawny. A championship stadium was completed in the parish early in 2007 and there has been an increase in housing developments in the area. Future development for the parish includes the other components of the Amaterra Development Plan, the Harmony Cove Development and it is also rumoured that another large local hotel chain has development for the area in the pipeline as well. These proposed developments will serve to attract migrants to the area who will be seeking employment. The urban sprawl that is affecting the city of Montego Bay may also be a factor in the increase in population in the parish as persons seek housing solutions close to St. James. The increase in the growth rate may also be influenced by the improvement in the road conditions in the parish, and therefore the transportation network, making Trelawny a parish where workers in the adjacent parishes of St. Ann and St. James may choose to reside.

Mitigation Measures:

- o As far as possible employ persons from the surrounding communities during this phase of the development to reduce the numbers of persons that will migrate to the area seeking employment.
- o The Local Planning Authority must ensure that development within the parish, and the areas surrounding the development area takes place in an orderly and sustainable manner.

8.1.2 COMMUNITY COHESION

A. SITE PREPARATION AND CONSTRUCTION PHASES

The level of the community cohesion is low, outside of the churches which are the common meeting places for residents in the areas. The development of the golf course may increase the level of community cohesion if members of the community become actively involved in the process from the onset.

Mitigation Measures:

- o As far as possible ensure that there is community involvement in the golf course design and implementation.
- o As far as possible employ persons from the surrounding communities during these phases of the development.

B. OPERATION PHASE

The development of the golf course may also positively affect the fabric of the community in its operation phase. This may be enhanced with the implementation of the following mitigation measures.

Mitigation Measures:

- o The developer should develop a Corporate Social Responsibility Programme which could provide assistance to the community such as the construction of a community centre and develop golf programmes for youth in the community.

8.2 ECONOMIC STRUCTURE

8.2.1 EMPLOYMENT AND INCOME

A. SITE PREPARATION AND CONSTRUCTION PHASES

Based on the results of the socio-economic assessment, the unemployment rates in the area are very low. The residents polled in the area are however excited about the increase in job availability that the development of the golf course will bring. Any available jobs will be provide an immediate positive impact on the employment and income situation at the level of the study area as well as at the parish and national levels. This phase of the

development will provide the most benefits in terms of sustained employment and increase in income. Initially, the site preparation phase will employ specific vehicles and equipment in order to clear vegetation, for landscaping and grading and levelling and the cutting of access roads for these vehicles and labourers to access the site. This will initially mean many skilled workers will be necessary to operate front-end loaders, excavators, bulldozers and backhoes and other vehicles. In addition to this unskilled labourers will still be necessary for other tasks. It is anticipated that approximately eighty-five (85) jobs will be directly created by the development during these phases.

The immediate area and surrounding communities may not have the pool of workers that are necessary to man these vehicles or marshal the site clearing work. If this is the case, then although the benefits to the community can still be seen in the use of unskilled labourers the major benefits may be seen more in the knock-on effects that accrue, such as vendors and the various shops in the area supplying the workers with meals and refreshments or the ingredients for such. This phase of the development will therefore have a short-term major positive impact on the employment and income at the local level.

Mitigation Measures:

- o As much as is possible it is recommended that persons from the nearby communities be employed to work on the construction site. This will avoid any feelings of resentment and will ensure that the community derives the most benefits from the development.
- o As far as possible purchase supplies to be used in the construction of the golf course from nearby suppliers.
- o Identify a specific area on the project site for vending type activities ensuring that there are garbage receptacles throughout the project site.

B. OPERATION PHASE

This phase of the development will also have a major positive impact on the employment and income generating opportunities both locally and nationally over the long-term. The operation of the golf course will mean that jobs will be available for turf maintenance workers, workers in the clubhouse and workers for general operation of the golf course. It is anticipated that this phase of the development will see the creation of approximately sixty

(65) jobs in the area. There will also be an increase in the demand for good and supplies to be used in the operation of the golf course.

The development of a championship golf course will also create a major \$ US generation for the area, as this will attract more visitors. The golf course will play an essential part in the attraction of these visitors which will increase the foreign revenue both locally and nationally.

This development will also have a cumulative effect, as the operation of the golf course will likely attract other business interest in the area which seeks to capitalise on the increase in visitor numbers to the parish. Being one of the first golf courses in the parish, the development will be a pre-cursor to other investors in the area, which therefore means a major positive impact on the employment and income both locally and nationally.

Mitigation Measures:

- o As much as is possible it is recommended that persons from the nearby communities be employed to work during the operation of the golf course. This will avoid any feelings of resentment and will ensure that the community derives the most benefits from the development.
- o As far as possible purchase goods and supplies from suppliers within the area to ensure that the community reaps the maximum benefit from the development.
- o The Local Planning Authority must play an important role in ensuring that the development slated for the area is monitored and implemented in an orderly and sustainable manner.

8.3 INFRASTRUCTURE

8.3.1 ROAD NETWORK

A. SITE PREPARATION AND CONSTRUCTION PHASES

These phases of the development may have a major negative impact on the present road network in the study area. The roads in their current states may not be able to handle the increase in heavy-duty equipment traffic. There are some roads which are impassable by regular motor vehicles.

Mitigation Measures:

- o The developer must improve the road network which provides access to the project area. This should be accompanied by an upgrade in the drainage along this road network. Ideally the road improvement works should take place prior to the infrastructural works at the development site.
- o These road improvements must be scheduled between 9:00 a.m. and 4:00 p.m. daily, so as not to disrupt traffic in the area and to abate the increase in ambient noise levels in the community.

B. OPERATION PHASE

The operation phase of the project may have a major negative impact on the road network in the area as the volume of traffic associated with the development of the golf course will be significantly increased, therefore placing a strain on the road network which needs current improvement.

Mitigation Measure:

- o Ensure that roads are regularly maintained.

8.3.3 UTILITIES**8.3.3.1 ELECTRICITY****A. SITE PREPARATION AND CONSTRUCTION PHASES**

These phases of the development will not have an impact on the electricity supplying the area.

B. OPERATION PHASE

This phase of the development will not have any impact on the electricity consumption in the area as the operation is not an energy intensive one. The developer should however implement the mitigation measures outlined below to reduce the energy bill of the golf course and its auxiliary activities.

Mitigation Measures:

- o Install energy saving lights within the club house and other buildings;
- o Ensure that a back-up generator is installed for use in periods of power outages. As far as possible a 'silenced' generator should be installed.
- o Utilise solar panels for equipment such as water heaters and lighting around the golf course;
- o Lights that are not operated by solar power should be fixed with light sensors to regulate the duration of on-time for these lights;
- o Ensure that clubhouse is designed in such a manner that there is reduction in the energy use associated with the operation of air conditioning units; and
- o Train golf course operation employees in the benefits of energy conservation.

8.3.3.2 WATER AVAILABILITY**A. SITE PREPARATION AND CONSTRUCTION PHASES**

Water is relatively scarce commodity within the area. These phases of the development will place a strain on an already limited supply through the construction of buildings and other infrastructural works proposed for the golf course development. The impact on water availability will therefore be negative, minor and short-term.

Mitigation Measures:

- o Ensure that there is adequate water available to supply the increase in demand that the construction activities will pose. It may be necessary for the upgrading works by the National Water Commission (NWC) to be undertaken prior to the start of the construction of the golf course.

B. OPERATION PHASE

The operation phase of the golf course will place an immense strain on the water availability in the area. Based on the evaluation of water availability in the area this supply will not be able to supply the volume of water which is required for the operation of the golf course and the auxiliary activities. Even with the use of recycled water and run-off for irrigation, the current supply will not be sufficient for the operation of the golf course. The

increase in other income generating activities in the area will have a cumulative major negative impact on already limited supply. This phase of the development will therefore have a major negative long-term impact on the water availability in the area.

Mitigation Measures:

- o Ensure that there is an upgrade to the water supply in the area prior to the operation of the course;
- o Water consumption during this phase can be reduced with the installation of water conservation fixtures in buildings, the maximising of recycled water in the irrigation activities , the frequent maintenance of irrigation systems to be installed along the golf course and a the conducting of training for golf course workers on the importance of water conservation.

8.3.3.3 TELECOMMUNICATIONS

A. SITE PREPARATION AND CONSTRUCTION PHASES

These phases of the development will not have an impact on the telecommunication services in the area.

B. OPERATION PHASE

The development may have a major positive impact on the telecommunications services available in the area. The development of a championship golf course may see an addition of other services such as ADSL to the area.

Mitigation Measure:

- o Liase with the telecommunications provider from the early stages of the development so that infrastructure work can be integrated with road upgrade works if necessary.

8.4 WASTE

8.4.1 SOLID WASTE

A. SITE PREPARATION AND CONSTRUCTION PHASES

A significant amount of solid waste will be generated in this phase through the clearing of vegetation for construction. This will therefore have a major negative short-term impact on solid waste collection in the area as currently the collection is limited to a once per week schedule. This current schedule will not be able to handle the removal of the solid waste which is expected to be generated during this phase of the development.

Mitigation Measures:

- o The developer should seek to hire a private licensed solid waste collection company to reduce the impact on the local collections services.
- o All the refuse generated from this phase of the development should be properly transported and disposed of at the nearest licensed solid waste facility.
- o Ensure that vending during these phases of the development is localised.
- o Provide garbage receptacles around the project site.
- o Ensure that all debris and garbage generated during this stage of the development is placed in a central place on the project site and collected by a licensed garbage disposal company who will deposit at the approved disposal site.

B. OPERATION PHASE

The operation phase of the development will have a major long-term negative impact on the solid collection in the area. Solid waste will be generated from the restaurants and activities conducted at the clubhouse. The accumulation of solid waste can cause the proliferation of domestic pests such as rats (*Rattus norvegicus* and *Rattus rattus*). Rats are also vectors for many diseases including leptospirosis, which very recently was a problem in the parish of Trelawny where this survey was undertaken. These vermin are very destructive and can rapidly multiply especially where garbage collection is infrequent and therefore food is abundant. This phase may also encourage stray animals such as dogs which can be nuisance species because they may bring with them ecto-parasites such as

fleas (*Ctenocephalides canis*) and ticks (*Ixodes sp.*), which can create health problems for domestic pets.

Solid waste will also be generated from the maintenance of turf. This will be in the form of grass clippings and other debris generated from maintenance activities. Pesticides and fertilizer packaging may be a potentially hazardous waste if not disposed of properly.

Based on the volume and nature of the waste to be generated at the site, the current solid waste collection mechanism which is in place will not be able to handle the solid waste which will be generated from the operation of the golf course. The impact from this development will also have the cumulative effect on the attraction of other business interests which will also place a strain on the solid waste collection in the area.

Mitigation Measures:

- o The developer should seek to hire a private licensed solid waste collection company, who will collect solid waste at least five (5) times per week to reduce the impact on the local collections services.
- o All refuse and debris generated from this phase of the development should be properly transported and disposed of at the nearest licensed solid waste facility.
- o All containers which were previously used to store pesticides and other chemicals should be bored with holes to ensure that these containers are not reused.

8.4.2 SEWAGE EFFLUENT

A. SITE PREPARATION AND CONSTRUCTION PHASES

A number of persons will be employed throughout these phases of the development and hence there will be generation of sewage. If not properly disposed of and treated the sewage may have a short-term, minor negative impact on surface and groundwater quality in the area, as well as affecting general human health of workers.

