ENVIRONMENTAL IMPACT ASSESSMENT (EIA) REPORT

LANCEWOOD VALLEY SUBDIVISION, CLARENDON

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EXECUTIVE SUMMARY

i. The Lancewood Valley property is located centrally between Old Harbour and May Pen in the Parish of Clarendon and is approximately 2 km south of the community of Sandy Bay. The project site is also located just north of the boundary of the Portland Bight Protected Area and lies adjacent to the Vere Plains Region boundary, which runs south-east along the railway line through Inverness and Freetown to the parish boundary of Clarendon and St. Catherine.

ii. The proponent intends to subdivide ninety (90) acres ~ 36 hectares into one hundred and twenty one (121) housing lots, complete with roads, electricity and water. Lots will range from 1,039 square meters to 11,190.09 square meters. It is anticipated that three (3) and four (4) bedroom houses will be built on the property and the project will be implemented over a one (1) year period.

iii. The land has predominantly been utilized for agriculture, namely for cattle rearing, in the last fifty (50) years. These practices have ceased however due to the frequent occurrences of praedial larceny. The property is presently in ruinate and is frequently grazed by stray goats that enter the property through pathways from nearby communities.

iv. The site is bordered by a small settlement on its northern border and a number of residences to the northwest and north-northwest. To the east of the property is Highway 2000 and to the south is a railway that is traversed by Jamaica Aluminium Company's (JAMALCO's) bauxite freight train.

v. Water for the development will be sourced from a well located in Twin Palms, which is operated by the National Water Commission (NWC). The daily water consumption by the development is estimated to be between 166,980 – 222,640 litres. This well has a licence to abstract 4,524,000 litres of water per day.

vi. A sewage treatment system comprising of a Septic Tank/Tile Field has been recommended for each lot. This will treat the wastewater to a secondary level which has been recommended by the Environmental Health Unit (EHU), Ministry of Health.

vii. Several regulations and legislation have been reviewed which pertain to the development. These serve to protect the interest of the developer, the public as well as preserving the natural environment.

viii. The climate experienced in the area is typical of the south coast of Jamaica. The rainfall in area ranges from a low of 39 mm in January to a high of 201 mm in October. Wind speeds vary from a maximum of 21 km/hr in June to a minimum of 10.2 in December. The temperatures range from a high of 32.4 ºC in July to a low of 16.9 ºC in January.

ix. Both the NO_2 and SO_2 values recorded at the site were well within the air quality standards that have been stipulated by the Natural Resources Conservation Authority (NRCA).

x. No streams or rivers are located within 2 km of the project site. A gully traverses through the property which leads to the Bowers River which is within the Portland Bight protected area. No water flow was observed during this assessment and therefore water quality analysis was not possible for this watercourse.

xi. Water quality analysis was undertaken for the Twin Palms well, which is the proposed water supply for the development. The results from this analysis show that the water quality from this well is within the World Health Organisation's Drinking Water Standards and is therefore suitable for potable use.

xii. Units of the Newport Formation of the White Limestone Group chiefly underlie the development area. The beds of the Newport Formation have good drainage properties that contribute to the lack of surface drainage within and in the general vicinity of the development area.

xiii. No major faults were identified in the area based on the surface geology.

xiv. Gentle slopes characterize the development area. Steep slopes exist, however, in the vicinity of the Shutes Gully close to the train line whereas moderately steep slopes are present along the area bordering the Old Harbour Bypass Road.

xv. The major soil types in this area are Bonny Gate and Four Paths.

xvi. There is no recorded history of flooding at the development site. The flood analysis shows that the development area is not vulnerable to flooding from the Shutes Gully traversing the project site to the west or from the gully to the east of the site. On the other hand, runoff from the project site will inundate the depression, which forms the southern part of the development area. Inundation of the depression is exacerbated due to its enclosure by the Old Harbour Bypass main road with only two (2) 1 m diameter culverts for water to flow out.

xvii. The area to be developed cannot be described as a noise sensitive community. With reference to decibel levels that have been recorded for street side traffic, the noise values recorded at the site fall well within the expected ranges for trafficked areas.

xviii. The vegetation in the area can be described as dry thorn scrub characterised by the prevalence of Cashaw Macca (*Prosopis juliflora*). The vegetation assessment showed that the floral species diversity in this area is very low. No endemic, rare, threatened or endangered species were observed during the assessment. Only one invasive alien species, the Water Hyacinth (*Eichhornia crassipes*), was observed.

xix. Twenty (20) species of birds representing nine (9) families were observed during the survey. Only one endemic species was observed, the Jamaican Euphonia. No rare, threatened, endangered or invasive alien species were observed during the assessment.

xx. Twenty one (21) species of butterflies were observed during the survey, three (3) of which are endemic subspecies, which include the Jamaican Gillipus (*Danaeus gillipus jamaicensis*), the Jamaican Polydamas (*Battus polydamas jamaicensis*) and the Jamaican White Peacock (*Anartia jatrophae jamaicensis*). No rare, threatened, protected or endangered species were observed in the assessment.

xxi. The Lancewood Valley area can be described as being a highly disturbed ecosystem with few communities and niches. This is mostly influenced by the climate of the area. Other factors such as bush fires and anthropogenic activity have also played a part in the ecology of the area.

xxii. The total population of the study area is approximately 6,079. The total population of Clarendon is 237, 024. This means that the population of the study area represents approximately 2.6 % of the parish population.

xxiii. 36.9% of the population of the study area is less than 15 years of age. This is higher than the national figure of 32.3% of the population. In contrast to this, 9.6% of the population of the study area is over the age of 60. This shows closer agreement with the national figure of 10.2%.

xxiv. The study area shows an 81% increase in population over the past ten years or an average rate of growth of 8.1% per year. At the parish level, the rate of population increase is roughly 12% for the same period or a yearly growth rate of approximately 1.2%. The national rate of population growth for the period 1991 to 2001 is 9.53%. At the present growth rate one can expect that the population of the study area will be almost 11,500 persons by the year 2012.

xxv. The unemployment rate for the active population of the island of Jamaica is approximately fourteen percent (14%). This compares with a significantly lower unemployment rate of nine percent (9%) for the parish of Clarendon. Just over seventy-six percent (76.4%) of the persons surveyed reported that they had jobs.

xxvi. The majority of the respondents, eighty-two percent (82%), did not consider crime to be a problem in the area. The remainder cited praedial larceny and petty theft among their concerns, as well as reports of occasional gun crimes in adjacent communities.

xxvii. Within the community of Lancewood there is no major vehicular traffic. Although the traffic is low, all residents wished for good roads. They hoped that with the

development there would be an improvement to the road network of their respective communities.

xxviii. As at 2001 there were 1646 houses in the study area. Of these, ninety-seven percent (97%) were separate or detached dwellings.

xxix. All the houses in close proximity to the development site (Lancewood Valley) reported that they have access to electricity or have electricity in their homes. Ninety percent (90%) of respondents said that they had access to piped water from the National Water Commission (NWC). Fixed line services are available in the Lancewood Valley area. Over 50 % of the respondents said they had fixed lines in their homes. Most respondents said they also relied on cellular service (Digicel, Cable and Wireless and Miphone) for their telephone communication needs.

xxx. Solid waste is collected in the area at least once per week by the Metropolitan Parks and Market (MPM) and disposed of at the Riverton Landfill.

xxxi. Two (2) alternatives to the proposed project were analysed including the 'no action' and agriculture alternatives. Based on the environmental and socio economic assessments of the area the chosen option will be the proposed subdivision.

xxxii. The environmental and socio-economic impacts were assessed using an impact identification matrix. The project may have major negative environmental impacts on the air quality, noise, surface water quality and the soil quality of the area. Mitigation measures have however been proposed to reduce these impacts. Minor negative impacts may include those to the climate, hydrogeology and ecology of the area. Mitigation measures have also been proposed to reduce these negative impacts. The socio-economic impacts predicted were mostly positive. Measures have been identified to enhance these positive impacts.

xxxiii. A hazard impact identification matrix was designed to determine the probability and magnitude of the hazards the project may be subjected to. The main hazards that may be associated with the project include technological impacts and accidents. The project is also susceptible to natural hazards.

xxxiv. Although negative impacts which may be caused by the development have been predicted, with the implementation of the recommended mitigation measures the negative impacts associated with the project can be markedly reduced.

xxxv. A monitoring report for the development was designed to ensure that the mitigation measures proposed have been implemented and are effective as well as to identify any unanticipated impacts that may arise from the project.

TABLE I: SUMMARY OF ENVIRONMENTAL MITIGATION MEASURES

ENVIRONMENTAL COMPONENT	MITIGATION MEASURES	ADDED COST TO THE DEVELOPER
PHYSICAL		
CLIMATE		
Site Preparation and Construction Phases	o All mature trees present must be maintained and not be removed during this phase of the development.	$ 0.00
	o Ensure that the road system implemented throughout the development and access roads to the development involves appropriate signals and signs to ensure the smooth flow of traffic. This will reduce the idling of vehicles and therefore reduce the emissions and noise in the area.	$ 0.00
Post- Construction Phase	o Incorporate as far as possible natural vegetation typical of the area during the landscaping of the development.	$ 0.00
	o Although the proper maintenance of vehicles by potential occupants of the development is not the responsibility of the developer, it must be impressed upon the potential residents to maintain their vehicles regularly.	$ 0.00
AIR QUALITY		
Site Preparation and Construction Phase	o The clearing of vegetation must be carried out on a phased basis; that is, only areas designated for construction during the necessary phase of development must be cleared to minimise the dust that may be generated.	$ 0.00
	o The area to be designated as a green space will be covered with sod to eliminate the dust to be generated from this area. This area will only be cleared within a week before the sod is to be laid.	$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.	~$500/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 of aggregate, sand and cement to prevent spillage.	$ 0.00

	o Extra care must be taken to reduce dust in periods when wind speed are greatest which is between June and July, e.g. extra wetting of the compound to suppress dust.	$ 0.00
	o Plant large trees on perimeter of compound to create a natural windbreak, which will also serve the purpose of being a sight, screen shielding the plant from public view.	$ 0.00
	o All staff employed at the construction site must be provided with dust masks and be asked to use them.	~$3000.00
	o All raw materials must be sourced as close as possible to the construction site.	$ 0.00
	o Where possible waste must be transported off-site for processing, not burnt or stored for any longer than is 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 are properly maintained and serviced.	$ 0.00
	o Machines must not be left idling for unnecessary periods; this will save fuel and reduce emissions and noise pollution.	$ 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
Post - Construction Phase	o Although the proper maintenance of vehicles by potential occupants of the development is not the responsibility of the developer, it must be impressed upon the potential residents to maintain their vehicles regularly.	$ 0.00
	o 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. This may necessitate the alteration of the existing roadway, which have implied impacts.	$ 0.00
WATER QUALITY		
Site Preparation and Construction Phases	o If diesel and motor oil is to be stored, 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 project activities and signs indicating the storage of these substances erected.	$ 20,000.00

	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 chemical toilet.	~ $20,000.00
	o Store all raw materials away from the vicinity of watercourses located on the property to avoid contamination of this area.	$ 0.00
	o General refuse must be transported and disposed of appropriately at the designated disposal site at Riverton Landfill by a licensed contractor.	$ 0.00
	o Install a proper drainage system to control rain/storm water runoff on the site.	$ 0.00
	o Implement the recommended sewage treatment method which involves a Septic Tank / Tile Field for each lot.	$ 0.00
Post - Construction Phase	o Ensure that the sewage treatment facilities are properly maintained.	~$5,000.00/month
	o Regularly maintain the drainage system, which controls the storm water runoff at the site.	$ 0.00
	o Ensure that general refuse is collected regularly and is transported and disposed of appropriately at the designated disposal site at Riverton Landfill by a licensed contractor.	$ 0.00
WATER QUANTITY		
Site Preparation and Construction Phases	o Although water supply is readily available, it is important for the developer to implement measures to conserve water as much as possible during these phases of the development.	$ 0.00
Post - Construction Phase	o The developer should encourage residents to gutter all houses and encourage residents to recycle water for landscaping purposes.	$ 0.00
	o The developer should encourage residents to install water saving devices (faucets, toilets etc.) into their home design.	$ 0.00
SOILS AND GEOLOGY		
Site Preparation and Construction Phases	o Remove as little vegetation as possible from the development site and re-vegetate cleared vegetation as soon as possible. These areas should be cleared in phases.	$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 and erosion.	$0.00
	o Designate a main access route for heavy machinery.	$0.00
	o Utilise sod layers in the open area, which will reduce the effect of soil erosion when grass is being established.	$0.00

	o	Avoid activities in these phases in period when wind velocities are highest which is between June and July.	$0.00
	o	Avoid activities in these phases in periods of heavy rainfall, which are September and October.	$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
	o	Ensure that general refuse is collected regularly and is transported and disposed of appropriately at the designated disposal site at Riverton Landfill by a licensed contractor.	$ 0.00
Post - Construction Phase	o	Stipulate that houses to be constructed within the subdivision must be guttered as runoff from roofs may typically cause accelerated soil erosion around the margins of buildings. (Residents can utilise water which can be utilised for irrigation of landscape).	$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 to increase run-off.	$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	Ponding may occur in the depression area and therefore this should be retained as a green area for recreation and possible for the detention of storm water.	$ 0.00
	o	Paved areas should be kept to a minimum to reduce runoff to the depression.	$ 0.00
	o	No lots or building of houses should take place below the 53m contours.	$ 0.00
	o	Keep paved areas to an absolute minimum and encourage the use of permeable material for parking lots etc. to allow infiltration into the ground.	$ 0.00
Post-Construction Phase	o	Keep paved areas to an absolute minimum and encourage the use of permeable material for parking lots etc. to allow infiltration into the ground.	$ 0.00

NOISE & VIBRATION		
Site Preparation and Construction Phases	o Access roads should be cut that are exclusively used for the transportation of workers, goods and materials. This road 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 or school.	$0.00
	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 when possible.	~$5,000.00
	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	~$10000.00
	o Construction hours should be limited to the hours of 8:00 to 6:00 p.m. daily.	$0.00
	o The delivery of raw materials must be limited to 8:00 a.m. and 6:00 p.m.	
Post-Construction Phase	o Proper traffic signage and signals where necessary or appropriate to effect the free and safe movement of traffic and thereby reduce the noise caused by traffic build-up.	$0.00
	o Properly maintained vehicles and well-inflated tyres to reduce the friction will produce less noise.	$ 0.00
	o Where carpooling and public transportation is feasible, it should be encouraged to reduce traffic and therefore noise.	$ 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.	$0.00
	o Re-vegetate cleared areas as soon as possible.	$0.00
	o Plant vegetation screens to reduce the visual effect of this stage of the development.	$0.00

	o Place caveats on titles of the properties so that the construction of homes within the subdivision will be carried out in a uniform fashion.	$ 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.	$ 0.00
Post-Construction Phase	o Incorporate as far as possible the natural vegetation throughout the site.	$0.00
	o Incorporate fruit trees, ornamentals and flowers throughout the development. Ensure that these plants however are not classified as Invasive Alien Species.	$0.00
BIOLOGICAL IMPACTS		
FLORA		
Site Preparation and Construction Phases	o Only clear vegetation that is absolutely necessary for the construction activities	$0.00
	o Retain all mature trees (> 25 cm in height) during this phase of the development	$0.00
Post-Construction Phase	o Incorporate ornamental and fruit trees as wells as flowers throughout the development. This will attract birds to the area.	$ 0.00
FAUNA – BUTTERFLIES		
Site Preparation and Construction Phases	o Plant native shrubs and herbs throughout the development such as *Lantana sp.* to encourage butterflies to remain in the area.	$0.00
FAUNA – AVIFAUNA		
Site Preparation and Construction Phases	o These activities can be undertaken at a time outside the breeding season (March to June) and would force the any migrant birds to find alternate areas for nesting instead of having nest failures being a direct result of the vegetation clearance.	$0.00
Post-Construction Phase	o Incorporate as much of the natural vegetation into the development as possible.	$ 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 Incorporate ornamental and fruit trees as wells as flowers throughout the development. This will attract birds to the area.	$ 0.00
OTHER MACRO FAUNA		
Site Preparation and Construction Phases	o If possible, introduce site clearing on a phased basis to allow species opportunity to relocate to suitable nearby habitats and to reduce the shock to the various habitats that would 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
Post-Construction Phase	o The planting of native species in lots should allow for the possible re-colonization by some of the species as well as adding to the aesthetic appeal of the development.	$0.00
	o The reservation of green spaces that are uninterrupted by aspects of the development may be used for "passive" habitat creation. Areas of the site can be replanted with plant species that may encourage the return of associated animal species.	$ 0.00

TABLE II: SUMMARY OF SOCIO-ECONOMIC MITIGATION MEASURES

SOCIO-ECONOMIC COMPONENT	MITIGATION MEASURES	COST
SOCIAL STRUCTURE		
DEMOGRAPHY		
Post – Construction Phase	o Give locals first purchasing options within the development.	$0.00
	o The Local Planning Authority must play an important role in ensuring that the community growth in the area is monitored and implemented in an orderly manner.	$0.00
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 ensure that the community gets the most benefits from the development.	$0.00
	o As far as possible source raw material to be used in development from local suppliers.	$0.00
	o Identify a specific area on the project site for vending type activities.	
Post-Construction Phase	o The Local Planning Authority must play an important role in ensuring that the community growth in the area is monitored and implemented in an orderly manner.	$0.00

CRIME AND VIOLENCE		
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 that may be felt from locals and may reduce the level of crime and violence during these phases of the development.	$0.00
	o Despite the added expense it is recommended that there be adequate security present at the site at all times.	~$3000/day
Post-Construction Phase	o Residents must be encouraged to implement measures to protect property. This could take the form of neighbourhood watches, burglar bars, security guards, and dogs.	$0.00
TRAFFIC		
Site Preparation and Construction Phases	o Place flagmen along road network to regulate the traffic during road upgrade.	$0.00
	o As far as possible employ persons from the community to reduce the increase in vehicles that will transport workers.	$0.00
	o Place warning signs informing persons of the upgrading works.	$0.00
Post-Construction Phase	o Carry out improvement on the access roads to the development, ensuring that these improvements are conducted to withstand and allow for the increase in traffic that is expected from the development.	$0.00
	o A traffic system that involves appropriate signals and signs to ensure the smooth flow of traffic must be implemented.	$0.00
	o The Local Planning Authority must play an important role in ensuring that the community growth in the area is monitored and implemented in an orderly manner.	$0.00
INFRASTRUCTURE		
HOUSING		
Post-Construction Phase	o The developer should offer locals the first purchasing options for houses within the development.	$0.00
	o The developer must liaise with the Local Planning Authority, with respect to advertising of the development so that the area may get most of the benefits from the development.	$0.00
ROAD NETWORK		

Site Preparation and Construction Phases	o The developer must liaise with the Local Planning Authority to 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
Post-Construction Phase	o Ensure that roads are regularly maintained.	$0.00
	o Ensure that road improvement works are properly conducted in order to minimise the level of maintenance.	
UTILITIES: Electricity		
Post-Construction Phase	o Ensure that light fixtures that have been fixed with light sensors to reduce electricity consumption.	$ 0.00
UTILITIES: Telecommunications		
Site Preparation and Construction Phases	o Liaise with the telecommunications provider from the early stages of the development so that infrastructural work can be integrated with road upgrade works if necessary.	$0.00
SOCIAL SERVICES		
EDUCATION		
Post-Construction Phase	o The Local Planning Authority must play an important role in ensuring that the community growth in the area is monitored and implemented in an orderly manner.	
TRANSPORTATION		
Post-Construction Phase	o The developer must liaise with the Local Planning Authority to improve the road network, which provides access to the project area.	$0.00
HEALTH SERVICES		
Site Preparation and Construction Phases	o Provide a First Aid Kit on site for any minor injuries that may occur on site.	$2000.00
	o 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
Post-Construction Phase	o The developers must liaise with Local Government to construct another Health Clinic within 2 km of the project area.	$0.00
POSTAL SERVICES		

Post-Construction Phase	Liaise with the Jamaica Post Company Ltd to construct a Postal Agency/Office within 2 km of the Lancewood Valley area. This could also support the surrounding communities and therefore deter residents from travelling to May Pen to retrieve their mail which will therefore reduce the implied impacts.	$ 0.00
SOLID WASTE DISPOSAL		
Site Preparation and Construction Phases	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 an approved disposal site. o	$0.00
	o Ensure that vending during these phases of the development is localised. o	$0.00
	o Provide garbage receptacles around the project site.	$0.00
Post-Construction Phase	o The developer must liaise with the Local Parish Council to ensure that there is adequate and timely garbage collection in the community.	$0.00
	o This garbage must be collected by a licensed garbage disposal company and deposited at the Riverton landfill.	$0.00
	o Encourage members of the community to embark on composting of waste, which can be used in the maintenance of the green area and for general use throughout out the landscaping efforts of the community.	$0.00

TABLE III: SUMMARY OF HAZARD IMPACT ASSESSMENT MITIGATION MEASURES

HAZARD	MITIGATION MEASURES	COST
TECHNOLOGICAL HAZARDS		
	o Keep a fully equipped first aid kit on the project site.	$2000.00

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.	~$120,000.00
	o Designate the roles and responsibilities of employees, which will enable a clear chain of command during an emergency or accident and allows persons to be aware of their responsibilities in the event of such occurrences.	$6000.00
	o Ensure that all machinery used on the site is properly maintained and inspected before use.	$2,000.00
	o Install a suitable, approved fire extinguisher at an accessible, conspicuous and unobstructed point.	$1000.00
	o Place conspicuous warning signs where hazardous or flammable substances will be stored.	$1000.00
	o Place information signs around the project site, which list the numbers of the persons responsible for handling emergencies on the site, the May Pen Fire Department, the May Pen hospital and closest Police Station.	$2,000.00
	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.	$ 500.00
Post-Construction Phase	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
ACCIDENTS		
Site Preparation and Construction Phases	o Keep a fully equipped first aid kit on the project site.	$0.00
	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 information signs around the project site, which list the numbers of the person responsible for handling emergencies on the site, the May Pen Fire Department, May Pen hospital and the nearest Police Station.	$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
	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 capable and trained to do so.	$0.00
	o Ensure that the area surrounding the gully that traverses the property is securely fenced so as to reduce the risk of an accident occurring in this area.	$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
Post-Construction Phase	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
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
LIGHTNING STORMS		
Site Preparation and Construction Phases	o Ensure that staff members at the construction site are aware of the measures to be implemented during a lightning storm.	$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 persons responsible for handling emergencies on the site, the Fire Department, and the May Pen's Bay hospital.	$0.00

	o Keep an emergency log to document any occurrences of any 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
Post-Construction Phase	o Encourage occupants of the development to be properly wired and grounded and fixed with lightning attenuators.	$0.00
EARTHQUAKES		
Site Preparation and Construction Phases	o Keep a fully equipped first aid kit on the project site.	$0.00
	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 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 emergency and allows persons to be aware of their responsibilities in the event of such occurrences.	$0.00
	o Place information signs around the project site, which list the numbers of the persons responsible for handling emergencies on the site, the Fire Department, and the May Pen hospital.	$0.00
	o Keep an emergency log to document any occurrences of any 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
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. INTRODUCTION

Mr. Ernest McFarlane, the owner of the Lancewood property, has proposed to subdivide 90 acres ~ 36.4 hectares of land known as Part of Lancewood Valley, Clarendon into one hundred and twenty (121) housing lots. 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 by the Agency.

This report aims to present the assessment criteria, the methodologies for the assessments, the identification of the possible impacts of the project, analyse project alternatives, recommend mitigation measures for all impacts identified (See ***Appendix I*** for the Terms of Reference (TOR) issued by NEPA for the conduct of the EIA) and to give an outline of a environmental monitoring plan for the development.