Mitigation Measures:

- o Ensure that chemical toilets are provided for use by employees during these phases of the development. A reasonable ratio would be one (1) chemical toilet per eight (8) workers.

B. OPERATION PHASE

Sewage will be generated by employees of the golf course and its auxiliary activities such as the club house and maintenance, as well as visitors to the development. Sewage that is not properly treated and not disposed of adequately poses may pose a major threat on surface and ground water quality. This may also have a major impact on human health.

Mitigation Measure:

- o The developer should ensure that all sewage treatment plants are maintained regularly and that all effluent released is within or below the irrigation standards for effluent as stipulated by the Natural Resources Conservation Authority (NRCA). (See **Section 11** for Effluent Standards)

8.5 SOCIAL SERVICES

8.5.1 HEALTH SERVICES

A. SITE PREPARATION AND CONSTRUCTION PHASES

There may be an influx of workers for these phases of the project. It is however anticipated that most of these workers will be recruited from within the project area and therefore these phases of the project will have a no impact on the Health Services in the area.

Mitigation Measures:

- o Provide a First Aid Kit on site for any minor injuries that may occur on site.
- o Inform and make arrangements with the nearest Health Clinic to accommodate any major injuries that may occur in these phases of the project.

B. OPERATION PHASE

The operation phase of the project will have no impact on the health services in the area.

Mitigation Measure:

- o Ensure that a fully functional medical station is implemented in the design which will be able to attend to medical needs of staff and patrons.

8.5.2 EMERGENCY SERVICES

8.5.2.1 FIRE SERVICES

The site preparation and construction phases may have a minor negative impact on the fire services in the area. The storage of diesel and other flammable substance for the use in machinery used in this phase of the development poses the possibility of fires. This is increased by the climatic factors such as levels of rainfall and wind speeds and the presence of large vegetated areas within the development. The impact of a fire is increased due to the location of the nearest fire station 13 km away.

A. SITE PREPARATION AND CONSTRUCTION PHASES

Mitigation Measures:

- o Burning should not be employed as a method of in the site preparation activities;
- o Bund areas where flammable substances will be stored. These bunds must be designed to hold approximately 1 ½ times the amount of the substances that will be stored;
- o Place warning signs in areas where flammable substances will be stored;
- o Erect signs which include the numbers of the Falmouth Fire Station within the construction site

B. OPERATION PHASE

The operation phase of the project may have a minor negative long-term impact on the Fire Services in the area. Copious amounts of chemicals will be stored onsite for the maintenance of the turf. These substances are mostly flammable and increase the susceptibility of the area to fires. In addition the use of propane for cooking and other activities at the clubhouse also increases the susceptibility for fires to occur. Mitigation measures have been identified for fire prevention and these are discussed in **Section 9.1**.

8.5.2.2 POLICE SERVICES

A. SITE PREPARATION AND CONSTRUCTION PHASES

Violence at construction sites in Jamaica is a common problem and with construction expected to take up to two (2) years to complete, the potential for crime and violence occurring may become evident. Therefore these phases of the development may affect have a minor negative, short term effect on the levels of crime and violence in the area and therefore have an impact on the police services in the area.

Mitigation Measures:

- o As much as is possible it is recommended that persons from the nearby communities be employed to work on the construction site. This will avoid any feelings of resentment that may be felt from locals and may reduce the level of crime and violence during these phases of the development.
- o Despite the added expense it is recommended that there be adequate security present at the site at all times during these phases.

B. OPERATION PHASE

The golf course will be a major income earner for the Amaterra Development and it is therefore expected that large sums of money will be handled at the site daily. This may attract criminal elements to the site and also increase the level of crime and violence in the surrounding communities. This possible surge in crime and violence may place a strain on the police services that are responsible for the area. In order to ensure the safety of the workers and patrons of the golf course development, it is recommended that the following mitigation measures be implemented.

Mitigation Measures:

- o Ensure that all buildings are properly secured ;
- o Ensure that perimeter fencing and lights are installed around the development site;
and
- o Ensure that there is adequate private security on site at all times.

8.5.3 TRANSPORTATION

A. SITE PREPARATION AND CONSTRUCTION PHASES

Access to public transportation is currently not a problem within the development area. This is further enhanced by the close proximity to the North Coast highway. This stage will therefore not have an impact on the transportation network in the area.

B. OPERATION PHASE

The increase in the population numbers of the development may have a minor positive impact on the transportation options of the study area, as the development may encourage a bus route to open up within the area. Persons would therefore be able to travel more freely between the community and the rest of the island. On the other hand, more workers may have an impact on the transportation system if this does not materialise.

Mitigation Measure:

- o The developer may wish to implement a transportation system for workers, in the event that as access to transportation becomes a problem for workers.

9.0 HAZARD IMPACT ASSESSMENT

A Hazard Impact Assessment (HIA) was undertaken to analyse the probability and magnitude of hazards directly associated with the Site Preparation, Construction and Operation phases of the development. It also includes an analysis of the vulnerability of the development to naturally occurring hazards and estimates the magnitude of these hazards. This process also includes an appraisal or evaluation of the hazards identified and the identification of recommendations on how to mitigate the effect of these hazards.

This section outlines the methodology used for the identification of the hazards and their magnitude associated with the project. Recommendations have been made to mitigate the effects of each of the hazards identified. The cost for each mitigation measure has been quantified and is presented in the **Table III** in the Executive Summary found in the first section of the report.

Methodology

A hazard analysis matrix was developed which included the main potential hazards associated with project activities as well as those caused by forces of nature. The results of this were used to differentiate between the hazards, which posed a high and moderate risk to the project. The matrix lists hazard types under broad headings with more detailed project specific categories. This can be seen in **Appendix 8**.

9.1 TECHNOLOGICAL HAZARDS

Fire and explosions may be described as Technological Hazards, which can cause serious injury or result in loss of life and damage to vegetation. The area being dry and heavily vegetated makes it more susceptible to the occurrence of a fire, which may spread rapidly. Being located along the coast allows it to be predisposed to varying wind speeds, which area greatest in the months of June and July and can exacerbate the effects of a fire.

A. SITE PREPARATION AND CONSTRUCTION PHASES

Flammable substances including diesel and motor oil may be stored or used on the project site for heavy-duty equipment. These substances are precursors for fires and explosions,

which may range from small incipient to larger fires of great intensity, which generates heat causing damage to property, injuries or loss of human life.

Mitigation Measures:

- o Provide all employees with safety and protective gear including hard hats, safety goggles, dust masks, gloves and safety shoes. Employees will be required to wear these at all times on the project site.
- o Designate the roles and responsibilities of employees, which will enable a clear chain of command during a fire or explosion and allows persons to be aware of their responsibilities in the event of such occurrences.
- o Ensure that all machinery used on the site is properly maintained and inspected before use.
- o Install several suitable, approved fire extinguishers at accessible, conspicuous and unobstructed points throughout the development area.
- o Place a fully equipped first aid kit on the project site.
- o Place conspicuous warning signs where hazardous or flammable substances will be stored.
- o Where flammable substances will be stored, this should be done in a bunded area which is able to contain 1 ½ times the substances that are stored on site. Different chemicals must not be stored in the same bund.
- o Place information signs around the project site, which list the numbers of the person responsible for handling emergencies on the site, the Falmouth Fire Department, and the Falmouth hospital.
- o Keep an emergency log to document any occurrences of fires and explosions as well as to record any damage to the property and human injuries. This log must also contain emergency contact information for all employees.

B. OPERATION PHASE

In this phase of the development, large volumes of chemical substances used in the maintenance of the golf course will be stored on the property, most of which are highly flammable. In addition the operation of the restaurant at the clubhouse will mean the

storage of LPG on site which is also highly flammable, which may increase the vulnerability of the operation to a fire or an explosion.

Mitigation Measures:

- o Only purchase the amount of chemicals that will be used in the short-term.
- o The developer must inform the Local Fire Department about the project so that measures may be put in place in anticipation of the increase demand on the fire services.
- o Designate the roles and responsibilities of employees, which will enable a clear chain of command during a fire or explosion and allows persons to be aware of their responsibilities in the event of such occurrences.
- o Ensure that all machinery used on the site is properly maintained and inspected before use.
- o Install the LPG tank in a secure location. This should be delimited by a fence which should have warning signs which are visible from all vantage points.
- o Install several suitable, approved fire extinguishers at accessible, conspicuous and unobstructed points throughout the clubhouse and the maintenance area.
- o Place conspicuous warning signs where hazardous or flammable substances will be stored.
- o Where flammable substances will be stored, this should be done in a bunded area which is able to contain 1 ½ times the substances that are stored on site. Different chemicals must not be stored in the same bund.
- o Place information signs around the project site, which list the numbers of the person responsible for handling emergencies on the site, the Falmouth Fire Department, and the Falmouth hospital.
- o Keep an emergency log to document any occurrences of fires and explosions as well as to record any damage to the property and human injuries. This log must also contain emergency contact information for all employees.

9.2 ACCIDENTS/GENERAL HUMAN HEALTH

Due to the nature of development accidents may be possible. These may occur during the all stages of the development. These accidents often happen unexpectedly and

unintentionally and can result in the loss of life and injuries, as well as damage to property. In addition it is very important that the developer considers the health and safety of its workers and visitors as the golf course operation will involve the use a significant amount of chemicals and raw materials in its maintenance.

A. SITE PREPARATION AND CONSTRUCTION PHASES

The probability of an accident occurring at the project site during these phases of the development is high. This is due to the intense use of machinery and other heavy-duty equipment used in this phase.

The levels of dust in the area is also likely to increase, which may cause respiratory illnesses in humans. It is therefore important that the mitigation measures outlined below are implemented to ensure the safety of staff members during these phases of the development.

Mitigation Measures:

- o Provide all employees with safety and protective gear including hard hats, safety goggles, dust masks, gloves and safety shoes. Employees will be required to wear these at all times on the project site.
- o Designate the roles and responsibilities of employees, which will enable a clear chain of command in the event of an accident and allows persons to be aware of their responsibilities in the event of such occurrences.
- o Place a fully equipped first aid kit on the project site. Ensure that a crew member is trained in basic first aid practices.
- o Place information/warning signs around the project site, which indicates where hazardous and flammable material will be stored. Signs must also be placed around the construction site displaying the numbers of the person responsible for handling emergencies on the site, the Falmouth Fire Department, and the Falmouth hospital.
- o Keep an emergency log to document any occurrences of any accidents that may occur on the site. This log must also contain emergency contact information for all employees.
- o Ensure that all machinery operating at the project is regularly serviced and maintained.

- o Ensure that persons operating equipment on the site are authorised, capable and trained to do so.
- o Liase with local health clinics informing them of the development so that measures may be put in place in anticipation of the increase demand on the health services

B. OPERATION PHASE

Accidents will happen whether by human error or failure of machinery. Therefore the probability of an accident happening during this stage of the development is high. Copious amounts of hazardous chemicals will be stored and used in the maintenance of the golf course. It is therefore imperative that measures be implemented to ensure the safety of workers and guests of the facility.