The objectives of this EIA are as follows:

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

1.1 STRUCTURE OF THE REPORT

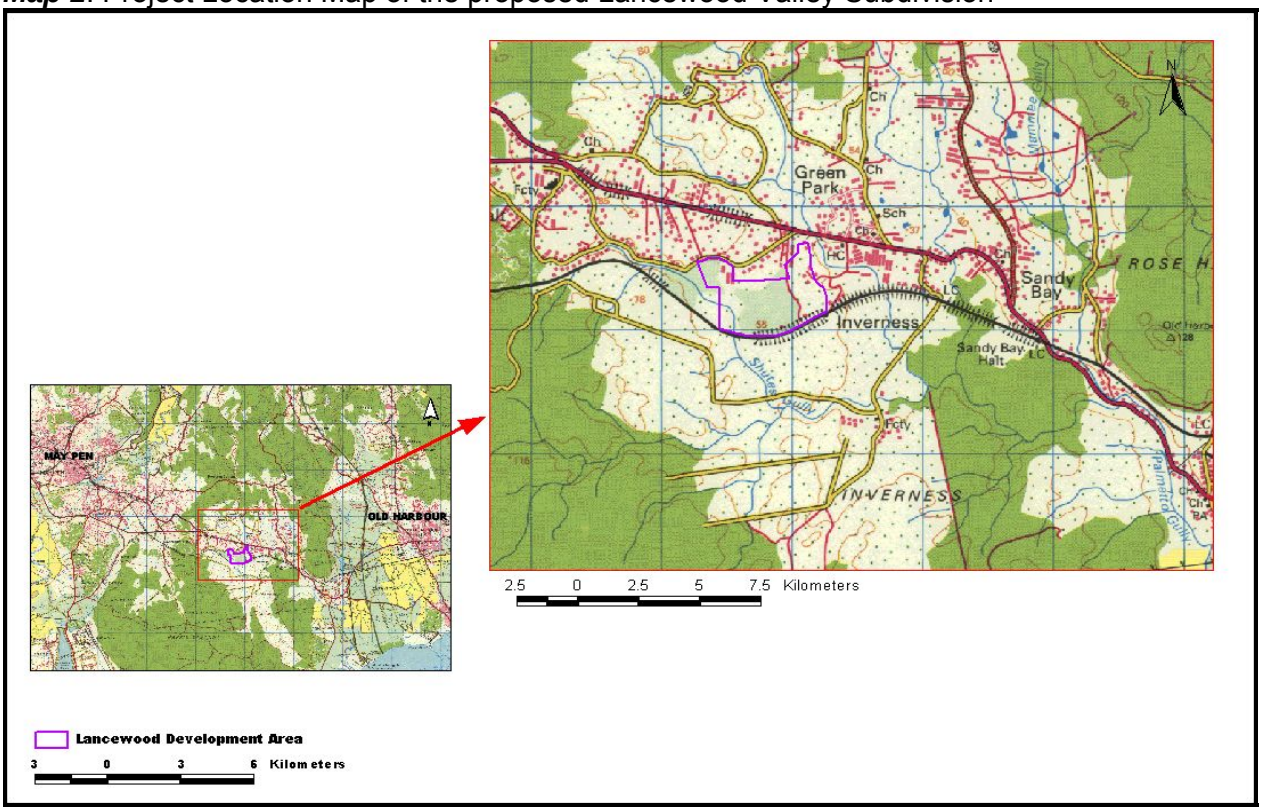
The report is divided into eleven (11) sections including the introductory chapter. ***Section 2*** of the report provides a description of the project including location and description of activities. This is followed by ***Section 3***, which presents an overview of all the pertinent laws and regulations 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 ***Sections 7, 8*** and ***9*** the environmental, socio-economic and hazard impacts are analysed and mitigation measures presented. ***Section 10*** provides an overview of the conclusions and recommendations made. A draft-monitoring plan for the development is presented in ***Section 11***. This is followed by the Bibliography in ***Section 12*** and the Appendices in ***Section 13***.

2. PROJECT DESCRIPTION

2.1 PROJECT LOCATION

The area to be developed is located in Lancewood Valley, Clarendon (See ***Map 1*** below). It is accessed from the South Coast Highway and is located centrally between Old Harbour and parish capital May Pen. It is also 2 km south of the Sandy Bay community.

Map 1: Project Location Map of the proposed Lancewood Valley Subdivision



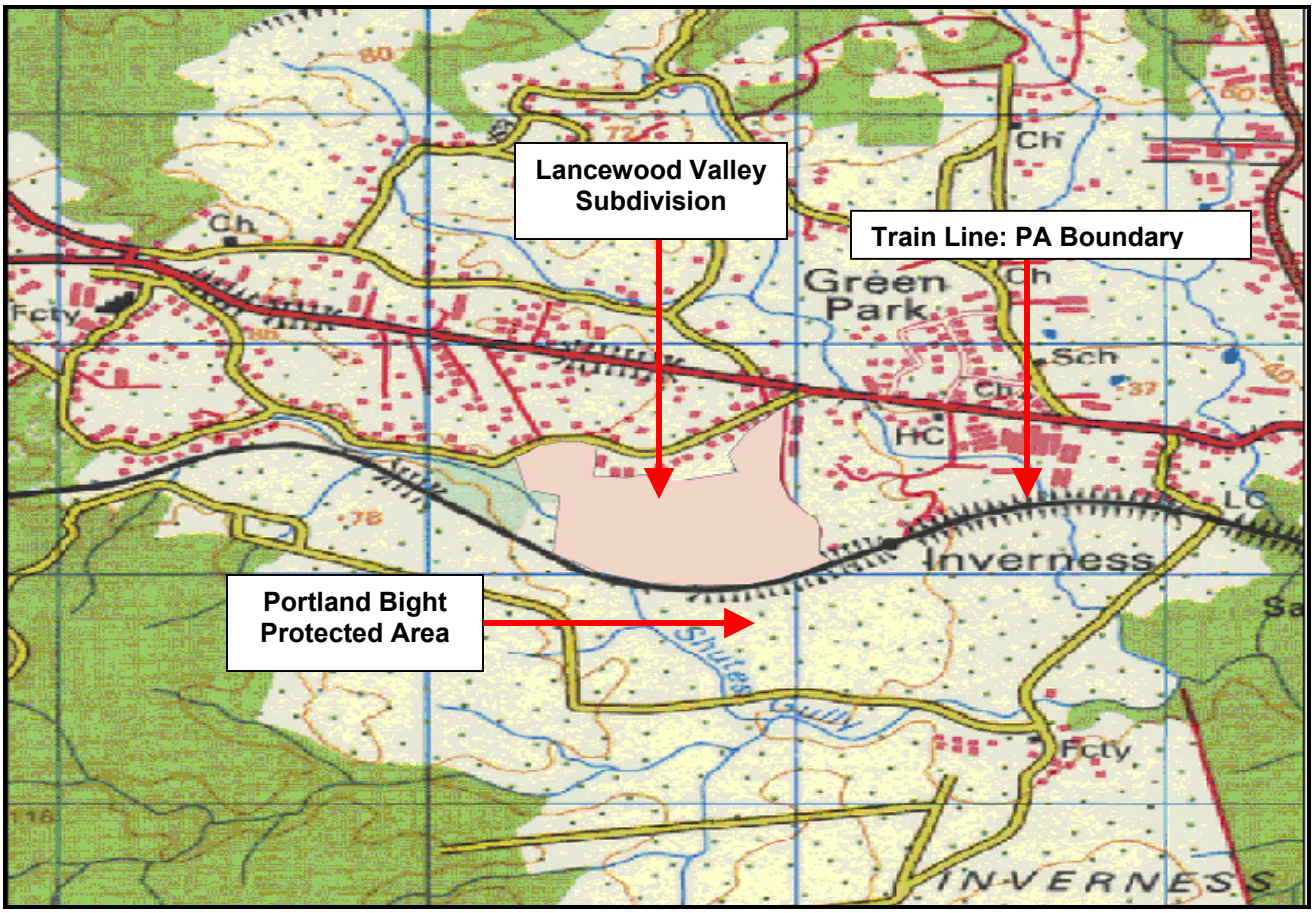
The project site is also located just north of the boundary of the Portland Bight Protected Area (PBPA). This protected area was declared in 1999 under Section 5 of the Natural Resources Conservation Authority (NRCA) Act of 1991, and is managed by the local Non-Government Organization, the Caribbean Coastal Area Management (CCAM) Foundation, whose offices are located in Lionel Town, Clarendon. This Protected Area is divided into four (4) regions and the Lancewood Valley property lies adjacent to the Vere Plains Region boundary, which runs south-east along the railway line through

Inverness and Freetown to the parish boundary of Clarendon and St. Catherine (CCAM, 2007)(See ***Map 2 & 3*** below for the Protected Area boundaries).

Map 2: Map Showing Portland Bight Protected Area and its Boundaries

Source: CCAM (2006)

Map 3: Map showing the location of the Lancewood Subdivision in respect of Portland Bight Protected Area



2.2 HISTORY OF THE SITE

The Lancewood Valley has been in use for some time, but to a large extent has remained undeveloped. Discussions with the developer and residents from the surrounding communities showed that the primary land use of the site for the past fifty (50) years has been for agricultural purposes, namely cattle rearing.

The current owner acquired the property in the late nineteen seventies and used the area as grazing pastures for cattle and goats. This activity was discontinued however due to the frequent occurrence of praedial larceny as well as the low financial returns from this activity.

2.3 DESCRIPTION OF THE AREA TO BE DEVELOPED AND CURRENT LAND USE

The portion of Lancewood Valley earmarked for the development is currently an undeveloped, mostly flat parcel of land with few areas with gently sloping gradients. The site is bordered by a small settlement on its northern border and a number of residences to the northwest and north-northwest borders. To the east of the property is Highway 2000, and to the south is a railway that is traversed by JAMALCO's Bauxite freight train (See ***Figure 1*** below). (*Reservations have been made for these two areas on the proposed development plan*) Three homes have been built on the property and are currently occupied; these are situated on lots 7, 18 and 19 (See ***Appendix II***). There is a crude pathway that vehicles can use to the very north of the property. Although one small section of the property showed evidence of use for charcoal burning this practice was not observed during the reconnaissance visits. Goats were also seen grazing on the property; these do not belong to the developer but enter the property through pathways from nearby fields in the community.

2.4 PURPOSE OF THE DEVELOPMENT

The purpose of the development is to provide much needed housing alternatives to the Clarendon region, which in recent years has been ever expanding. In addition the project aims to promote community growth and development of Lancewood Valley and its surrounding communities, while providing economic gain for all stakeholders involved.

Figure 1: Picture showing the aerial view of the Lancewood Valley Area to be developed

Source: Google Earth (2006)

2.5 PROPOSED PROJECT DESIGN

The proponent intends to carry out the development on approximately 90 acres ~ 36 hectares. This will include the subdivision of the property into one hundred and twenty one (120) housing lots complete with roads, electricity and water. The land use for the development is shown in ***Table 1*** below.

Table 1: Table showing the land use during the development

LAND USE	AREA/HECTARE
Residential Lots	28.5
Roads	3.06
Common Area	4.8
TOTAL	**36.4**

2.5.1 RESIDENTIAL LOTS

The activities will involve the clearing and grading of land and subsequently the subdivision of the property into one hundred and twenty one (121) lots. These lots will range from 1,039 square meters to 11,190.09 square meters.

2.5.2 ROADS AND INFRASTRUCTURE

Access roads and other infrastructure including electricity and water supply will be implemented in the development.

2.5.3 MINERAL NEEDS

The construction of the development will require the following raw materials for construction: cement, aggregate (fine and coarse) and sand for the construction.

2.5.4 WATER SUPPLY AND DEMAND

Water for the development will be sourced from a well located in Twin Palms, which is operated by the National Water Commission (NWC). This well has a licence to abstract 4,524,000 litres of water per day.

It is anticipated that three (3) and four (4) bedroom houses will be constructed at the site which will accommodate four (4) to eight (8) persons per household. It is estimated that the water use per person is approximately 230 litres per day (EHU, 2005). Therefore the approximate water demand for each household will range from 1380 litres to 1840 litres. Approximate daily water consumption for the entire development will range from 166,980 – 222,640 litres.

2.5.5 SEWAGE TREATMENT AND DISPOSAL SYSTEM

Based on recommendations of the Environmental Health Unit (EHU), Ministry of Health sewage treatment should be at least to a secondary level. *Volume 4: Guidelines for Wastewater and Excreta Treatment,* (2006) recommends that a sewage treatment design comprising of a Septic Tank/Tile Field is an appropriate method of treatment of sewage. These guidelines however stipulate that a minimum area of 560 m^2 is required

for the construction of this system. The lots to be developed at the Lancewood Valley subdivision range 1039 m^2 to 11,190.09 m^2. These lots sizes are therefore sufficient for onsite construction of the Septic Tank/ Tile Field sewage treatment design for each housing lot.

Estimating that there will be 95 % wastewater, based on water consumption, each onsite system (Septic Tank/Tile Field) should be built to facilitate the maximum of approximately 1500 litres of wastewater per day for three (3) bedroom houses and 2000 litres for four (4) bedroom houses.

2.6 PROJECT IMPLEMENTATION

It is anticipated that the project will be implemented over a one-year period as outlined in ***Table 2*** below.

Table 2: Table Showing The Proposed Implementation Schedule of the Project

ACTIVITY	YEAR 1			
	Q1	Q2	Q3	Q4
Subdivision of entire development				
Construction of Access Roads				
Implementation of Infrastructure (Water, Electricity and Sewage Treatment Facility)				
Development of Common Area				
Sale of Lots				

3. 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 include 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 to present 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:

- Natural Resources Conservation Authority (NRCA);
- Town Planning Authority (TPA) and;
- 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:

- Subdivisions of 10 lots or more
- Housing projects consisting of 10 houses
- 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 subdivide a property 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 Clarendon Parish Council. It is also important to note that planning permits cannot substitute for environmental permits or vice versa.

i 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 are determined by the Terms of Reference (TOR) approved by NEPA (See ***Appendix I)*** 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.

ii. The 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 there-under."*

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.

iii. Environmental Permit and Licence to Discharge

In addition to the permit to build, 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 Clarendon was published in 1982. 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.

i. 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.

ii. 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 prefabricated units, while individual lot owners will have to apply for individual planning permission from the local Parish Council. 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.

3.1.2 THE LOCAL IMPROVEMENTS ACT

Apart from planning permission, the Clarendon Parish Council also administers the Local Improvements Act, which requires developers to apply for permission to subdivide lots for sale or residential purposes. Developers are required by section 5 of that Act to deposit maps with the Council that show to scale the streets and ways to be formed and laid out, as well as the street works. That is, location and dimension of sewers, water pipes, gas pipes and lighting mains. If necessary, the developer may have to have these confirmed by a Commissioned Surveyor.

The developer will have to confirm application fees with the parish council but a guide is that subdivisions of over one hundred (100) lots may be charged at a rate of 0.4% of the value of the land and the cost of the infrastructure development. Normally half is paid on application and half on grant of the subdivision approval. The Council can also allow a fee payment schedule if the development is expected to take more than eighteen (18) months.

3.1.3 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 or parties are still dissatisfied with the compensation presented the matter may be brought before the Supreme Court.

3.1.4 THE REGISTRATION OF TITLES ACT (1989)

The Registration of Titles Act was promulgated in 1989. Under this Act all registered titles are evidence of ownership, which is guaranteed by the Government of Jamaica. The system used for the registration of titles in Jamaica is similar to the Australian Torrens System of land registration. Registration in Jamaica is however not compulsory. Once a parcel of land has been registered, all subsequent transfers must be made under the Act.

3.1.5 HOUSING ACT (1968)

The Housing Act (1968) is administered by the Ministry of Housing and guides the Ministry in the procedures to be employed for the acquisition of land required for housing schemes, the approval of these housing schemes and the completion of schemes by housing associations. Section 9 of the Act outlines that before a scheme is approved the specifications and particulars of the proposed housing scheme including

information relating to the roads, water supply, sewerage and lighting will be furnished to the Local Authority within whose area the scheme is being proposed.
Before considering the approval of a scheme, the Minister must consider any objections or representations made to him in pursuance of Section 9 and shall afford the Local Authority to make such objections or representations an opportunity to be heard.

3.1.6 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.

3.1.7 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.

3.1.8 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 Act of 1942. Under this Act it is an offence to:

- Set fire to trash without serving an officer of the nearest police station with notice or clearing open space around trash.
- Set fire to trash between 6 p.m. and 6 a.m.
- Leave open –air fire unattended.

- Failure by occupier of land to take responsible steps to extinguish fire on his land.
- Set a fire contrary to order or permit.

3.1.9 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) jurisdiction over the disposal of solid waste in Jamaica. Under this Act it is illegal to:

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

3.1.10 THE CLEAN AIR ACT (1964)

The Clean Air Act (1964) refers to developments where there are industrial works, which in the opinion of an inspector is 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 enquiries with respect to these premises.

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

- A building or structure which is or likely to become a health hazard due to structural defects or unsanitary conditions.
- Premises or other places where unsanitary conditions are present or are likely to become a health hazard.

- Accumulation or deposit of solid waste, human or animal excreta.
- Dust, smoke, fumes, gases or effluvia emitting from any manufacturing process or caused from trade or business.
- Lack of water or water supply system.
- Water supply that is not maintained in a sanitary condition.
- Discharge of sewage, industrial waste or any other noxious matter into the sea or any watercourse or unto any land.

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):

- Promote the conservation of biodiversity.
- Sustainable use of its components.
- 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:

- 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
- 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.

4. 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 presents the methodologies employed in conducting the baseline assessment for each area as well as the results and observations from these assessments.

4.1 PHYSICAL ENVIRONMENT

4.1.1 CLIMATE

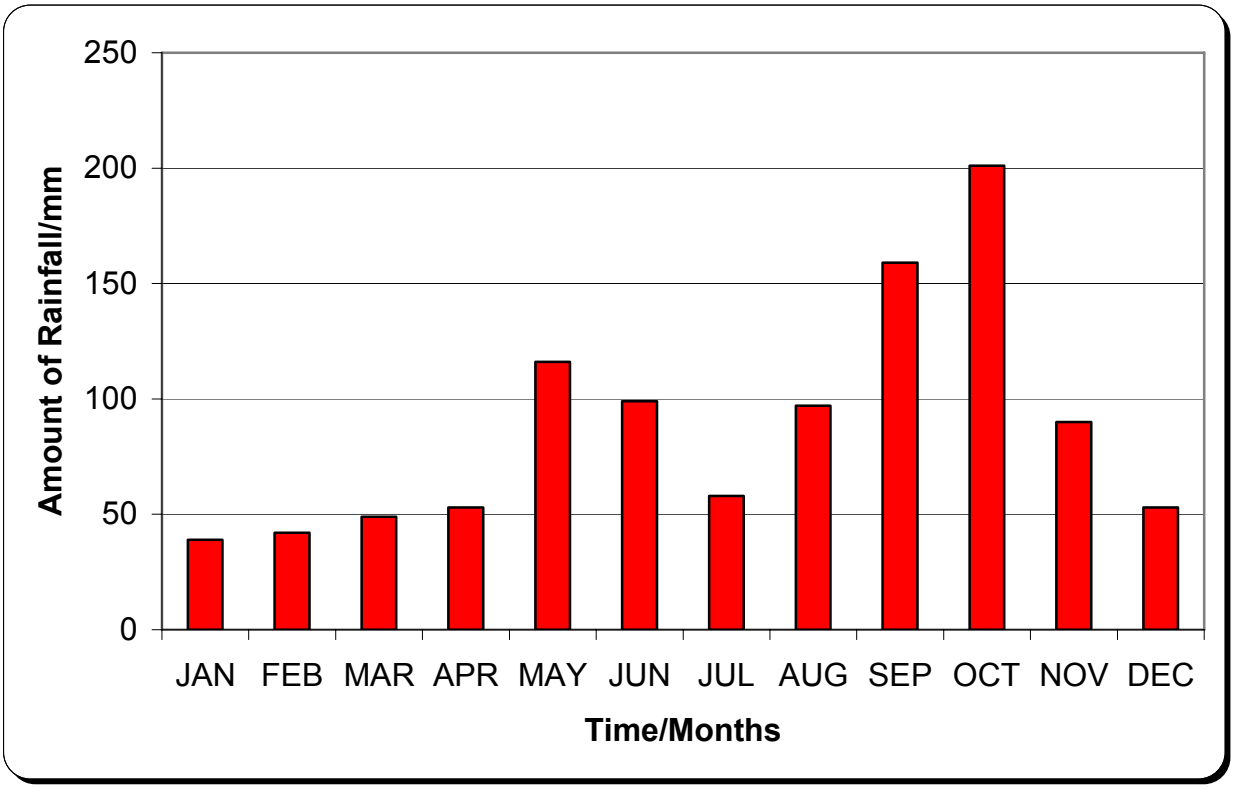
Methodology

The data presented in this section was collected by secondary research. The National Meteorological Service of Jamaica has collected a plethora of climate data for the island. The closest meteorological research centre to the proposed subdivision is the Bodles Research Centre, which is located approximately 7 km from the Lancewood Valley area.

a. Rainfall

The proposed site for development is located within the Rio Minho Watershed. The 30-year mean for rainfall data collected at the Bodles meteorological station is shown in ***Figure 2*** below. The data shows that the average rainfall in the area ranges from a low of 39 mm in January to a high of 201 mm in October.

Figure 2: Graph showing the 30 Year Mean Rainfall for the Bodles Meteorological Station



Source: National Meteorological Service, Jamaica (2006)

b. Wind

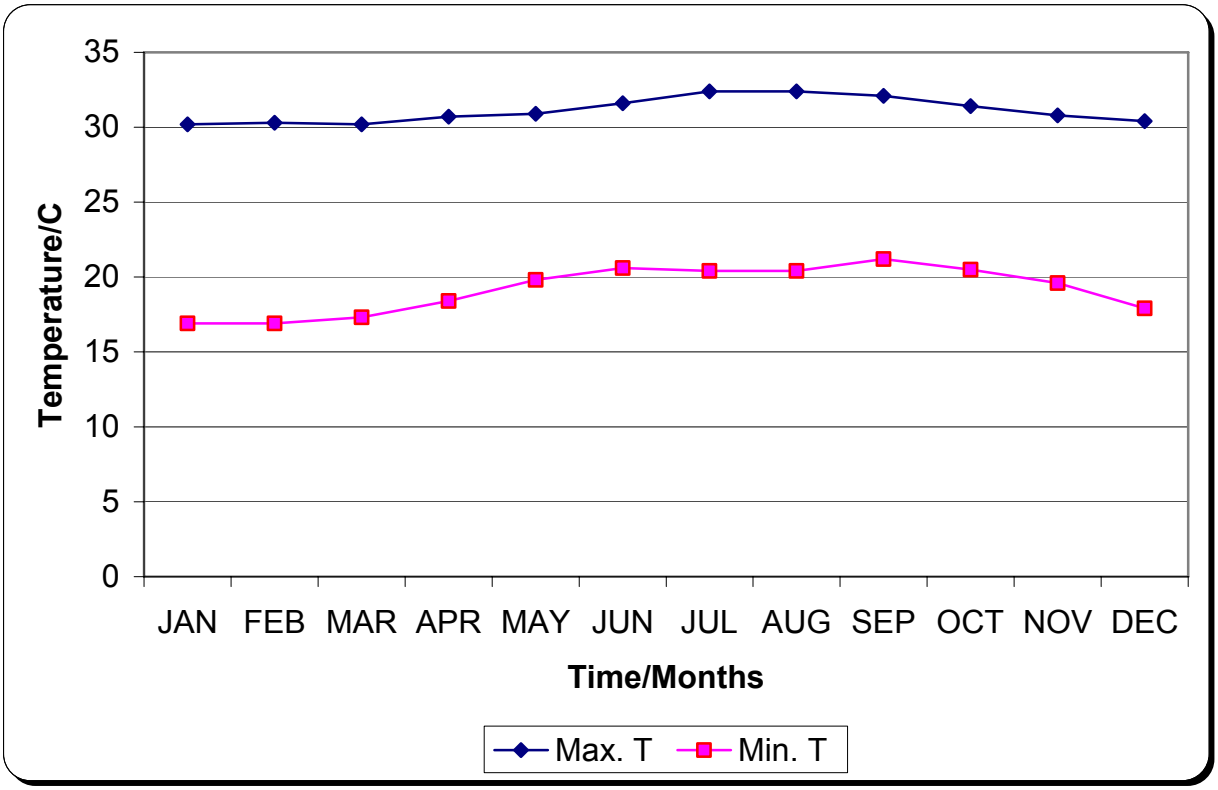
The island's wind patterns are dominated by the Northeast Trade Winds. On the south coast, wind patterns during the day have an east-south-easterly direction, with an average speed of 33 km/h (18 knots). At night, these Trade Winds combine with land breezes which blow offshore down the slopes of the hills near the coast. As a result the wind patterns on the south coast have a northerly component, with a maximum speed of 13 km/hr (7 knots) during the night. Between June and July the wind speeds reach a maximum of 48 km/hr (26 knots). These wind speeds decrease as you move further inland.

Data from the Bodles research station shows that wind speeds in this area reach a maximum of approximately 21 km/hr in June and a minimum of 10.2 km/hr in December.

c. Temperature

The temperatures recorded in the area are reflective of the southern coast of the island. These temperatures range from a high of 32.4 ºC in July to a low of 16.9 ºC in January. See ***Figure 3*** below for the graph, which shows the mean temperatures recorded at the Bodles Research centre.

Figure 3**:** Graph Showing the Temperature Ranges for the Bodles Research Station, Clarendon



Source: National Meteorological Service, Jamaica (2006)

d. Relative Humidity

The relative humidity recorded at the Bodles Research Center shows that the humidity in this area is relatively constant throughout the year ranging from a low of 72 in July to a high of 79 between September and October.