Mitigation Measures:

- o Ensure that there is a fully operation medical station which will be able to attend to both guests and workers on site;
- o Ensure that workers with the responsibility in the maintenance area are supplied with safety gear and will be required to wear these at all times;
- o Ensure that only the required amounts of chemicals to be used in the short-term will be stored at the maintenance facility;
- o Ensure that chemicals are stored in a safe and secure environment, and that only authorised persons will be allowed in these storage areas. These areas should be properly signed to indicate that hazardous chemicals are stored in this area;
- o Ensure that pesticides and fertilisers are administered only by trained personnel;
- o Develop and implement a Health and Safety Training Manual for the golf course for employees of the golf course;
- o Do not apply pesticides, fertilizers or irrigate the golf course during opening hours;
- o Ensure that there are 'no-spray' zones within the golf course and that staff is trained to identify these areas;
- o Develop and implement and health and safety training manual for staff;
- o The golf course will be irrigated by several sources of water including the treated effluent from two (2) of the sewage treatment plants on site. It is important that the effluent maintains the irrigation standards as stipulated by the Natural Resources Conservation Authority (NRCA), to ensure that the health of guests and workers is

not compromised. Where recycled water is stored in water features throughout the golf course, this should be properly labelled in several languages to indicate that the water has been recycled and not suitable for human consumption. Purple has been tagged as the universal colour for signs in places where recycled water is stored ;

- o Bore holes in containers which were previously used to store pesticides and other chemicals to prevent re-use. All pesticide packaging should be collected and disposed of by a licensed waste disposal operator.

9.3 NATURAL HAZARDS

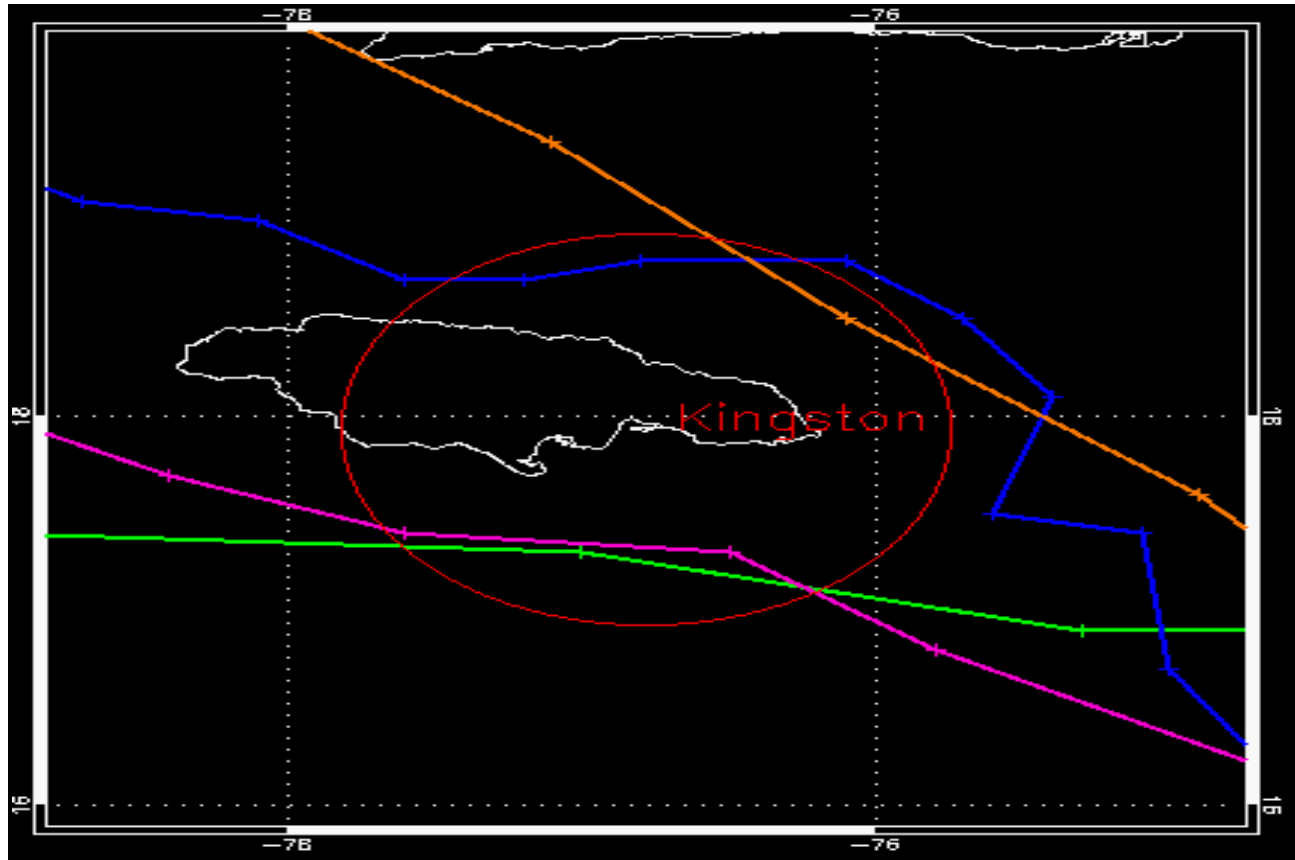
Because of Jamaica's location, geology and geography the island is prone to a range of natural hazards including those of a meteorological and geological nature. The major threats include hurricanes, tropical storms, floods, land slippage and earthquakes. These hazards can cause damage to property, injuries of varying severities and loss of human life.

9.3.1 METEOROLOGICAL HAZARDS

9.3.1.1 HURRICANES AND TROPICAL STORMS

Jamaica being in the North Atlantic Hurricane Belt is very susceptible to hurricanes. Between June and November each year Jamaica enters the "Hurricane Season". Hurricanes usually bring very inclement weather conditions including strong winds, and heavy rainfall, which can lead to flooding. Jamaica's location also makes its susceptible to Tropical storms which may have the same effects but to a lesser extent. The project is located along the coast and therefore the effects of a hurricane or tropical storm may be greater as compared to inland areas. The frequency of hurricanes affecting the island have increased in the past number of years with two major hurricanes (Felix and Dean) and tropical storm Noel affecting the island in 2007. The tropical storms and hurricanes affecting the island between the years 2000 to 2006 are shown in **Map 10** below. Although all areas of the development may be affected in the event of one of these disasters, holes (15 & 16) which are closest to the coast may be the most affected.

Map 10: Tracking Map showing the Tropical Storms/Hurricanes that have affected Jamaica between 2000-2006



KEY	Name of Hurricane/Tropical Storm	CATEGORY	DATE
—	Hurricane Iris	1	October 7, 2001
—	Hurricane Ivan	5	September 11, 2004
—	Hurricane Dennis	3	July 7, 2005
—	Tropical Storm Lili		September 29, 2002

A. SITE PREPARATION AND CONSTRUCTION PHASES

There is a high probability that the area will be susceptible to hurricanes and tropical storms. The effects of these can be reduced however by carrying out the activities outlined below.

Mitigation Measures:

- o Relocate all mobile machinery and equipment to suitable storage facilities.
- o Ensure that any loose roofing material is securely fastened prior to the hurricane.

- o Keep a logbook and record all damage that may have occurred after the hurricane.
- o Do not use electrical or mechanical machinery after the hurricane without proper inspection.
- o Remove all stockpiled material (aggregate and sand) and move to proper storage facilities.
- o Evacuate all project personnel from development site.
- o Ensure that holes to be located along the coast are designed so that they have sufficient elevation to take into account the possibility of storm surges associated with tropical storms and hurricanes as well as sea level rise which is thought to be a repercussion of climate change.

B. OPERATION PHASE

There is a high probability that the area will be susceptible to hurricanes and tropical storms due to the location of the island of Jamaica. The removal of vegetation, namely trees may exacerbate the effects that may be caused by a hurricane and/or tropical storm.

Mitigation Measures:

- o Relocate all mobile machinery and equipment to suitable storage facilities.
- o Ensure that any loose roofing material is securely fastened prior to the hurricane.
- o Keep a logbook and record all damage that may have occurred after the hurricane.
- o Ensure that all raw materials used in the maintenance of the golf course are properly secured and that the area is sufficiently bunded to ensure that there is containment in the event of an accident.
- o Do not apply fertilizers or pesticides prior to a hurricane as intense periods of rain may increase run-off and therefore may cause possible contamination of adjacent water resources.
- o Following the hurricane water quality monitoring should be conducted on all water ways and ambient waters in the vicinity of the golf course.

9.3.2 EARTHQUAKES

Jamaica lies in a high-risk earthquake zone. Earthquakes can cause loss of human life and injuries as well as causing damage to infrastructure. The study area is dominated by hard

lithologies such as the limestone that are typically associated with lower ground shaking during an earthquake. On the other hand, superficial deposits (e.g. sand and gravel) generally respond more aggressively. Close to the coast where there may be a low to moderate build up of superficial deposits and where the water table is demonstrably high, requires further evaluation regarding liquefaction potential. This would be standard with any major infrastructure development.

Earthquakes are not predictable therefore proper preparation prior to an earthquake is necessary to mitigate the effects of this natural disaster if one must occur. With the implementation of the mitigation measures outlined below the effects of an earthquake can be reduced both in the construction and operation phases of the development.

A. SITE PREPARATION AND CONSTRUCTION PHASES

Mitigation Measures:

- o Ensure that employees are aware of the precautions to take during an earthquake;
- o Ensure that staff at the construction site is aware of the measures to be implemented during an earthquake;
- o Designate the roles and responsibilities of employees, which will enable a clear chain of command in the event of an accident and allows persons to be aware of their responsibilities in the event of such occurrences;
- o Place a fully equipped first aid kit on the project site;
- o Place information signs around the project site, which list the numbers of the person responsible for handling emergencies on the site, the Fire Department, and the Falmouth hospital;

B. OPERATION PHASE

Mitigation Measures:

- o Ensure that employees are aware of the precautions to take during an earthquake.
- o Ensure that staff at the construction site is aware of the measures to be implemented during an earthquake.

- o Designate the roles and responsibilities of employees, which will enable a clear chain of command in the event of an accident and allows persons to be aware of their responsibilities in the event of such occurrences.
- o Place a fully equipped first aid kit on the project site;
- o Place information signs around the project site, which list the numbers of the person responsible for handling emergencies on the site, the Fire Department, and the Falmouth hospital;
- o All areas which are used for storage where chemicals are stored for use in the maintenance of the golf course should be checked for damage, leaks and spills;
- o All hazardous chemicals must be stored should be banded to hold 1 ½ times the amount of chemical stored ;
- o All spills should be cleaned up immediately and all hazardous waste disposed according to regulations.

9.3.2 LANDSLIDES

A. SITE PREPARATION AND CONSTRUCTION PHASES

Due to the indurated (hard) nature of most of the limestone units, coupled with the low to moderate gradients on much of the development site, the landslide potential is considered low.

Mitigation Measure:

- o Retain vegetation along steep slopes, which will assist in maintaining the current slope stability, and lessen the potential for erosion at the development site.

10.0 DRAFT MONITORING PLAN

This section of the report aims to present a Draft Monitoring Plan for golf course development. This monitoring plan has been developed to ensure that the environmental and socio-economic mitigation measures that have been recommended are implemented and are effective, as well as to identify any unanticipated impacts that might arise as a result of the project. The draft implementation schedule for this monitoring plan for the next four (4) years is shown in **Table 20** below.