4.1.2 AIR QUALITY

The location of the proposed subdivision predisposes it to a determination of the air quality in the area as it is adjacent to both Highway 2000, and the Jamaica Alumina Company Ltd. (JAMALCO) train line which transports bauxite from the mines to the processing plant located in Hayes, Clarendon. Given these factors it is important to monitor air quality for possible pollutants. NO_2 and SO_2 were measured (as indicators of NO_x and SO_x, respectively).

4.1.2.1 METHODOLOGY

Passive air quality monitors were used to determine NO_2 and SO_2 concentrations in the area. Passive monitors are relatively inexpensive and may provide estimates of the annual mean concentrations of pollutants from monthly exposures (Morris and Therivel 2001).

Each monitor is composed of a vial capped at one end and which is open to the atmosphere at the other. Each is fitted with metal gauze containing an adsorbent specific to the pollutant, which is being monitored. These monitors were removed from their plastic screw-capped containers and the date and time recorded; they were attached with the coloured cap facing upward from a suitable, sturdy tree branch using wire for support (See ***Figure 4*** below). Monitors were placed at four (4) designated sites on the property and the GPS coordinates for each site noted. *Site 1* close proximity to the highway, *Site 3* close to the train line, and the other two sites, *Sites 2* and *4*, were placed in central areas of the property. (See ***Appendix III***) These monitors were labelled and placed in duplicate at each site i.e. two each for NO_2 and SO_2. At the end of the two-week sampling period, the container was replaced in the screw-capped container and the date and time again recorded. These readings were taken to allow calculation of the exposure time. Another set of monitors were placed in the same area and the date and time recorded. These were left in the field for another two weeks. At the end of the two-week period, the date and time were then recorded.

After the completion of the monitoring period, the monitors were collected for analysis. NO_2 was determined using UV/Vis Spectrophotometry (Sulphanilamide method) and SO_2 was determined by Ion Chromatography.

Figure 4: Picture showing the mounted Passive Air Quality Monitors

4.1.2.2 PRESENT STATUS

a. Nitrous Oxides

The results from the analysis showed that the NO_2 values ranged from a low of 5.4µg/m^3 to a high of 15.2µg/m^3. The highest values were recorded at the monitoring *Site 1* which is located closest to the highway. This was expected as there were more point sources in this area. The other three monitoring sites (*Sites 2 – 4*) showed significantly lower values than *Site 1*. The results are shown in ***Table 3*** below.

Table 3: Table showing the monthly averages of NO_2 recorded at the air quality monitoring sites

SITE NUMBER	LOCATION	NO_2 (µg/m^3)
1	Highway	15.2
2	Mango Tree	6.8
3	Train Line	5.6
4	Tree (Middle)	5.4

b. Sulphur Dioxide

As compared to the NO_2 readings, there was less variation in the SO_2 values from monitoring site to monitoring site, although the readings recorded at *Site 2* exhibited a slightly lower reading than the other three (3) sites (See ***Table 4*** below).

Table 4: Table showing the monthly averages of SO_2 recorded at the air quality monitoring sites

SITE NUMBER	LOCATION	SO_2 (µg/m^3)
1	Highway	18.5
2	Mango Tree	12.6
3	Train Line	17.8
4	Tree (Middle)	16.9

4.1.2.3 DISCUSSION

Overall the highest NO_2 (15.2 µg/m$^{3)}$ readings recorded at the development site are however much lower than typical NO_2 values that have been recorded in the Kingston Metropolitan Area, where the annual mean ranges from 20 to 25 µg/m^3 (Chemistry Department, University of the West Indies, Mona, 2006). In addition, these values are well within the Natural Resources Conservation Authority (NRCA) air quality standards, which states that annual mean concentration of NO_2 should be $\leq$ 100 µg/m^3 (See ***Table 5*** below).

Similarly, data from the Chemistry Department of the University of the West Indies shows that SO_2 that has been recorded in the Kingston Metropolitan Area varies from 15 to 20µg/m^3. Overall the values recorded at the site are well within the Natural Resources Conservation Authority's Air Quality Standards, which state that the annual mean for SO_2 should not exceed 80µg/m^3 (See ***Table 5*** below).

Table 5: Table showing the Jamaica National Ambient Air Quality Standards

POLLUTANTS	STANDARDS μg/m^3					
	Annual		24 hr		1 hr	
	1^0	2^0	1^0	2^0	1^0	2^0
PM_{10}	50		150			
SOx	80	60	365	280	700	
NOx	100					

Source: NAAQS (2002)

4.1.3 WATER QUALITY & QUANTITY

Water quality refers to the physical and chemical conditions of surface and groundwater within an area. These physical conditions include the water temperature and the presence of particulate matter, whereas the chemical conditions depend on the types and concentrations of dissolved chemicals present (Morris and Therivel 2001).

Water quantity refers to the storage of water within the various environmental systems and the flows of water within and between these systems (Morris and Therivel 2001).

4.1.3.1 WATER QUALITY

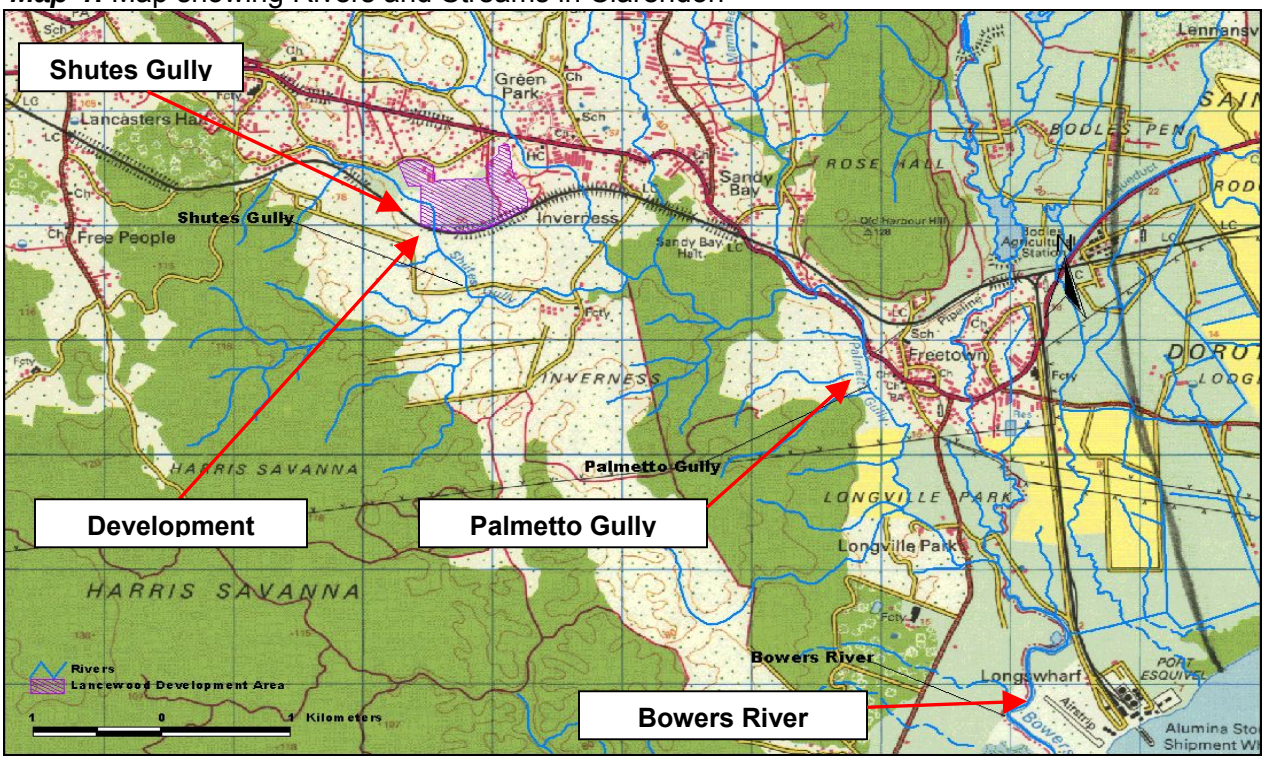
i. Surface Water

Based on the review of maps of the area and reconnaissance visits two (2) watercourses run in close proximity to the development area. These include the Shutes Gully, which traverses the property to the west, and an unnamed gully which is located to the east of the property. Both gullies flow in a generally southeasterly direction and converge southeast of the property before entering the Palmetto Gully. The Palmetto Gully then flows into the Bowers River, which flows into the sea in the vicinity of Port Esquivel operated by the Jamaica Alumina Company (JAMALCO), (See ***Map 4*** below). This area is within the marine boundaries of the Portland Bight Protected Area (PBPA). The marine waters in this area contain extensive coral reefs, seagrass meadows and mangrove wetlands (CCAM, 2006). At the time of this assessment, however no flows were observed in the gully and the water observed was assumed to have settled from rains during the time of the assessment. Therefore, no determinations were deemed necessary for these watercourses.

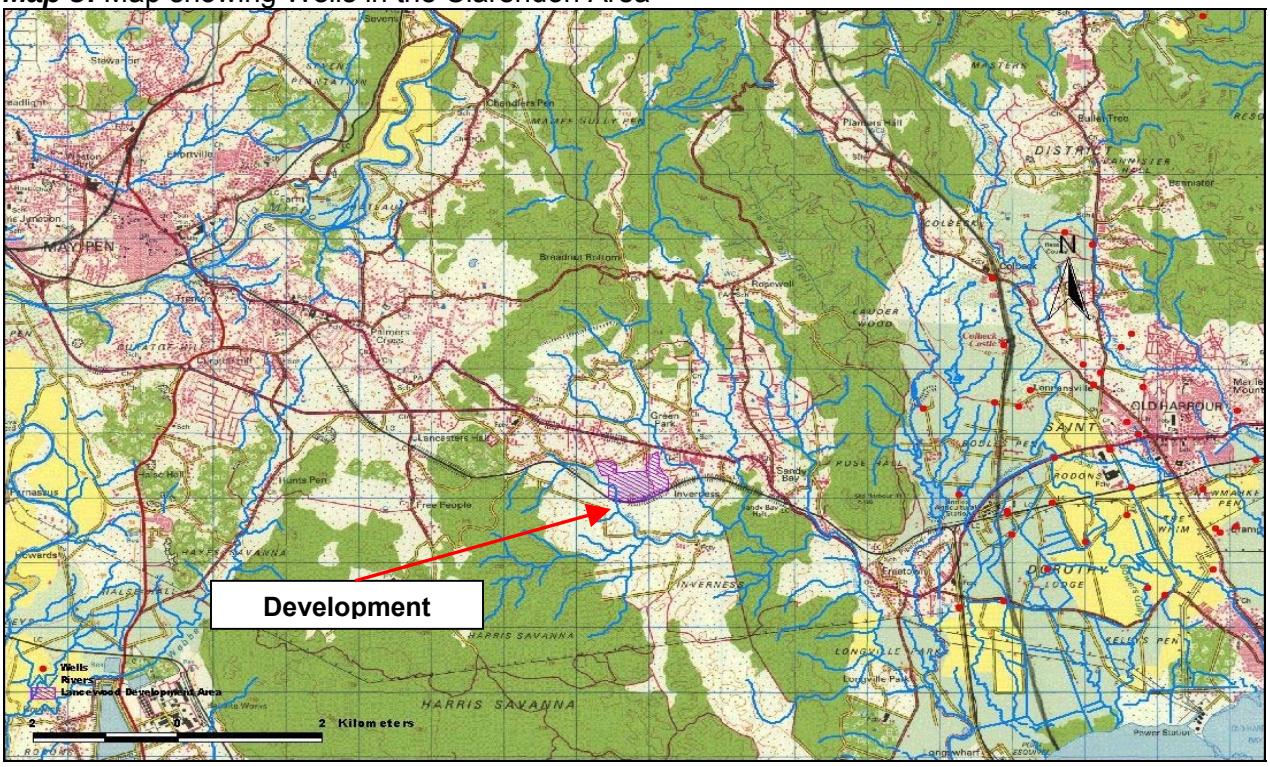
ii. Ground Water

The analysis of the maps of illustrating the wells in Clarendon (Please see ***Map 5*** below) shows that there are no wells within the vicinity of the proposed Lancewood Valley subdivision. Enquiries with residents and the developer showed that the Lancewood Valley community is supplied with water from a well located within the Twin Palms development. This well is operated by the National Water Commission (NWC) and is the proposed source of water supply for the development.

***Map 4*:** Map showing Rivers and Streams in Clarendon



***Map 5*:** Map showing Wells in the Clarendon Area



4.1.3.1.1 METHODOLOGY

A water sample was obtained from the Twin Palms well on Thursday January 18, 2007. The samples were kept in cold storage (<4^{0}C) until delivery to the laboratory for analysis. The determinations are shown in ***Table 6*** below.

Table 6: Methods of Analysis of Water Samples

PARAMETER	TEST METHOD	DETECTION LIMIT
Faecal Coliform	MPN (Most Probable Number) Tubes	3 MPN/100ml
Total Coliform	MPN Tubes	3MPN/100ml
Total Suspended Solids	Photometric Method (HACH 8178)	1 mg/L
Nitrate	Cd reduction	0.76 mg/L
Phosphate	Acid Persulfate Digestion; Amino Acid	0.06 mg/L
Sodium	Flame Atomic Absorption Spectrophotometry (F-AAS)	0.5 mg/L
Arsenic	F-AAS	20 μg/L
Manganese	F-AAS	10 μg/L

4.1.3.1.2 PRESENT STATUS

The results of the water quality analyses are shown in ***Table 7*** below.

Table 7**:** Water Quality Data for Twin Palms, Clarendon

PARAMETER	Twin Palms	WHO LIMIT
Faecal Coliform (MPN)	<3	Undetected
Total Coliform (MPN)	<3	Undetected
Total Suspended Solids (mg/L)	2	na
Nitrate (mg/L)	3.52	50
Phosphate (mg/L)	1.67	na
Sodium (mg/L)	13.9	20
Arsenic (μg/L)	<10	10
Manganese (μg/L)	<20	400

i. Total and Faecal Coliform

Total and faecal coliform were undetected in the sample as required by the World Health Organisation (WHO) Guidelines for Drinking Water Quality (3rd Edition, WHO, 2004).

ii. Total Suspended Solids

Total Suspended Solids (TSS) in the sample was 2 mg/L. A health-based guideline has not been established for TSS. The level present in the sample, however, would not render the source unfit as a source of potable water.

iii. Nitrates

Total Nitrate (NO_3) was determined to be 3.52 mg/L, well below the WHO limit of 50 mg/L.

iv. Phosphates

Phosphate (PO_4) in the water sample was found to be 1.67 mg/L. No health-based guideline has been issued by the WHO.

v. Sodium

Sodium was determined to be 13.9 mg/L; the WHO suggests that potable water must contain less than 20 mg/L.

vi. Manganese and Arsenic

Manganese and Arsenic were undetected, meeting the WHO limits of 400 and 10 μg/L respectively.

4.1.3.1.3 DISCUSSION OF BASELINE ASSESSMENT

The well located at Twin Palms currently supplies Lancewood Valley and its surrounding communities with potable water and is constantly monitored for quality by the National Water Commission (NWC). No local drinking water standards are available for Jamaica and therefore the World Health Organisation (WHO) standards are those that are used. Based on the results of the water quality analysis and comparison with the WHO standards the proposed source of water for the Lancewood Valley development is suitable for drinking and household use.

4.1.3.2 WATER QUANTITY

Water for the development will be sourced from a well located in Twin Palms, which is operated by the National Water Commission (NWC). This well has a licence to abstract 4,524,000 litres of water per day.

It is anticipated that three (3) and four (4) bedroom houses will be constructed at the site which will accommodate four (4) to eight (8) persons per household. It is estimated that the water use per person is approximately 230 litres per day (EHU, 2005). Therefore the approximate water demand for each household will range from 1380 litres to 1840 litres. Approximate daily water consumption for the entire development will range from 166,980 – 222,640 litres.

The well located at Twin Palms has the generating capacity to supply the development with water. The developer has been in discussion of the National Water Commission with respect to this.

4.1.4 GEOLOGY

4.1.4.1 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.

4.1.4.2 PRESENT STATUS

i. Rock Formations

Units of the Newport Formation of the White Limestone Group chiefly underlie the development area. The limestone beds of this unit are moderately indurated and are fossiliferous (sometimes containing mollusc macrofossils in addition to the ubiquitous microfossils). The beds are generally poorly exposed, but good surface exposures occur in naturally formed drainage sites (notably Shutes Gully) and in other areas within the proposed development borders that appear to have been used for very small-scale surface mining. The beds of the Newport Formation have good drainage properties that contribute to the lack of surface drainage within and in the general vicinity of the development area. This, amongst other factors, contributes to the ecology of the dry limestone hills of the Portland Bight Protected Area to the south.

ii. Faults

No major faults were identified in the area based on the surface geology. One linear feature can be identified on the satellite imagery, which coincides with the Shutes Gully. It is possible that this gully developed along a minor fault. The absence of fault rocks in the gully suggests that if this were a fault it is not one along which considerable displacement has taken place.

The reconnaissance data suggests that the area does not have a considerable thickness of superficial deposits. As such, the ground acceleration experienced in this area during an earthquake would be less than that experienced on the alluvial plains

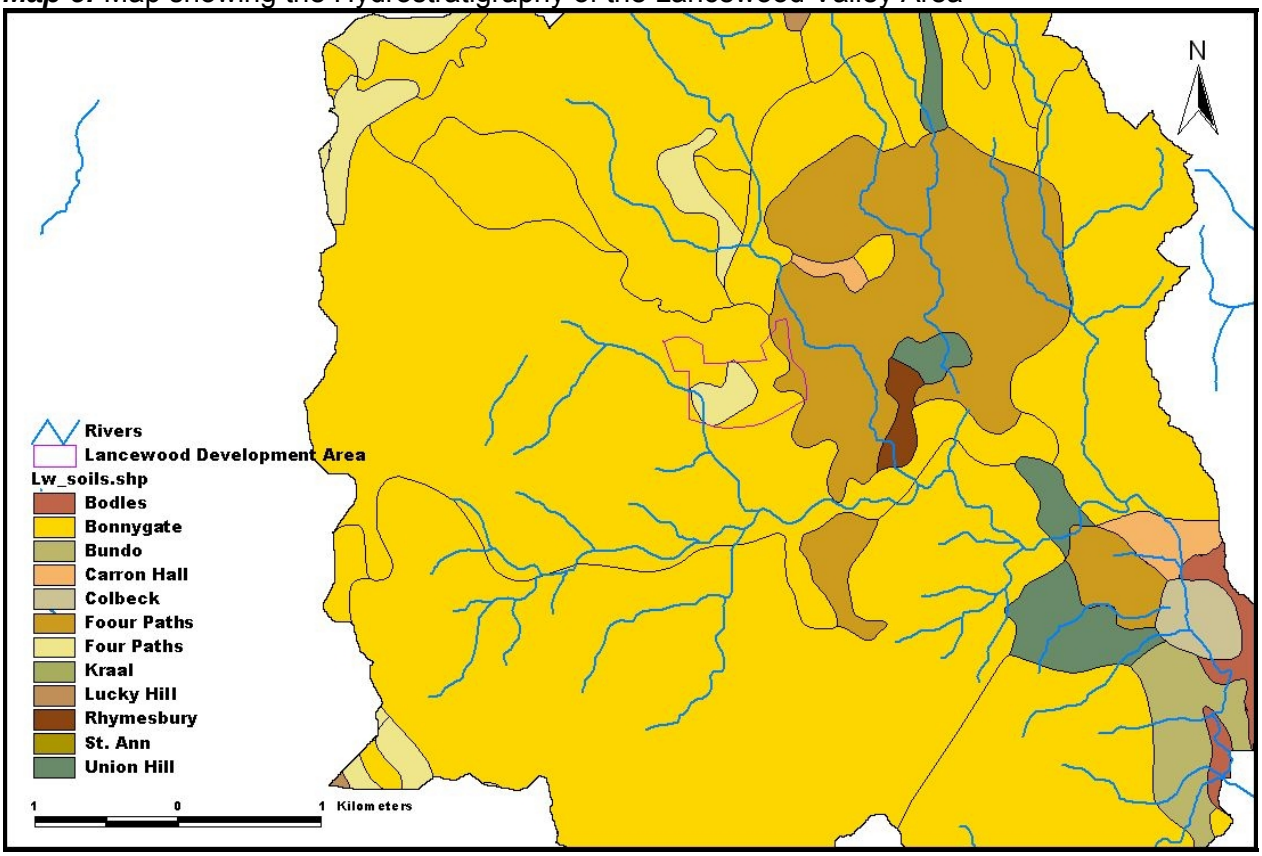
nearby. It is not possible, however, to make a qualitative assessment of this hazard potential until further geotechnical evaluations are conducted.

ii. Soils and Topography

Gentle slopes characterize the development area. Steep slopes exist, however, in the vicinity of the Shutes Gully close to the train line, whereas moderately steep slopes are present along the land area bordering the Old Harbour Bypass Road. Based on the general topography and distribution of the rock outcrops, the existence of a considerable soil thickness in the area is thought unlikely. It is likely that much of the area is covered with a relatively shallow thickness of soil probably not exceeding approximately one (1) m in areas of greatest soil cover.

The soil type in this area is classified as mostly Bonny Gate and Four Paths (See ***Map 6*** below).

Map 6: Map showing the Hydrostratigraphy of the Lancewood Valley Area



4.1.5 HYDROGEOLOGY

4.1.5.1 HYDROGEOLOGY ASSESSMENT

i. Hydrological Setting

The Lancewood development area is located centrally between Old Harbour and May Pen in the Parish of Clarendon. It is approximately 2 km south of Sandy Bay. The Shutes Gully traverses the property to the west while another unnamed gully is located to the east of the property. Both gullies flow in a generally southeasterly direction and converge southeast of the property before entering the Palmetto Gully. The Palmetto Gully then flows into the Bowers River, which flows to the sea. (See ***Map* 4 in Section 4.1.3** above)

The development area is gently sloping with a small depression located to the south of the property ***(Figures 5a*** and ***5b***). During a reconnaissance trip in September 2006, ponded water was observed in these depressions (***Figure 6*** below). The depression to the south is bounded by the railway line to the south, which also forms the southern boundary of the property. To the east the depression is bounded by the Old Harbour Bypass/Highway 2000 main road. Runoff from the property will flow into this depression which discharges into the unnamed gully to the east of the property via two 3 feet (1m) diameter culverts at the Old Harbour Bypass Road (***Figure 7*** below).

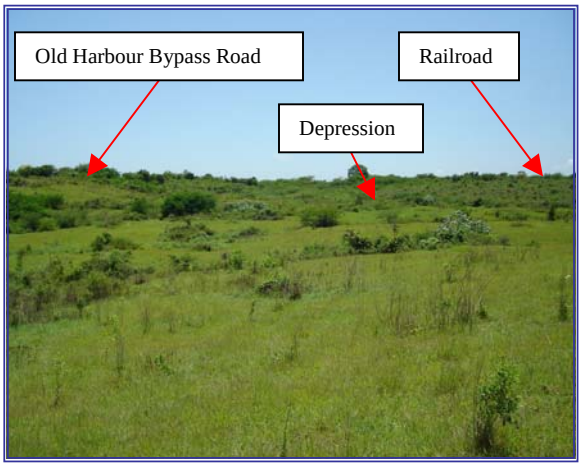


***Figure 5a*:** Depression bounded to the south and east by railroad and Old Harbour Bypass respectively.

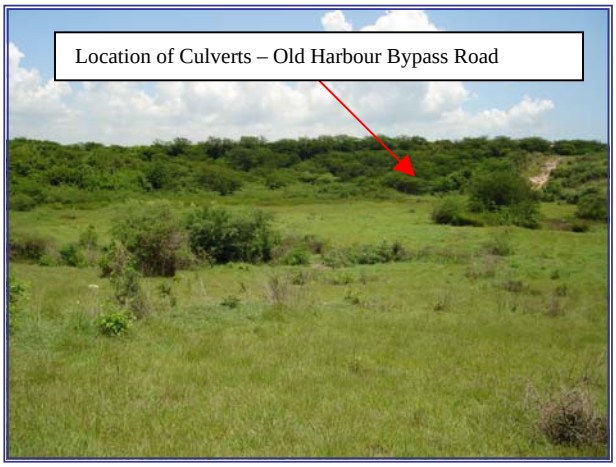


***Figure 5b*:** Location of culverts at the Old Harbour Bypass Road in the depression

Figure 6: Ponded water observed in the depression during reconnaissance trip in September 2006