10.1 ENVIRONMENTAL PARAMETERS

10.1.1 AIR QUALITY

The development may have a negative impact on the air quality in the area during the Site preparation, Construction and to a lesser extent in the Operation Phase of the development. The main impacts to air quality during the Site preparation Construction phases will be due to the increase in dust and the increase in the vehicular traffic. It is therefore necessary to monitor the PM₁₀, NO_x and SO_x levels in the area at different intervals during these phases to ensure that the levels of these pollutants remain within the Natural Resources Conservation Authority's (NRCA) National Ambient Air Quality Standards (2002) as outlined in **Table 35** below. Although Jamaica has its own standards values recorded can also be compared with the World Health Organisation's (WHO) air quality standards as well, shown in **Table 36** below. Although the Operation Phase is not expected to have a major impact on air quality, it will be necessary to intermittently monitor the air quality of the area to ensure that the levels of pollutants in the area are within the air quality standards.

Table 35: Table showing the Jamaica National Ambient Air Quality Standards

POLLUTANTS	STANDARDS $\mu\text{g}/\text{m}^3$					
	Annual		24 hr		1 hr	
	1 ^o	2 ^o	1 ^o	2 ^o	1 ^o	2 ^o
PM ₁₀	50		150			
SO _x	80	60	365	280	700	
NO _x	100					

Source: NAAQS (2002)

Table 36: Table showing the World Health Organisation's (WHO) Air Quality Guidelines

Pollutant	Averaging Time	Standard ($\mu\text{g}/\text{m}^3$)
PM ₁₀	Annual	20
	24-hour	50
NO ₂	Annual	40
	1-hour	200
SO ₂	24-hour	20
	10-minute	500

Source: World Health Organisation (2007)

10.1.2 NOISE AND VIBRATION

Noise and Vibration levels will have to be monitored especially during the construction phase due to the use of heavy-duty construction machinery as well as the increased traffic to the area. It is therefore imperative that the noise and vibration of the area is monitored to ensure that the standard ambient noise levels are not exceeded. The World Health Organization (WHO) has released various guidelines for community noise. One such figure is 50dB LA_{eq} for outdoor living areas, although it suggests that this value can be up to 55dB LA_{eq} in some circumstances. The standards which may be used in the monitoring activities are shown in the table below.

Table 37: Noise standards and Guidelines from The United States Environmental Protection Agency, the World Health Organisation and the European Commission

ORGANIZATION	INDUSTRIAL AREA	COMMERCIAL AREA	RESIDENTIAL AREA	SILENCE ZONE
	Day / Night	Day / Night	Day / Night	Day / Night
U.S.(E.P.A.)	70	60	55	45
W.H.O. & E.C.	65	55	55 / 45	45 / 35

10.1.3 WATER

10.1.3.1 WATER QUALITY – TERRESTRIAL (SURFACE AND GROUNDWATER) AND MARINE

The development in both the construction and operation phase may have a major long-term negative impact on the water quality (surface, groundwater, terrestrial and marine) in the areas. It is critical that the water quality in all these areas be monitored consistently to

ensure that they are in keeping with the required standards as stipulated by the Natural Resources Conservation Authority (NRCA). No standards have been developed for marine water quality; therefore the United States Environmental Protection Agency's (EPA) standards may be used during the monitoring exercise for comparison.

Table 38: Table showing the Natural Resources Conservation Authority's (NRCA) Ambient Freshwater Standards for Jamaica

PARAMETER	MEASURED AS	STANDARD RANGE	UNIT
Calcium	(Ca)	40.00-101.0	mg/L
Chloride	(Cl ⁻)	5.00- 20.0	mg/L
Magnesium	(Mg ²⁺)	3.60- 27.0	mg/L
Nitrate	(NO ₃ ⁻)	0.10- 7.5	mg/L
Phosphate	(PO ₄ ³⁻)	0.01 - 0.8	mg/L
pH	(-)	7.00- 8.4	-
Potassium	(K ⁺)	0.74- 5.0	mg/L
Silica	(SiO ₄ or Si ₂ ⁺)	5.00- 39.0	mg/L
Sodium	(Na ⁺)	4.50- 12.0	mg/L
Sulfate	(SO ₄ ²⁻)	3.00- 10.0	mg/L
Hardness	(CaCO ₃)	127.00-381.0	mg/L (as CaCO ₃)
Biochemical		0.80- 1.7	mg/L
Conductivity		150.00-600	ΦS/cm
Total Dissolved Solids		120.00-300	mg/L

Table 39: Marine Water Quality Standards

PARAMETER	*EPA STANDARDS	**NRCA STANDARDS
BOD (mg/L)	1.18 mg/L	
DO (mg/L)	4.8 mg/L	
Nitrate (mg/L)	0.081 mg/L	
O-Phosphate (mg/L)	0.055 mg/L	
TSS (mg/L)		< 10 mg/L

Water from two (2) of the sewage treatment plants will be used for the irrigation of the golf course. In order to maintain the water quality in the adjacent water features, it is imperative that the effluent must be monitored to ensure that the effluent is meeting the required

effluent irrigation standards as stipulated by the Natural Resources Conservation Authority (NRCA) which are shown in **Table 40** below.

Table 40: Table showing the Natural Resources Conservation Authority's Sewage Effluent Standards for Irrigation

PARAMETER	STANDARDS
Biochemical Oxygen Demand	15 mg/L
Total Suspended Solids	15 mg/L
Total Nitrogen	10 mg/L
Phosphates	4 mg/L
Chemical Oxygen Demand	100 mg/L
PH on site	6-9
Faecal Coliform	12 MPN/100mL.
Residual Chlorine	1.5 mg/L

10.1.3.2 WATER QUANTITY

A significant amount of water will be used in the daily operation of the golf course and its auxiliary activities. It is important therefore to ensure that the residents of the surrounding communities are not affected by this daily use of water and that adequate water is being supplied to these residents.

10.1.4 SOILS AND GEOLOGY

The soil quality and quantity at the development site has to be monitored especially during the construction phase of the development to determine the levels of soil erosion and the change in soil quality and chemistry. During the operation phase, soil chemistry has to be monitored periodically to determine the need for application of chemicals which will be used in the maintenance of the golf course in this phase.

10.1.5 ECOLOGY

It will be important to ensure that all mature trees, where possible are retained during the site clearance and construction phase of the development and that protected species such as the Jamaican Purple Orchid, and the Yellow Snake if observed are captured and released or placed at a National Environment and Planning Agency (NEPA) approved wildlife sanctuary. It will also be critical to ensure that where 'green-belts' are included in the golf course design, that these are sufficient to maintain the populations of animals that

will exist in the area during the development. Where fencing has been put in place for the delineation of these areas, it will be necessary to monitor these areas to ensure that there is not secondary encroachment into these forested areas. Ecological surveys should be undertaken to effectively assess the changes to the ecology of the area during the various stages of the development.

10.2 SOCIO - ECONOMIC PARAMETERS

The socio-economic parameters pertaining to the project will also have to be monitored to ensure that the mitigation measures recommended are offsetting any negative impact identified or enhancing positive socio- economic impacts. The implementation schedule for the monitoring of these parameters is shown in **Table 34** below.

10.3 HAZARDS

The hazards that may be associated with the project also need to be monitored consistently to ensure that all recommendations have been implemented to reduce the impact of these hazards. The implementation schedule for the monitoring of these hazards is shown in **Table 34** below.

TABLE 34: TABLE SHOWING THE IMPLEMENTATION SCHEDULE FOR THE MONITORING PLAN FOR THE PROPOSED DEVELOPMENT

PARAMETERS TO BE MONITORED	MONITORING SCHEDULE																PERSON RESPONSIBLE
	YEAR 1				YEAR 2				YEAR 3				YEAR 4				
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	
ENVIRONMENTAL PARAMETERS																	
Air Quality																	NEPA/DEVELOPER
Water Quality																	NEPA/DEVELOPER
Noise and Vibration																	NEPA/DEVELOPER
Ecology																	NEPA/DEVELOPER
Waste																	Developer/NSWMA/Local Authority/MOH
SOCIO-ECONOMIC PARAMETERS																	
Demography																	Local Planning Authority
Employment and Income																	Local Planning Authority
Crime and Violence																	Developer/ Community Group Police Force
Road Maintenance																	Developer/Local Planning Authority
HAZARDS																	
Technological Hazards																	Developer/Community Group/Local Fire Department
Accidents																	Developer/Community Group
Natural Hazards																	Developer/Community Group

11.0 CONCLUSIONS AND RECOMMENDATIONS

Several alternatives to the proposed construction of an eighteen (18) hole golf course were analysed. Based on this analysis from an environmental and socio-economic assessment the proposed project would present the best use of the area demarcated for the development.

Several major negative environmental impacts were identified that may arise from the project. This includes the wholesale clearing of a significant amount of undisturbed vegetation resulting in habitat loss and habitat fragmentation, which may have a negative impact on the species who occupy this area. Whilst the species identified in this area do not represent ones with a very high ecological value, their importance to the health of the ecosystem should not be discounted, as they all play very important roles in maintaining a balance in the ecology of the area. This impact will be further exacerbated by the cumulative impacts of the activities involved in the site preparation, construction and operation phases of the development as well as from the remaining activities planned for the area. Another possible major negative impact will be the impact to surface water both in the terrestrial and marine environments. This is of particular concern as the marine environment represents a moderately healthy ecosystem, which is not typical of areas along the north coast of the island. It is also thought that turtles utilise the beach as nesting sites which have been classified as endangered and protected species. Other major negative impacts include increase in ambient noise levels and impacts to air quality in the area, the most significant terms of the impacts will however be short-term.

The socio-economic benefits may however present a major positive long-term effect for the surrounding communities, the parish of Trelawny and nationally. The various activities planned within the development may provide a major economic boost for the area, which the parish of Trelawny has been aiming for, for a very long time. A significant amount of direct and indirect employment opportunities will be created, which will raise the standard of living, reduce the level of unemployment and enable a better way of life for the people of communities such as Kettering, Carey Park and Sterling Castle *inter alia*.

There will be negative, irreversible damage to the environment if this project follows through, but there will also be a major enhancement in economic growth and development for the country of Jamaica. It may be possible that development and environmental management can co-exist with the implementation of the mitigation measures that have been outlined in this report. Timely and consistent monitoring is the key to ensuring that the development is implemented and operated in a consistent and sustainable manner. The developer, all relevant agencies and the residents of the community all have a very important role in ensuring that sustainable development rings through in this development.

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13. APPENDICES

APPENDIX 1:

A. TERMS OF REFERENCE FOR THE CONDUCT OF AN ENVIRONMENTAL IMPACT ASSESSMENT (EIA) FOR A GOLF COURSE BY AMATERRA JAMAICA LTD.

The Environmental Impact Assessment (EIA) for the Golf Course will:

- 1) Provide a complete description of the existing site proposed for development. Detail the elements of the development, highlighting areas to be reserved for construction and the areas which are to be preserved in their existing state.
- 2) Identify the major environmental issues of concern through the presentation of baseline data, which should include social and cultural considerations.
- 3) Outline the Legislations and Regulations relevant to the project.
- 4) Predict the likely impacts of the development on the described environment, including direct, indirect and cumulative impacts, and indicate their relative importance to the design of the development's facilities.
- 5) Identify mitigation action to be taken to minimise adverse impacts and quantify associated costs.
- 6) Design a Monitoring Plan which should ensure that the mitigation plan is adhered to.
- 7) Describe the alternatives to the project that could be considered at that site

To ensure that a thorough Environmental Impact Assessment is carried out the following tasks will be undertaken:

Task #1: Description of the Project

The EIA will provide a comprehensive description of the project, noting areas to be reserved for construction and landscaping, areas to be preserved in their existing state as well as activities and features which will introduce risks or generate impact (negative and positive) on the environment. This will include the description of any imported material to be used on the golf course, the likely impacts of any invasive species and control methods if applicable will be discussed. This section of the report will also give information on the application rates that will be employed during the use of fertilizers, pesticides and insecticides for the maintenance of the golf course. Material Safety Data Sheets will also be provided for the pesticides and insecticides to be used. The use of treated effluent for the irrigation of the golf course, the type and level of treatment of the effluent and

application rate will also be discussed. This will involve the use of maps, site plans, and other graphic aids and images, as appropriate, and include information on location, general layout and size, as well as pre-construction, construction, and operation plans. For projects to be done on a phased basis it is expected that all phases should be clearly defined the relevant time schedules provided and phased maps, diagrams and appropriate visual aids be included.

Task #2 Description of the Environment:

This task will include the review of baseline data presented in the Strategic Environmental Assessment (SEA) completed in December 2005 for the development and conducting baseline assessments where data is lacking. This will include the review of the baseline data for the:

- i) Physical environment
- ii) Biological environment
- iii) Socio-economic and cultural constraints.

Where data is insufficient the consultant will conduct assessments to fill the gaps. This will include the detailed methodologies employed to obtain baseline and other data.

Baseline data that will be reviewed include:

(A) Physical

- i) A review of the existing **geology** and **hydrology**. Special emphasis will be placed on storm water run-off, drainage patterns, effect on groundwater and availability of potable water. Any slope stability issues that could arise will be thoroughly explored. Soil quality will also be analysed. Quality indicators will include but not necessarily be limited to pH, nitrates phosphates and other minerals.
- ii) **Water quality** of any existing wells, rivers, ponds, streams or coastal waters in the vicinity of the development. Quality Indicators will include but not necessarily be limited to nitrates, phosphates, faecal coliform, and suspended solids. The potential for pollution and/or contamination of sediment due to the lavish use of fertilisers in golf courses will be evaluated.

- iii) Noise levels of undeveloped site and the ambient noise in the area of influence.
- v) Obvious sources of pollution existing and extent of contamination.
- vi) Availability of solid waste management facilities.

(B) Biological

The flora and fauna (terrestrial and aquatic) of the area will be reviewed, with special emphasis on rare, endemic, protected or endangered species. Migratory species will also be considered. There may be the need to incorporate micro-organisms to obtain an accurate baseline assessment. Generally, species dependence, niche specificity, community structure and diversity will be considered.

(C) Socio-economic & cultural

Present and proposed land use; planned development activities, issues relating to squatting and relocation, community structure, employment, distribution of income, goods and services; recreation; public health and safety; cultural peculiarities, aspirations and attitudes will be explored. The historical importance of the area will also be examined. While this analysis is being conducted, it is expected that an assessment of public perception of the proposed development be conducted. This assessment may vary with community structure and may take multiple forms such as public meetings or questionnaires.

Task #3 - Legislative and Regulatory Considerations

The pertinent regulations and standards governing environmental quality, safety and health, protection of sensitive areas, protection of endangered species, siting and land use control at the national and local levels will be outlined. The examination of the legislation should include at minimum, legislation such as the NRCA Act, the Wildlife Protection Act, the Town and Country Planning Act, legislation and policies from the Forestry Department, Building Codes and Standards, Development Orders and Plans and the appropriate international convention/protocol/treaty where applicable.

Task #4 - Identification of Potential Impacts

The major environmental and public health issues of concern will be identified. Potential impacts as they relate to, (but are not restricted by) the following:

- Change in drainage pattern
- Flooding potential
- Landscape impacts of excavation and construction
- Loss of natural features, habitats and species by construction and operation
- Pollution of potable, coastal, surface and ground water
- Air pollution
- Capacity and design parameters of proposed sewage treatment facility
- Socio-economic and cultural impacts.
- Risk assessment
- Noise
- Impact on existing developments and the marine environment

The impacts will be distinguished between significant positive and negative impacts, direct and indirect, long term and immediate impacts. The extent and quality of the available data, explaining significant information deficiencies and any uncertainties associated with the predictions of impacts will be addressed. Project activities and impacts will be represented in matrix form with separate matrices for pre and post mitigation scenarios.

Task #5 Mitigation

Guidelines will be prepared for avoiding, as far as possible, any adverse impacts due to proposed usage of the site and utilising of existing environmental attributes for optimum development. Financial and economic values will be assigned to mitigation methods.

Task #6 - Monitoring

A plan to monitor the implementation of mitigation or compensatory measures and project impacts during construction and operation of the facility will be outlined. An Environmental Management Plan for the long-term operations of the site should also be prepared.

An outline-monitoring programme should be included in the EIA, and a detailed version submitted to NEPA for approval after the granting of the permit and prior to the commencement of the development. At the minimum the monitoring programme and report should include:

- o Introduction outlining the need for a monitoring programme and the relevant specific provisions of the permit license(s) granted.

- o The activity being monitored and the parameters chosen to effectively carry out the exercise.
- o The methodology to be employed and the frequency of monitoring.
- o The sites being monitored. These may in instances, be pre-determined by the local authority and should incorporate a control site where no impact from the development is expected.
- o Frequency of reporting to NEPA
- o The Monitoring report should also include, at minimum:
 - o Raw data collected. Tables and graphs are to be used where appropriate
 - o Discussion of results with respect to the development in progress, highlighting any parameter(s) which exceeds the expected standard(s).
 - o Recommendations
 - o Appendices of data and photographs if necessary.

Task #7 - Project Alternatives

The alternatives to the project including the no-action alternative will be analysed. This examination of project alternatives should incorporate the use history of the overall area in which the site is located and previous uses of the site itself.

Task #8 – Report Preparation and Generation

All findings will be presented in the **EIA report** and will reflect the headings in the body of the Torso, as well as references. Fourteen (14) hard copies and an electronic copy of the report will be submitted. The report will include an appendix with items such as maps, site plans, the study team, photographs, and other relevant information.

B. NOTICE OF INTENT TO CONDUCT ENVIRONMENTAL IMPACT ASSESSMENT (EIA) FOR A GOLF COURSE BY AMATERRA JAMAICA LTD.

A Notice of Intent for the conduct of the Environmental Impact Assessment (EIA) was published in the Jamaica Gleaner on Thursday November 30, 2006. This is shown in *Figure i* below.

Figure i: Notice of Intent advertisement for the conduct of the Environmental Impact Assessment (EIA) for the proposed Amatererra Golf Course.

THE GLEANER, THURSDAY, NOVEMBER 30, 2006

NOTICE OF INTENT

THIS SERVES AS A NOTICE OF INTENT FOR THE CONDUCT OF AN ENVIRONMENTAL IMPACT ASSESSMENT FOR THE DEVELOPMENT OF A GOLF COURSE BY AMATERRA JAMAICA LTD. TRELAWNY

In accordance with the Permits and Licences Regulations (1996) of the Natural Resources Conservation Authority (NRCA) Act 1991, the NRCA has exercised its right to require an Environmental Impact Assessment (EIA) of the above-captioned development proposal before a decision to issue an Environmental Permit is made.

This development is proposed by Amatererra Jamaica Ltd. and entails the construction of an eighteen (18)-hole golf course at Duncans Bay, Trelawny. As such, Amatererra Jamaica Ltd. has retained the services of ENVIROCONJA to assist them with the conduct of this EIA study.

Before this EIA can be started, appropriate Terms of Reference (ToR) for the assessment must be agreed upon by the applicant and the National Environment and Planning Agency (NEPA). The Draft ToR for this development is available for public inspection at the following locations:

- Trelawny Parish Library, Rodney Street Falmouth, Trelawny; and
- National Environment and Planning Agency (NEPA) website: www.nepa.gov.jm

If you wish to comment on the draft ToR, please do so within seven (7) working days of the date of the publication of this notice. Please address comments to:

MANAGER
Applications Secretariat Branch
Golf Course, Amatererra Jamaica Ltd.
National Environment and Planning Agency
10 Caledonia Ave., Kingston 5
Telephone: (876) 754-7540
Email: applications@nepa.gov.jm

C. APPROVAL OF TERMS OF REFERENCE FOR THE CONDUCT OF THE IMPACT ASSESSMENT (EIA) FOR A GOLF COURSE BY AMATERRA JAMAICA LTD.

This Terms of Reference was approved by the National Environment and Planning Agency on March 27, 2007 which is shown in **Figure ii** below.

Figure ii: Letter from the National Environment and Planning Agency showing the approval of the Terms of Reference for the conduct of the Environmental Impact Assessment



Ref. No. 2006-07017-EP00078

March 27, 2007

Mr. Keith Russell
Amaterra Jamaica Limited
P.O. Box 49
Falmouth
Trelawny.

Dear Mr. Russell

Re: Terms of Reference (ToRs) for the Environmental Impact Assessment for the Golf Course at Duncans Trelawny

The National Environment and Planning Agency offers no objection to the Terms of Reference (TOR) submitted with cover letter for the Environmental Impact Assessment (EIA) in connection with the captioned application.

On this basis, you should proceed with the execution of the EIA. Please note that on completion, fourteen (14) copies and an electronic copy of the EIA report are to be presented to this office.

Any reply or subsequent reference to this communication should be addressed to the Chief Executive Officer, to the attention of Miss Natalie Davidson, and the above reference number quoted.

Yours sincerely


Marc Rammelaere
for Chief Executive Officer/ Government Town Planner

cc: Miss Sara Simpson – Senior Consultant, Enviroconja
Ms. Frances Blair – Manager, Applications Secretariat Branch, NEPA

MR/ndd

Any reply or subsequent reference to this communication should be addressed to the Chief Executive Officer, to the attention of the officer dealing with the matter, and the reference quoted where applicable.