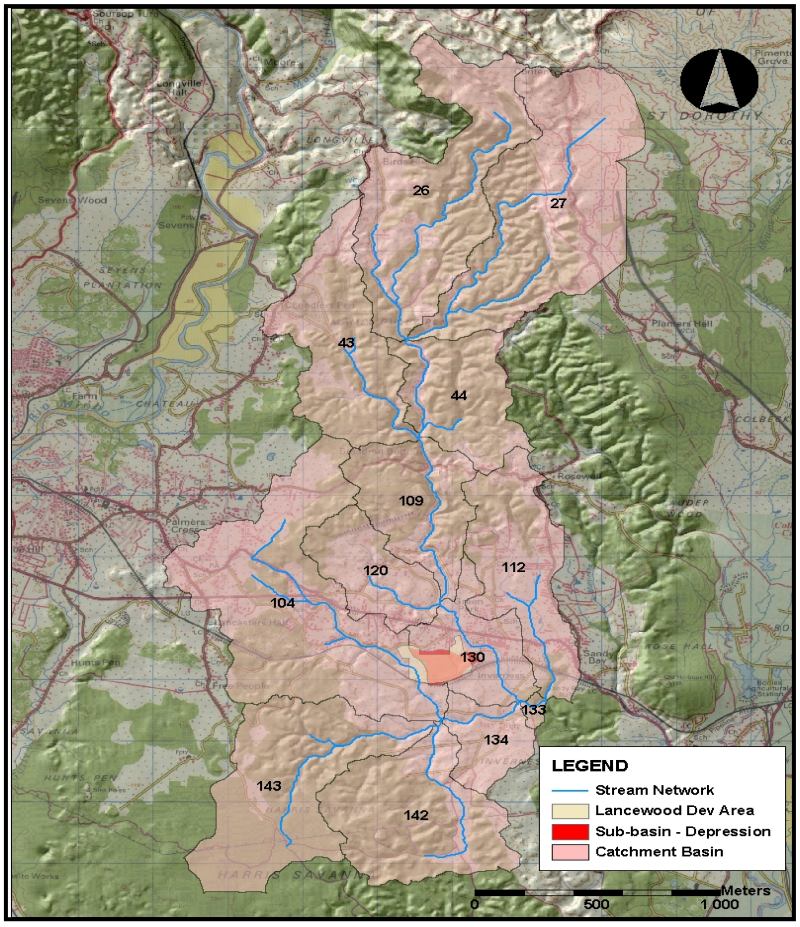
Figure 7: Culverts at the Old Harbour Bypass Road in the depression

ii. Catchment Basin Boundary

The catchment basin in which the Lancewood Development Area is delineated in ***Map 7*** below has an area of 46 km^2. This catchment basin drains to the Palmetto Gully. The basin boundaries were delineated from contours digitized from *1:12,500* scale topographic maps produced by the Survey Department using the HEC-GeoHMS *(ArcGIS extension for HEC-HMS[1] support)* software developed by the US Army Corps of Engineers and ArcGIS.

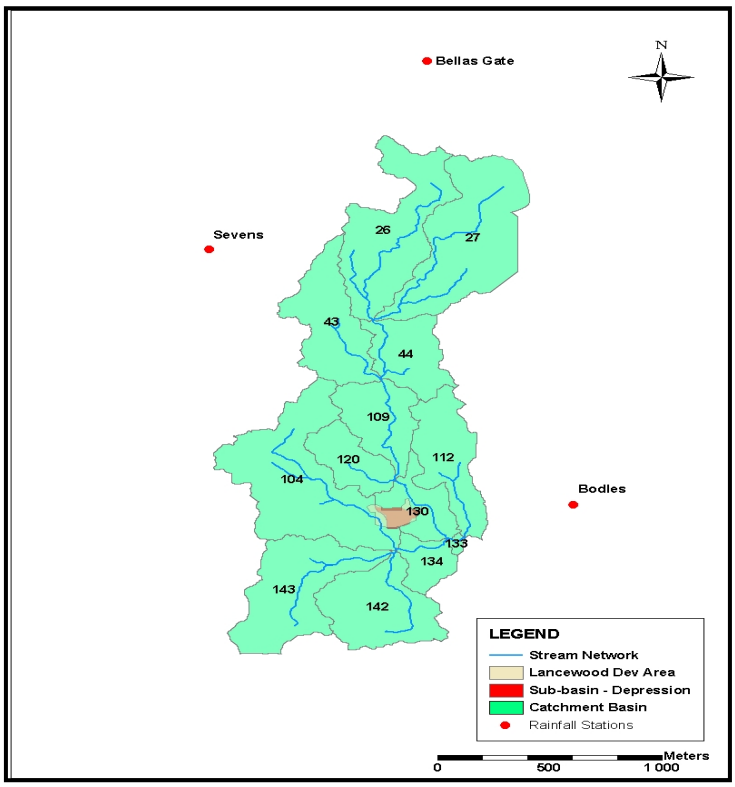
This catchment area is further sub-divided into thirteen (13) smaller sub-basins. The proposed development area cuts across sub-basins *104* and *130* as shown in ***Map 7***. Sub-dividing the catchment into smaller sub-basins allows for runoff and flood impact analysis of the proposed development to be analyzed in greater detail.

[1] Hydrologic Engineering Center – Hydrologic Modeling System



Map 7: Map showing the Catchment Basin in which the Lancewood Development Area is delineated

Data from three (3) rainfall stations namely Sevens, Bellas Gate and Bodles were considered for the hydrological analysis. The spatial distributions of these rainfall stations are illustrated in ***Map 8*** below. Bellas Gate was used as the representative rainfall station because of its location in the north of the basin where most surface runoff is expected to generate and because it represents the worst-case scenario of the available rainfall data.



Map 8: The Spatial Distribution of the Rainfall Stations in the Lancewood Valley Development Area.

Estimates of the maximum 24-hour rainfall at the stations for different return periods are shown in ***Table 8*** below. These were extracted from data published by the National Meteorological Service of Jamaica.

Table 8: Table showing the Maximum 24-hour rainfall for different return periods (T)

Return Periods (T) (yrs)	Maximum 24-hour Rainfall (mm)		
	STATIONS		
	Sevens	Bellas Gate	Bodles
2 Years	100	140	94
5 Years	147	197	140
10 Years	178	251	170
25 Years	211	320	208
50 Years	247	371	236
100 Years	275	421	264

4.1.5.1.1 METHODOLOGY

The hydrologic analysis was done using the HEC-HMS software developed by the Hydrologic Engineering Center of the US Army Corps of Engineers. The US Soil Conservation Service *[now the Natural Resources Conservation Service (NRCS)]* Curve Number (SCS-CN) methodology was used to compute the losses in the basin. The runoff

hydrograph was generated using the SCS Unit Hydrograph and Routing was done using the Lag routing methodology. The SCS Type 1A storm was used as the hyetograph.

i. Sub-basin Parameters

The sub-basin parameters required to estimate the runoff were, for the most part, generated by the HEC-GeoHMS and ArcGIS software. These include areas, slopes and hydraulic lengths such as lengths of flowpaths. ***Table 9*** below shows the area, CN and basin lag time used for each sub-basin in the hydrologic analysis.

Table 9: Table showing run-off determination parameters for the Lancewood development Area

Sub-basin	Area (km^2)	CN	Basin Lag (min)
26	6.007	55	210
27	7.296	54	203
43	4.120	50	321
44	2.752	37	213
104	7.956	85	172
109	2.865	80	112
112	3.579	82	117
120	2.065	66	102
130	2.199	87	79
143	5.253	67	240
142	4.333	67	188
134	1.330	81	50
133	0.136	85	16

The sub-basin lag time was estimated from the equation:

$$t_{lag} = \left(\frac{155.22 L^{0.8} \left[(1000/CN) - 9 \right]^{0.7}}{1900\, S^{0.5}} \right)$$

Where:
t_{lag}: Watershed lag-time (min)
L: Length of longest flow-path (m)
S: Slope of the longest flow-path (%)
CN: Average Curve Number

ii. Estimates of Runoff Rates and Volumes

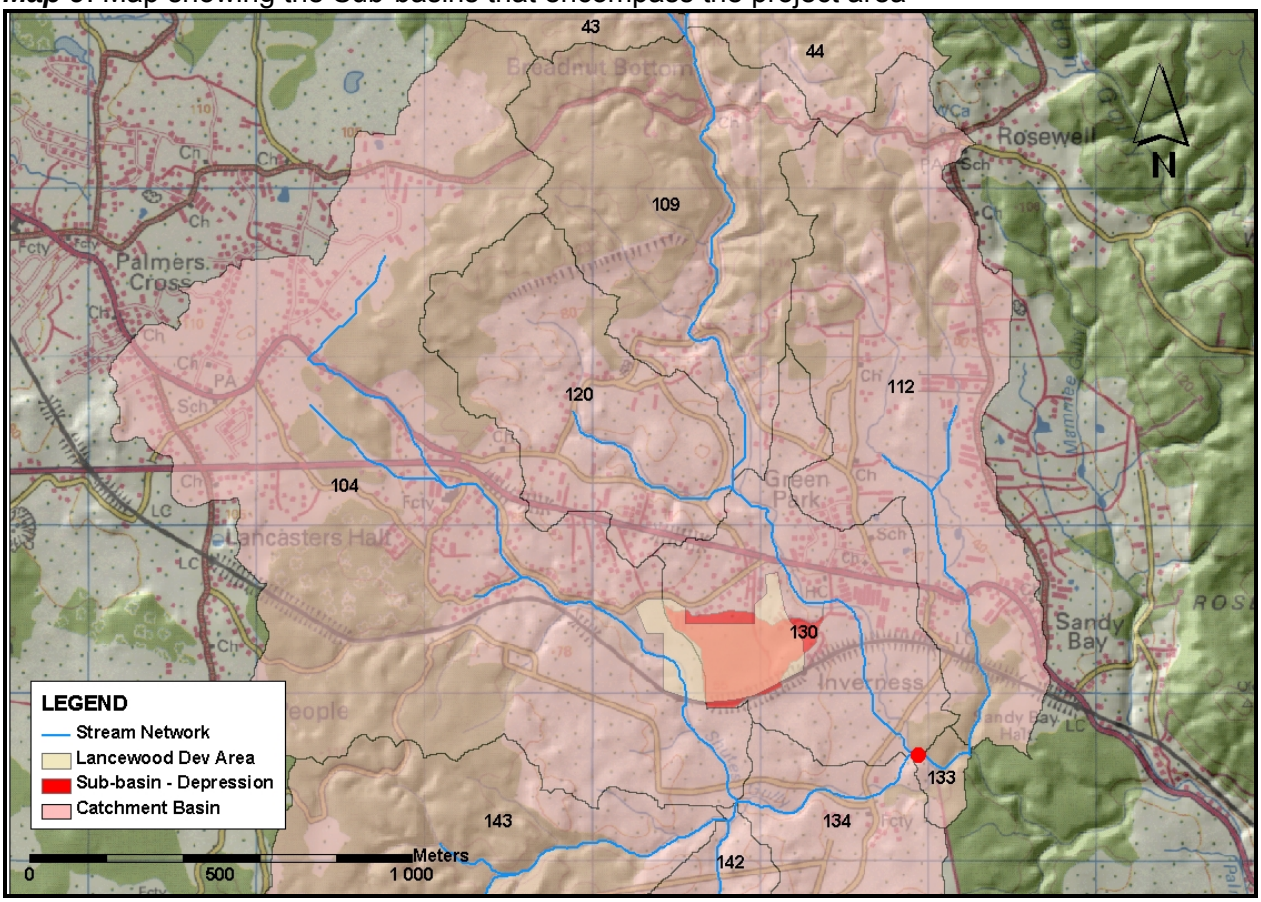
The peak runoff rates and runoff volumes were estimated for the 2, 5, 10, 25, 50 and 100 yr return period floods and for scenarios reflecting the existing or pre-development state and the post-development state of the project area.

Runoff estimates were determined for sub-basins 104 and 130; the two basins that encompass the project area (***Map 9*** *below*). Within these sub-basins, the project site takes up approximately 1.5% of sub-basin 104 and approximately 14% of sub-basin 130. The sub-basin that drains to the depression was also delineated. This sub-basin is totally within sub-basin 130 and constitutes approximately 15% of the total area. Runoff from this sub-basin was calculated as 15% of the total runoff from sub-basin 130.

Runoff values were also taken at point A, the point at which the total runoff from the project site is combined. The flows at this point determine the total impact of the development on runoff and its likely impact on downstream communities.

Runoff values are tabulated in ***Tables 10*** and **11*.***

Map 9: Map showing the Sub-basins that encompass the project area



iii. Estimation of Runoff from Sub-Basin 104 – to Shutes Gully

The results of the runoff rates of sub-basin 104 are summarized in ***Table 10***. The table shows the peak flow rates and runoff volumes relating to the different return periods rainfalls for the pre and post-development state of the project area.