Managing and protecting Jamaica's land, wood and water
A Government of Jamaica Agency

**D. ENVIRONMENTAL PERMIT FOR THE STRATEGIC ENVIRONMENTAL
ASSESSMENT (SEA) FOR THE AMATERRA DEVELOPMENT ISSUED BY
THE NATIONAL ENVIRONMENT AND PLANNING AGENCY (NEPA)**

***APPENDIX 2: SITE LAYOUT PLAN OF THE PROPOSED
DEVELOPMENT***

APPENDIX 3: LIST OF PESTICIDES AND FERTILIZERS TO BE USED FOR THE MAINTENANCE OF SOD AND TURF

Table i: Table showing the list of Recommended Pesticides for use on Seashore Paspalum and the Alternatives that are available in Jamaica

PEST	PRODUCT NAME	CHEMICAL NAME	Alternative Available In Jamaica	Application Rate (per 100 m ²)
Mole Crickets	Dursban 0.5% B	Chlorpyrifos	Able to Dilute to a safe limit on the spot	0.45 – 0.9 kg
Sod Worm	Dursban Pro	Chlorpyrifos	Able to Dilute to a safe limit on the spot	0.44 litres
Spittlebugs	Dursban 2E		Able to Dilute to a safe limit on the spot	0.044 litres
	Dursban 0.5%B	Chlorpyrifos	Able to Dilute to a safe limit on the spot	0.45 kg
White Grubs			No alternative available locally	
Japanese Beetle			No alternative available locally	
Green Chafers			No alternative available locally	
June Beetle			No alternative available locally	
Billbugs	Dursban Pro	Chlorpyrifos	Able to Dilute to a safe limit on the spot	0.088-0.177 litres
Cutworms			No alternative available locally	
Armyworms	Dursban Pro	Chlorpyrifos	Able to Dilute to a safe limit on the spot	0.044 litres
Imported Fire Ants	Dursban Pro	Chlorpyrifos	Able to Dilute to a safe limit on the spot	0.02 litres/15 liters of water

Adapted from: Seaisle1.com and Information from the Pesticides Control Authority and Agrigrace Ltd

Table ii: Table showing the list of Recommended Fungicides to control Dollar Spot in Seashore Paspalum and the Alternatives that are available in Jamaica

Product Name	Chemical Name	Alternatives Available In Jamaica	Application Rate (Per 100 M ²)	Application Interval (Days)
Banner 14.3L	Propiconazole	Bumper 25EC	1-2 fl.oz/2-5 gal. water	14-28
Cleary's 3336, Topsin, Fungo, Systec 1998	Thiophanate methyl	Vydate L	1-2 oz/5 gal. water	10-28
Tersan LSR, Protect T/O	Maneb, Maneb + zinc sulfate, mancozeb	Pencozeb	3-8oz/3-5 gal. water	7-10

Adapted from Seaisle1.com NOTE: None of these fungicides are specifically labeled for *Paspalum vaginatum* use, check the label to find out if fungicide is for general or specific turf use

Table iii: Table showing the list of Recommended Fungicides to control Fusarium Bight in Seashore Paspalum and the Alternatives that are available in Jamaica

Product Name	Chemical Name	Alternatives Available In Jamaica	Application Rate (Per 100 M ²)	Application Interval (Days)
Cleary's 3336, Topsin, Fungo, Systec 1998	Thiophanate methyl	Vydate L	1-2 oz/5 gal. water	10-28
Banner 14.3L	Propiconazole	Bumper 25EC	1-2 fl.oz/2-5 gal. water	14-28

Table iv: Table showing the list of Recommended Fungicides to control Fusarium Bight in Seashore Paspalum and the Alternatives that are available in Jamaica

HERBICIDES THAT ARE NON-INJURIOUS TO SEASHORE PASPALUM				
POST-EMERGENCE HERBICIDE				
COMMON NAME	TRADE NAME	ALTERNATIVE AVAILBALE IN JAMAICA	BROADCAST RATE/ACRE	
MCP+2, 4-D+dicamba	Trimec Southern SL	Kambamaster	Read Label	0.7+0.4+0.08
2, 4-D+dicamba+dicloprop	Super Trimec SL	Kambamaster	Read Label	Read Label
dicamba	Vanquish SL	Kambamaster	0.5 - 1.0 pts	0.25 -0.5
(DORMANT TURF/ RENOVATION/ BORDER MAINTENANCE)				
glyphosate	Roundup	-----	0.75 pt.	0.375

Adapted from: Seaisle1.com

List of 'Environmentally Friendly' Nematicide(s)/Biocide(s) available in Jamaica

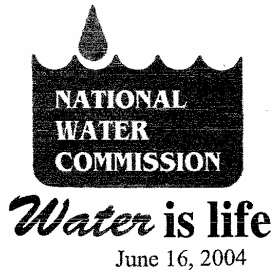
- o Sincocin
- o Aza-direct (Neem Extract 4x effective as any other neem product affects every stage of pest development.

***MATERIAL SAFETY DATA SHEETS FOR CHEMICALS TO BE
USED ON THE GOLF COURSE***

***APPENDIX 4:* INFORMATION ON SEWAGE TREATMENT
SYSTEM TO BE IMPLEMENTED AT THE GOLF COURSE**

APPENDIX 5: WATER

Figure iii: Letter from the National Water Commission (NWC) indicating partnership with Amaterra Jamaica Ltd to upgrade water resources in the area



☐ 28-48 Barbados Avenue
P.O. Box 65, Kingston 5
Tel: (876) 929-5430-5
Fax: (876) 926-1329

☐ 18 Oxford Road
Kingston 5
Tel: (876) 926-5825-7
Fax: (876) 926-7121

☐ 4 Marescaux Road
Kingston 5
Tel: (876) 929-3540-5
Fax: (876) 960-0582

☐ 2a Manhattan Road
Kingston 5
Tel: (876) 929-3540-
Fax: (876) 968-824

☐ 231A Old Hope Road
Kingston 6
Tel: (876) 977-4998
977-5000
Fax: (876) 927-1870

☐ 28-30 Church Street
Kingston
Tel: (876) 922-8110-8
Fax: (876) 967-1499

Mr Charles H Murphy III
Chief Operating Officer
Amaterra (Jamaica) Limited
P O Box 49
Falmouth
Trelawny

Dear Murphy

Re: Water Supply for Ocean Point Development

We note your letter dated May 26, 2004 regarding water for your proposed project at Ocean Point in Trelawny. You have indicated that the ultimate water requirement of this project is 1 (one) million gallon per day.

The National Water Commission (NWC) is taking steps to implement a water supply project that will improve the supply between Martha Brae and Harmony Hall which, in turn, will put us in a position to serve your development. The estimated cost for elements of the water supply project that directly relate to your development is US\$18.61M.

NWC will be charging a fee for connecting to this new water supply system. The connecting fee is based on the project cost, the water requirement of the development and the additional water that will be availed by this project. Based on your water requirement, the connecting fee for your development is US\$7.83M.

We have enclosed for your consideration a draft agreement that would be made between NWC and yourselves, that would be the framework for our relationship on this matter.

Sincerely yours


VERNON BARRETT
Assistant Vice President
Systems Planning Development

Attachment

Copy: President
VP, Corporate & Strategic Planning
VP, Western Division
Chief Engineer
Area Manager, Hanover/Westmoreland

Table v: Table showing the Estimated Water Use per Restroom Fixture

FIXTURE	WATER USE PER DAY/FIXTURE (Litres)
Faucet	35
Toilet	25
Urinal	15

Adapted from the EHU, (2005)

Table vi: Table showing the Estimated Water use by Facility Type

FACILITY TYPE	WATER USE PER DAY (Litres)	CAPITA
Bar/Cocktail Lounge	55-75	Per seat
Restaurant	100	Per seat

Adapted from the EHU, (2005)

APPENDIX 6: ECOLOGY

A. TERRESTRIAL: FLORA

Table vii: Table showing the List of Plant Species Observed within the Development Area

COMMON NAME	SCIENTIFIC NAME	VEGETATION TYPE	ECOLOGICAL IMPORTANCE	ABUNDANCE RATING
Columnar Cacti	<i>Cephalocereus</i> sps.	Cactus		F
Dildo Pear	<i>Stenocereus</i> sps.	Cactus		A
	<i>Tillandsia</i> sps.	Epiphyte		O
Jamaican Purple Orchid	<i>Broughtonia sanguinea</i>	Epiphyte	Endemic / Endangered CITES Appendix 2 species	O
	<i>Ipomea</i> sps.	Epiphyte		
Tank Bromeliads	<i>Hohenbergia</i> sp.		Possibly Endemic	O
Maidenhair Spleenwort	<i>Asplenium tricomane</i> s	Fern		O
Beach Grass	<i>Sporobolus virginicus</i>	Grass		O
Bear Grass	<i>Xerophyllum tenax</i>	Grass		O
Salt Grass	<i>Distichlis spicata</i>	Grass		O
Sand Spur	<i>Cenchrus incertus</i>	Grass		A
	<i>Spartina patens</i>	Grass		O
Broomweed	<i>Sida acuta</i>	Herb		O
Devil's Horse Whip	<i>Achyranthes indica</i>	Herb		A
Prickle Withe	<i>Hylocereus triangularis</i>	Epiphyte	Endemic	F
Spider Lilly	<i>Hymenocallis littoralis</i>	Herb		R
Wild Coffee		Herb		O
Adams Needle	<i>Yucca filamentosa</i>	Herb		
	<i>Sagittaria</i> sps	Herb		O
Devils Trumpet	<i>Datura stramonium</i>	Herb		O
Pepper Elder	<i>Peperomia pellucida</i>	Herb		O
	<i>Neptunia pubescens</i>	Herb		F
	<i>Lobelia</i> sps.	Herb		F
Seaside Purslane	<i>Sesuvium portulacastrum</i>	Herb/Shrub		F
Beach Croton	<i>Croton punctatus</i>	Shrub		A
Cashaw Macca	<i>Prosopis juliflora</i>	Shrub	Invasive	F
Lantana/Mountain Sage	<i>Lantana</i> sps.	Shrub		O
Grey Nickle	<i>Caesalpinia</i>	Shrub		O

	<i>bonduc</i>			
Sarsaparilla	<i>Smilax regelli</i>	Shrub		A
Spanish Stopper	<i>Eugenia foetide</i>	Shrub		O
Wild Rosemary	<i>Croton linearis</i>	Shrub		F
Wild Tamarind	<i>Pithecellobium arborum</i>	Shrub		F
	<i>Cordia bullata</i>	Shrub	Endemic	F
Lead Tree	<i>Leucaena leucocephala</i>	Shrub	Invasive	O
	<i>Agave sisalana</i>	Shrubby tree		O
Wild Popanax	<i>Acacia tortuosa</i>	Small tree		
Acacia	<i>Acacia sps.</i>	Tree		A
Almond	<i>Terminalia catappa</i>	Tree		F
Bitter Wood	<i>Picrasma excelsa</i>	Tree		O
Black Iron Wood	<i>Krugiodendron ferreum</i>	Tree		F
Black Mangrove	<i>Avicennia germinans</i>	Tree		A
Brazilian Pepper Tree	<i>Schinus terebinthifolius</i>	Tree	Invasive	O
Breadnut	<i>Brosimum alicastrum</i>	Tree		R
Button Mangrove	<i>Conocarpus erectus</i>	Tree		F
Cabbage Palm	<i>Sabal palmetto</i>	Tree		O
Calabash	<i>Crescentia cujete</i>	Tree		O
Cedar	<i>Cedrela odorata</i>	Tree		O
Coast Live Oak	<i>Quercus agrifolia</i>	Tree		F
Dog Wood	<i>Piscidia piscipula</i>	Tree		O
Greenheart Ebony	<i>Rocheportia acanthophora</i>	Tree		F
Guango	<i>Samanea saman</i>	Tree		
Guava	<i>Psidium guajava</i>	Tree		O
Guinep	<i>Melicoccus bijugatus</i>	Tree		
Lance Wood	<i>Xylopia muricata</i>	Tree		O
Logwood	<i>Haematoxylum campechianum</i>	Tree	Invasive	F
Maiden Plum	<i>Comocladia pinatifolia</i>	Tree		O
Mango	<i>Mangifera indica</i>	Tree		F
Noni	<i>Morinda citrifolia</i>	Tree		O
Poison Wood	<i>Metopium toxiferum</i>	Tree		O
Red Birch	<i>Bursera simaruba</i>	Tree		
Red Mangrove	<i>Rhizophora</i>	Tree		

	<i>mangle</i>			
Sea Grape	<i>Cocoloba uvilera</i>	Tree		A
Seaside Mahoe	<i>Thespesia populnea</i>	Tree		
Soursop	<i>Annona muricata</i>	Tree		F
Star Apple	<i>Chrysophyllum cainito</i>	Tree		F
Strangler Fig	<i>Ficus aurea</i>	Tree		A
Sweet Wood	<i>Nectarandia coriaca</i>	Tree		O
Tamarind	<i>Tamarindus indica</i>	Tree		F
Broom Thatch	<i>Thrinax parviflora</i>	Tree	Endemic	O
Trumpet Tree	<i>Cecropia peltata</i>	Tree		O
Water Mahoe	<i>Hernandia catapifolia</i>	Tree	Endemic	A
Weeping Willow	<i>Casuarina equisetifolia</i>	Tree		R
White Mangrove	<i>Laguncularia racemosa</i>	Tree		O
Wild Fig	<i>Ficus perforata</i> L.	Tree		
Wild Mahogany	<i>Trichilia hirta</i> L.	Tree		A
Agave	<i>Agave sps</i>	Tree		A
Woman Tongue Tree	<i>Albizia lebbbeck</i>	Tree		O
Railroad Vine	<i>Ipomoea pes-carpe</i>	Vine		F
Seaside Bean	<i>Canavalia maritima</i>	Vine		F
Sea Lavender	<i>Mellotonia graphalodes</i>	Vine		F
Strapleaf Air Plant	<i>Guzmania</i>	Vine		O
Wicca	<i>Philadendron</i>	Vine		F
Bay Bean	<i>Canavalia rosea</i>	Vine		O
Ping Wing	<i>Bromelia pinguin</i>			A
Sea Oats	<i>Unida paniculata</i>			O
	<i>Sephalocerus swartzii</i>			O

B. TERRESTRIAL: FAUNA

Table viii: Table showing the Avifauna Observed within the Development Area

Scientific Name	Common Name	Island Status	Abundance
Ardeidae	Herons, Egrets and Bitterns		
<i>Bubulcus ibis</i>	Cattle Egret	R	Fairly common
<i>Ardea herodias</i>	Great Blue Heron	NBR	Uncommon
<i>Egretta thula</i>	Snowy Egret	R	Locally common
<i>Egretta caerulea</i>	Little Blue Heron	R	Locally common

Anatidae	Swans, Geese and Ducks		
<i>Anas discors</i>	Blue-winged Teal	NBR	Locally common
<i>Anas clypeata</i>	Northern Shoveler	NBR	Rare
Cathartidae	New World Vultures		
<i>Cathartes aura</i>	Turkey Vulture	R	Common
Accipitridae	Hawks, Eagles and Kites		
<i>Buteo jamaicensis</i>	Red-tailed Hawk	R	Rare
Falconidae	Falcons and Caracaras		
<i>Falco sparverius</i>	American kestrel	R	Uncommon
Charadriidae	Plovers and Lapwings		
<i>Pluvialis squatarola</i>	Black-bellied Plover	NBR	Locally common
<i>Charadrius semipalmatus</i>	Semipalmated Plover	NBR	Locally common
<i>Charadrius wilsonia</i>	Wilson's Plover	R	Locally common
Scolopacidae	Sandpipers and Yellowlegs		
<i>Tringa flavipes</i>	Lesser Yellowlegs	NBR	Uncommon
<i>Actitis macularia</i>	Spotted Sandpiper	NBR	Uncommon
<i>Tringa solitaria</i>	Solitary Sandpiper	NBR	Uncommon
<i>Calidris minutilla</i>	Least Sandpiper	NBR	Locally common
<i>Arenaria interpres</i>	Ruddy Turnstone	NBR	Locally common
Skuas, Gulls and Terns	Laridae		
<i>Sterna maxima</i>	Royal Tern	R	Fairly common
Columbidae	Pigeons and Doves		
<i>Columba leucocephala</i>	White-crowned Pigeon	R	Common
<i>Zenaida asiatica</i>	White-winged Dove	R	Fairly common
<i>Zenaida aurita</i>	Zenaida Dove	R	Fairly common
<i>Zenaida macroura</i>	Mourning Dove	R	Rare
<i>Columbina passerina</i>	Common Ground Dove	R	Common
<i>Leptotila jamaicensis</i>	Caribbean Dove	R	Common
<i>Geotrygon montana</i>	Ruddy Quail-dove	R	Rare
Psittacidae	Parrots, Macaws and Allies		
<i>Aratinga nana</i>	Olive-throated Parakeet	R	Common
<i>Amazona collaria</i>	Yellow-billed Parrot	E	Rare
<i>Forpus passerinus</i>	Green-rumped Parrotlet	I	Uncommon
Cuculidae	Cuckoos and Anis		
<i>Coccyzus minor</i>	Mangrove Cuckoo	R	Uncommon
<i>Saurothera vetula</i>	Jamaican Lizard Cuckoo	E	Fairly common
<i>Crotophaga ani</i>	Smooth-billed Ani	R	Fairly common
Strigidae	Typical Owls		
<i>Pseudoscops grammicus</i>	Jamaican Owl	E	Fairly common*
Trochilidae	Hummingbirds		
<i>Anthracothorax mango</i>	Jamaican Mango	E	Rare
<i>Mellisuga minima</i>	Vervain Hummingbird	R	Fairly common
<i>Trochilus polytmus</i>	Red-billed Streamertail	E	Fairly common
Todidae	Todies		
<i>Todus todus</i>	Jamaican Tody	E	Uncommon
Picidae	Woodpeckers		
<i>Melanerpes radiolatus</i>	Jamaican Woodpecker	E	Common

Tyrannidae	Tyrant Flycatchers		
<i>Myiarchus stolidus</i>	Stolid Flycatcher	R	Common
<i>Tyrannus dominicensis</i>	Gray Kingbird	BR	Fairly common
<i>Tyrannus caudifasciatus</i>	Loggerhead Kingbird	R	Common
<i>Myiarchus validus</i>	Rufous-tailed Flycatcher	E	Rare
<i>Myiarchus barbirostris</i>	Sad Flycatcher	E	Common
Hirundinidae	Swallows		
<i>Pterochelidon fulva</i>	Cave Swallow	R	Fairly common
<i>Progne dominicensis</i>	Caribbean Martin	BR	Uncommon
<i>Hirundo rustica</i>	Barn Swallow	NBR	Uncommon
Corvidae	Crows		
<i>Corvus jamaicensis</i>	Jamaican Crow	E	Uncommon
Muscicapidae	Muscicapids		
<i>Turdus aurantius</i>	White-chinned Thrush	E	Fairly common
Mimidae	Mockingbirds and Thrashers		
<i>Dumetella carolinensis</i>	Gray Catbird	NBR	Rare
<i>Mimus polyglottus</i>	Northern Mockingbird	R	Common
Vireonidae	Vireos		
<i>Vireo modestus</i>	Jamaican Vireo	E	Common
<i>Vireo altiloquus</i>	Black-whiskered Vireo	BR	Fairly common
Emberizidae	Emberizids		
<i>Parula americana</i>	Northern Parula	NBR	Uncommon
<i>Dendroica caerulescens</i>	Black-throated Blue Warbler	NBR	Uncommon
<i>Dendroica discolor</i>	Prairie Warbler	NBR	Common
<i>Setophaga ruticilla</i>	American Redstart	NBR	Fairly common
<i>Mniotilta varia</i>	Black-and-white Warbler	NBR	Fairly common
<i>Geothlypis trichas</i>	Common Yellowthroat	NBR	Uncommon
<i>Dendroica tigrina</i>	Cape May Warbler	NBR	Rare
<i>Sturnus vulgaris</i>	European Starling	I	Fairly common
<i>Coereba flaveola</i>	Bananaquit	R	Common
<i>Euphonia jamaica</i>	Jamaican Euphonia	E	Fairly common
<i>Icterus leucopteryx</i>	Jamaican Oriole	R	Fairly common
<i>Quiscalus niger</i>	Greater Antillean Grackle	R	Fairly common
<i>Tiaris olivacea</i>	Yellow-faced Grassquit	R	Fairly common
<i>Loxipasser anoxanthus</i>	Yellow-shouldered Grassquit	E	Uncommon
<i>Loxigilla violacea</i>	Greater Antillean Bullfinch	R	Fairly common
<i>Dendroica petechia</i>	Yellow Warbler	R	Locally common
<i>Euneornis campestris</i>	Orangequit	E	Rare
<i>Sicalis flaveola</i>	Saffron Finch	I	Rare

Key :

I = Introduced species (3)

E = Endemic Species (15)

R = Resident Species (44 including the endemics)

BR = Breeding Resident or Summer Migrant (3)

NBR = Non-breeding Resident or Winter Migrant (19)

Table ix: Table showing the List of Butterfly Species Observed within the Development Area

COMMON NAME	SCIENTIFIC NAME	OVERALL ABUNDANCE	INITIAL TIME OF SIGHTING	ECOLOGICAL IMPORTANCE
Zebra	<i>Heliconius charitonius simulator</i>	Abundant	11:05am	
White Peacock	<i>Anartia jatrophae jamaicensis</i>	Frequent	11:15am	
Buckeye	<i>Junonia evarete/ Junonia genoveva</i>	Abundant	10:30am	
Tropical Fritillary	<i>Euptoieta hegesia hegesia</i>	Frequent	10:40am	
Malachite	<i>Spiroeta stelenes stelenes)</i>	Rare	12:40pm	
Dorcas	<i>Mestra dorcas</i>	Occasional	2:05pm	
Checkered Skipper	<i>Pyrgus oileus</i>	Occasional	11:30am	
Jamaican Albatross	<i>Appias Drusilla castalia</i>	Occasional	1:20pm	Endemic
Maerula	<i>Anteos maerula maerula</i>	Rare	12:04pm	
Cuban Swallowtail	<i>Papilio andraemon</i>	Occasional	12:49pm	
Jamaican Goatweed Butterfly	<i>Anaea troglodyta</i>	Rare	12:24am	

Table x: Table showing the List of Other Macrofauna Observed within the Development Area

COMMON NAME	SCIENTIFIC NAME/ORDER	ECOLOGICAL IMPORTANCE
MAMMALS		
Goat	<i>Capra aegagrus</i>	
Dog	<i>Canis familiaris</i>	
Chicken	<i>Gallus gallus domesticus</i>	
Mongoose	<i>Herpestes auropunctatus</i>	Invasive Alien
REPTILES		
	<i>Anolis lineatopus</i>	Endemic
	<i>Anolis grahami</i>	Endemic
	<i>Anolis opalinus</i>	
***Jamaican Yellow Snake	<i>Epicrates subflavus</i>	Endemic/Endangered/Protected
INSECTS		
Ants, Bees, Wasps	Order Hymenoptera	
Green Clearwing/Pondhawk	<i>Erythemis simplicicollis</i>	
Roseate Skimmer	<i>Orthemis ferruginea</i>	
Grasshopper	Order Orthoptera Sub -Order Caelifera	
Mosquito	<i>Anopheles sp.</i>	Nuisance Species
Flea	<i>Ctenocephalides canis</i>	
Ticks	<i>Ixodes sp</i>	
CRUSTACEANS		
Hermit Crabs	<i>Coenobita clypeatus</i>	

***Possibly present

C. MARINE: FLORA

Table xi: Table showing the List of Algae Species observed

COMMON NAME	SCIENTIFIC NAME	ABUNDANCE RATING
-	<i>Dictyota sp.</i> ,	D
-	<i>Lobophora sp</i>	
-	<i>Sargassum sp</i>	
-	<i>Halimeda sp</i>	
-	<i>Turbinaria sp</i>	

Table xii: Table showing the List of Seagrass Species observed

COMMON NAME	SCIENTIFIC NAME	ABUNDANCE RATING
Turtle Grass	<i>Thalassia testudinum</i>	D

D. MARINE: FAUNA

Table xiii: Table showing the List of Coral Species observed

SCIENTIFIC NAME
<i>Agaricia agaricites</i>
<i>Colpophyllia natans</i>
<i>Diploria labyrinthiformis</i>
<i>Diploria strigosa</i>
<i>Millipora alcicornis</i>
<i>Montastrea cavernosa</i>
<i>Montastrea annularis</i>
<i>Montastrea faveolata</i>
<i>Porites asteroides</i>
<i>Porites porites</i>
<i>Siderastrea siderea</i>

Table xiv: Table showing the List of Fish Species observed

COMMON NAME	SCIENTIFIC NAME	ABUNDANCE RATING
Sergeant Major	<i>Abudefduf saxatilis</i>	F
Night sergeant	<i>Abudefduf taurus</i>	F
Ocean Surgeonfish	<i>Acanthurus bahianus</i>	F
Doctorfish	<i>Acanthurus chirurgus</i>	M
Blue Tang	<i>Acanthurus coeruleus</i>	M
Porkfish	<i>Anisotremus virginicus</i>	S
Trumpetfish	<i>Aulostomus maculatus</i>	S

Spanish Hogfish	<i>Bodianus rufus</i>	F
Sharpnose Puffer	<i>Canthigaster rostrata</i>	S
Bar Jack	<i>Caranx ruber</i>	F
Foureye Butterflyfish	<i>Chaetodon capistratus</i>	F
Banded Butterflyfish	<i>Chaetodon striatus</i>	S
Blue Chromis	<i>Chromis cyanea</i>	A
Balloonfish	<i>Diodon holocanthus</i>	F
Rock Hind	<i>Epinephelus adscensionis</i>	F
Graysby	<i>Epinephelus cruentatus</i>	F
Coney	<i>Epinephelus fulvus</i>	F
Fairy Basslet	<i>Grama loreto</i>	M
French Grunt	<i>Haemulon flavolineatum</i>	F
Slippery Dick	<i>Halichoeres bivittatus</i>	F
Rock Beauty	<i>Holocanthus tricolor</i>	S
Squirrelfish	<i>Holocentrus adscensionis</i>	M
Blue Hamlet	<i>Hypoplectrus gummigutta</i>	F
Barred Hamlet	<i>Hypoplectrus puella</i>	F
Mutton Snapper	<i>Lutjanus analis</i>	S
Schoolmaster	<i>Lutjanus apodus</i>	F
Black Durgon	<i>Melichthys niger</i>	F
Yellowtail Damselfish	<i>Microspathodon chrysurus</i>	F
Yellow Goatfish	<i>Mulloidichthys martinicus</i>	M
Striped Parrotfish	<i>Scarus croicensis</i>	F
Princess Parrotfish	<i>Scarus taeniopterus</i>	F
Harlequin Bass	<i>Serranus tigrinus</i>	F
Redband Parrotfish	<i>Sparisoma aurofrenatum</i>	F
Dusky Damselfish	<i>Stegastes dorsopunicans</i> (formerly <i>fuscus</i>)	M
Beaugregory	<i>Stegastes leucostictus</i>	F
Threespot Damselfish	<i>Stegastes planifrons</i>	F
Yellow Stingray	<i>Urolophus jamaicensis</i>	S

KEY :

S – single , F – Few[2 – 10 species] , M- Many[11- 100 species] A –Abundant [> 100 species]

Table xv: Table showing the **possible** Turtle species that may nest along the beaches of the development site

COMMON NAME	SCIENTIFIC NAME	ECOLOGICAL IMPORTANCE
Loggerhead Turtle	<i>Caretta caretta</i>	Protected
Hawksbill Sea Turtle	<i>Eretmochelys imbricata</i>	Protected
Leatherback Turtle	<i>Dermochelys coriacea</i>	Protected
Green Sea Turtle	<i>Chelonia mydas</i>	Protected

Table xvi: Table showing the List of Invasive Alien Plant Species in Jamaica

SCIENTIFIC NAME	COMMON NAME
<i>Schinus terebinthifolia</i>	Brazilian Pepper Tree
<i>Spathodea campanulata</i>	African Tulip Tree
<i>Haematoxylum campechianum</i>	Logwood
<i>Casuarina equisetifolia</i>	Casuarina/Willow
<i>Bambusa vulgaris</i>	Bamboo
<i>Brachiaria decumbens</i>	
<i>Coix lacryma-jobi</i>	Job's Tears
<i>Melinis minutiflora</i>	Wynne Grass
<i>Panicum maximum</i>	Guinea Grass
<i>Themeda arguens</i>	Piano Grass
<i>Hydrilla verticillata</i>	Hydrilla
<i>Acacia mearnsii</i>	Black Wattle
<i>Adenanthera pavonina</i>	Red Bead Tree
<i>Calliandra calothyrsus</i>	
<i>Leucaena leucocephala</i>	Lead Tree
<i>Mimosa pigra</i>	
<i>Prosopis juliflora</i>	Cashaw/Mimosoid Legume
<i>Ardisia solanacea</i>	Blackberry
<i>Eucalyptus sp.</i>	Eucalyptus
<i>Melaleuca spp.</i>	Bottle Brush
<i>Psidium cattleianum</i>	Strawberry Guava
<i>Syzygium jambos</i>	Rose Apple
<i>Moghania strobilifera</i>	Wild Hops
<i>Ulex europaeus</i>	Gorse
<i>Pittosporum undulatum</i>	Mock Orange
<i>Pittosporum viridiflorum</i>	
<i>Polygonum chinense</i>	
<i>Eichhornia crassipes</i>	Water Hyacinth
<i>Grevillea robusta</i>	Silky Oak
<i>Angiopteris erecta</i>	Giant Fern
<i>Gleichenia sp.</i>	
<i>Nephrolepis multiflora</i>	False Boston Fern
<i>Thelypteris opulanta</i>	Sword Fern
	Stinkwood
<i>Rubus ellipticus</i>	Cheeseberry
<i>Rubus sp.</i>	Black Raspberry
	African Cherry,
<i>Lantana sp. (excluding L. camara)</i>	
<i>Alpinia allughas</i>	
<i>Hedychium coccineum</i>	
<i>Hedychium coronarium</i>	White Ginger Lily
<i>Hedychium gardnerianum</i>	

Adapted from: Wild Life and Protected Areas Act, Schedule 7- Invasive Alien Species in Jamaica

APPENDIX 7: SOCIO-ECONOMIC SURVEY FORM: PUBLIC PERCEPTION

SOCIO – ECONOMIC SURVEY: AMATERRA JAMAICA LTD.

1. DATE: _____

2. COMMUNITY: _____

3. OCCUPATION: _____

4. How long have you been a resident/fisherman/ operated your business in the area? ☐ within the last five years ☐ within the last 10 years ☐ within the last twenty years ☐ over twenty years ago

5 . Are you aware of the Amatterra Jamaica Ltd development that has been planned in your community? ☐ Y ☐ N

If yes what do you know about the development?

6. Are you aware that an eighteen hole golf course has been included as part of the project?

☐ Y ☐ N

7. Do you now use the property in any way? ☐ Y ☐ N

If yes how do you use the property? _____

7 Do you think this development will affect your community in a good or bad way?

☐ Good ☐ Bad

How do you think it will affect the community Good/Bad?

8. Is there any other land-use that you would have like to seen the property used for?

APPENDIX 8:

A. ENVIRONMENTAL IMPACT ASSESSMENT MATRIX

PROJECT ACTIVITIES	IMPACT	
	SITE LAYOUT/ CONSTRUCTION PHASE	OPERATION PHASE
PHYSICAL ENVIRONMENT		
CLIMATE	- St, L, N,G	- Lt, L,N,G
AIR QUALITY	- St, L	- Lt, L
WATER QUALITY	-- St, L	-- Lt, L
WATER QUANTITY	- St, L	-- Lt, L
SOIL & GEOLOGY	- St, L	-- Lt, L
HYDROGEOLOGY	- St, L	No impact
NOISE AND VIBRATION	-- St, L	- Lt, L
LANDSCAPE AND VISUAL	- St, L	++ Lt, L
BIOLOGICAL ENVIRONMENT		
FLORA	-- Lt, L	- Lt, L
FAUNA: AVIFAUNA	-- Lt, L	- Lt, L
FAUNA: BUTTERFLIES	-- Lt, L	- Lt, L
FAUNA: OTHER MACRO-FAUNA – Mammals	-- Lt, L	- Lt, L

KEY:

++ Major Positive	-- Major Negative	+ Minor Positive	- Minor Negative
St Short Term	Lt Long Term	○ No Impact	N/A Not Applicable
L Local	N National	G Global	

B: SOCIO-ECONOMIC IMPACT ASSESSMENT MATRIX

PROJECT ACTIVITIES	IMPACT	
	SITE PREPARATION /CONSTRUCTION PHASE	POST – CONSTRUCTION PHASE
SOCIAL STRUCTURE		
LAND USE	O	N/A
COMMUNITY STRUCTURE	O	N/A
DEMOGRAPHY	- St, L	N/A
EMPLOYMENT AND INCOME	++ St, L,N	++ Lt, L,N
CRIME AND VIOLENCE	- St, L	- St, L
TRAFFIC	- St, L	- St, L
INFRASTRUCTURE		
Road Network	- St, L	++ Lt, L,
UTILITIES: Electricity	O	- St, L,N
UTILITIES: Water	- St, L	-- Lt, L,N
UTILITIES: Telecommunications	O	+ Lt, L,
WASTE		
SOLID WASTE	- St, L	-- Lt, L
SEWAGE	- St, L	- Lt, L
SOCIAL SERVICES		
Health	- St, L	N/A
Emergency Services	- St, L	- Lt, L
Transportation	- St, L	- Lt, L

++ Major Positive
St Short Term
L Local

-- Major Negative
Lt Long Term
N National

+ Minor Positive
O No Impact
G Global

- Minor Negative
N/A Not Applicable

C: HAZARD IMPACT ASSESSMENT MATRIX

HAZARD	PROJECT ACTIVITIES	
	SITE PREPARATION/ CONSTRUCTION PHASES	OPERATION PHASE
TECHNOLOGICAL HAZARDS	+ O	+ O
ACCIDENTS/GENERAL HUMAN HEALTH	+ O	+ O
EARTHQUAKES	+ O	+ O
HURRICANES	+ O	+ O

Key:

+ Great Probability

+ Moderate Probability

O High Magnitude

O

Moderate

Magnitude

APPENDIX 9: PROJECT TEAM

The project team for the conduct of the Environmental Impact Assessment (EIA) comprised of the following persons:

- o Johann Antoine BSc Zoology, MSc Natural Resources Management
- o Sara Simpson BSc. Botany, M.A. Environmental Impact Assessment and Management
- o Dr. Gavin Gunter: BSc. Geology, PhD. Geology
- o Dayne Buddo, PhD. Marine Biology (Pending)
- o Leslie Hoo-Fung: BSc. Analytical Chemistry
- o Jevcon Engineering