Table 10: Table showing the runoff rates and volume to the Shutes Gully for the pre and post-development state of the project area

RETURN PERIOD	PEAK RUNOFF RATE (m^3/s)		VOLUME ($1000m^3$)	
	Pre-Development	Post-Development	Pre-Development	Post-Development
2 Year	19.4	19.5	777	782
5 Year	30.8	30.9	1208	1213
10 Year	41.8	41.9	1625	1630
25 Year	55.8	55.9	2163	2273
50 Year	66.2	66.3	2563	2569
100 Year	76.3	76.4	2957	2962

iii. Estimation of Runoff from Sub-basin 130 – to Un-named Gully

The results of the runoff rates of sub-basin 130 are summarized in ***Table 11***. The table shows the peak flow rates and runoff volumes relating to the different return periods rainfalls for the pre and post-development state of the project area. The figures include runoff values for the sub-basin that contributes flow to the depression within the project site.

Table 11: Table showing the runoff rates and volume to the un-named gully east of the project site for the pre and post-development state of the area

Return Period	Peak Runoff Rate (m^3/s)		Volume ($1000m^3$)	
	Pre-Development	Post-Development	Pre-Development	Post-Development
2 Year	8.2	8.5	226	238
5 Year	12.7	13.0	347	359
10 Year	17.0	17.3	463	476
25 Year	22.4	22.7	613	626
50 Year	26.4	26.6	724	737
100 Year	30.3	30.5	833	846

iii. Estimation of Runoff to Depression

Runoffs to the depression are computed 15% of the runoff from sub-basin 130. Although a small section of the development area lies outside of the sub-basin draining to the depression, it was assumed that all increases in runoff resulting from the development goes to the depression. ***Table 12*** presents the surface runoffs to the depression.

Table 12: Table showing the runoff rates and volume to the depression for the pre and post-development state of the area

Return Period	Peak Runoff Rate (m^3/s)		Volume ($1000m^3$)	
	Pre-Development	Post-Development	Pre-Development	Post-Development
2 Year	1.23	1.53	34	46
5 Year	1.91	2.21	52	64
10 Year	2.55	2.85	69	82
25 Year	3.36	3.66	92	94
50 Year	3.96	4.16	109	122
100 Year	4.45	4.75	125	138

iv. Estimation of Runoff to Point A – Combined Runoff

The runoff values of the combined flows at point A are summarized in ***Table 13***. The table shows the peak flow rates and runoff volumes relating to the different return periods for the pre and post-development state of the project area.

Table 13: Table showing the combined runoff rates and volume to Point A for the pre and post-development state of the area

Return Period	Peak Runoff Rate (m^3/s)		Volume ($1000m^3$)	
	Pre-Development	Post-Development	Pre-Development	Post-Development
2 Year	43.9	44.1	2519	2536
5 Year	79.3	79.5	4434	4452
10 Year	118.2	118.3	6430	6448
25 Year	172.5	172.6	9138	9157
50 Year	214.9	215.0	11217	11236
100 Year	257.8	257.9	13301	13320

4.1.5.2 FLOOD RISK ASSESSMENT

Due to the scale of the project and the project location a flood impact assessment was undertaken for the site.

4.1.5.2 .1 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 digitized from 1:12,500 topographic maps produced by the Survey Department. Basin characteristics such as elevation and slope as well as cross-sectional data are generated from the DTM using ArcGIS and HEC-GeoRAS *(an ArcGIS extension for support of HEC-RAS)* software.

The potential for flooding of the project site by the Shutes Gully and the gully to the east of the site is assessed. The level of inundation of the depression from surface runoff from the project site is also assessed. The two culverts at the Old Harbour Bypass provide the only outlet from the depression assuming infiltration into the ground is negligible. Accordingly, an assessment of the culverts being 50% blocked was included in the analysis, the other being that they are free of debris.

i. Peak Flows

The peak flows used in the HEC-RAS model are the peak runoff values generated in the hydrologic analysis. These flows are presented in ***Section 4.1.5.2*** above. Given the small differences observed, only the post-development flows were used in the flood analysis.

ii. Mannings Roughness Coefficient

The Mannings roughness coefficients used are $0.08m^{1/3}/s$ for the channels and $1.5m^{1/3}/s$ for the overbanks. Relatively high roughness coefficients are used because of high vegetation in the channels and on the overbanks. The roughness coefficient used for the culverts is $0.016m^{1/3}/s$.

PRESENT STATUS: FLOOD EXTENTS

a. Gullies

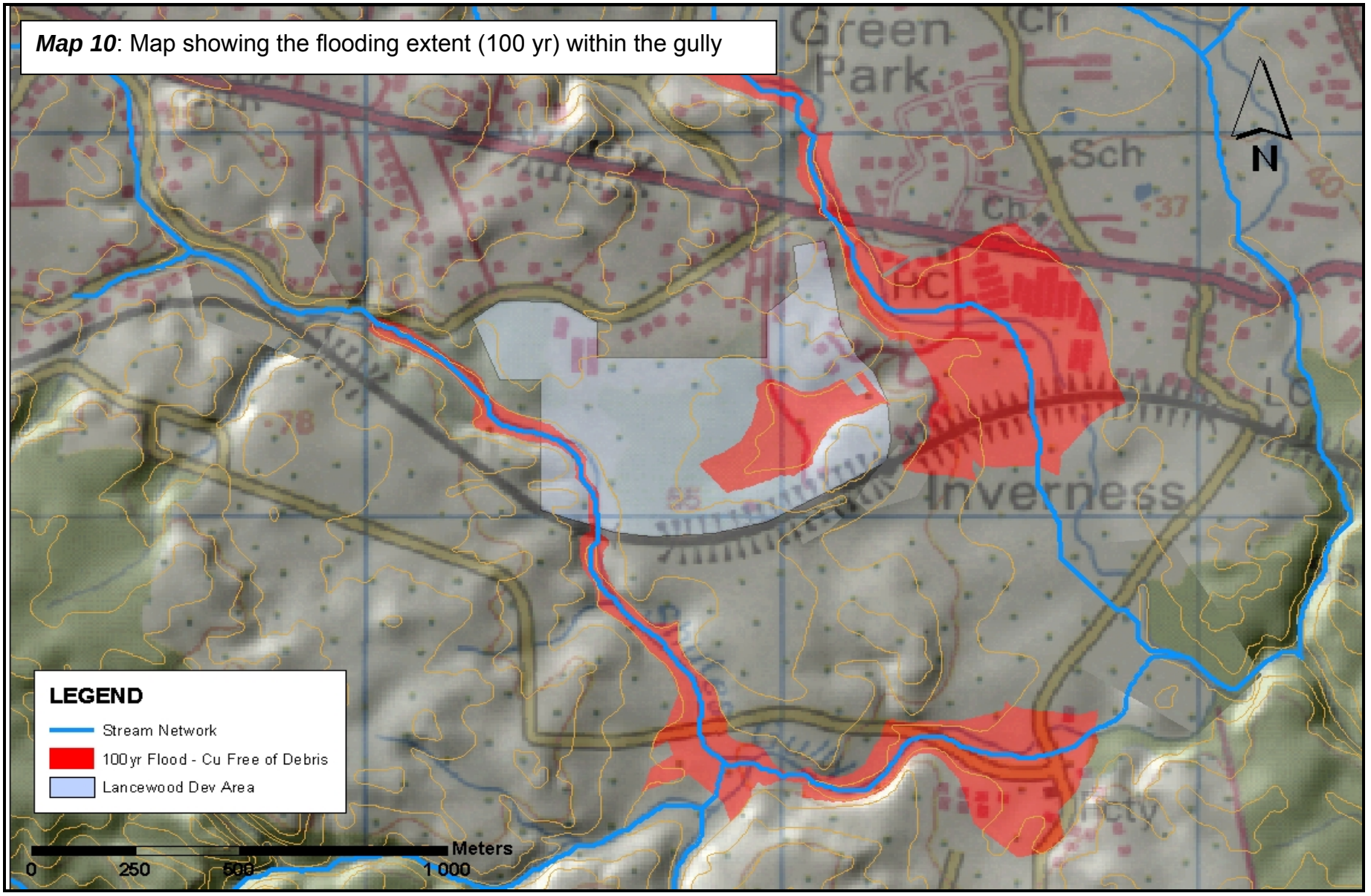
The extents of flooding for the two gullies that traverse the property are presented in ***Map 10*** below. The map show that floods resulting from these two gullies with return periods up to 100 yrs will not affect the project site. For clarity, only the 100 yr return period flood extent is shown in the map.

b. Depression

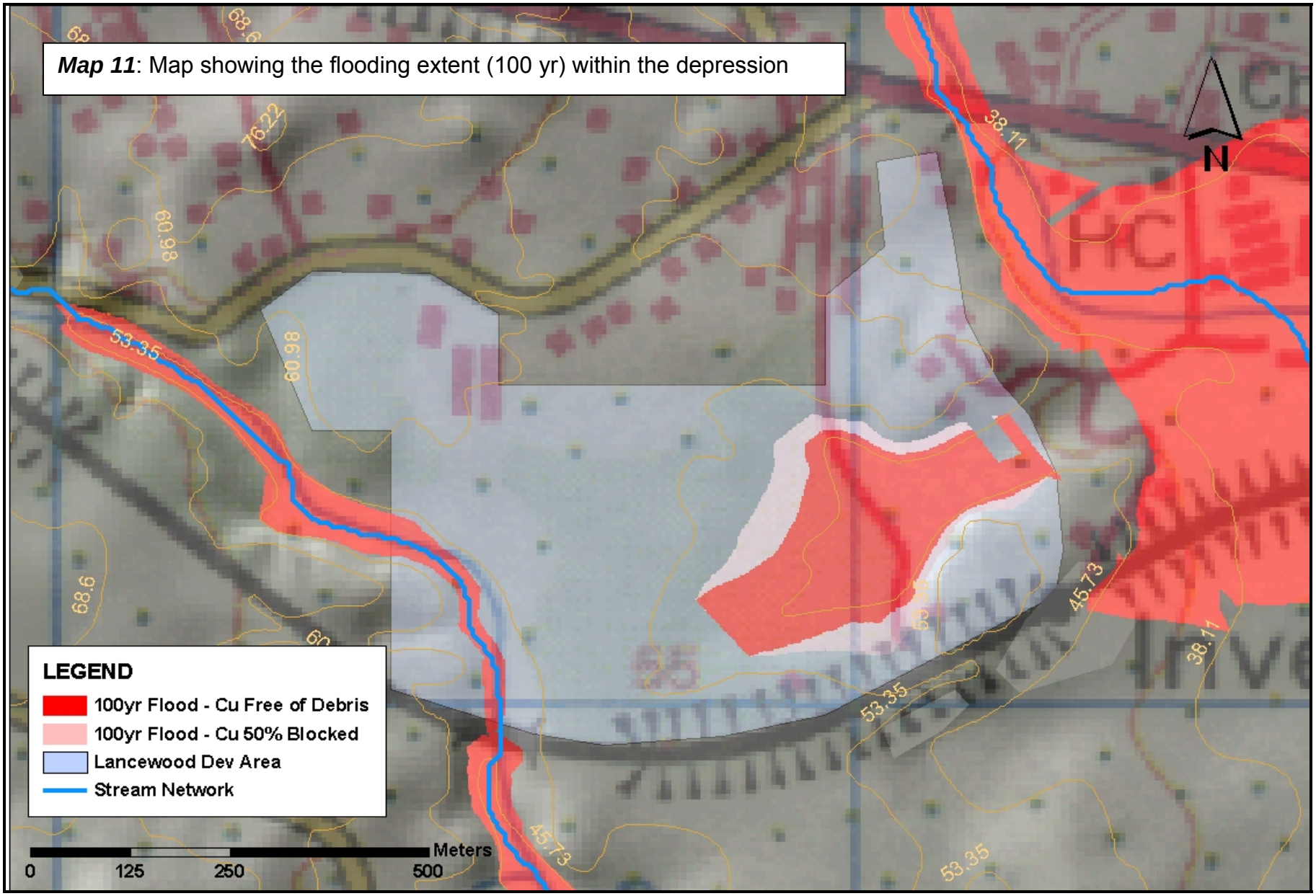
The extent of flooding within the depression is presented in ***Map 11***. Only the 100 yr flood extents are delineated for clarity. The map shows the flood extent when the culverts are free of debris overlaid on the flood extent for the 100 yr flood when the culverts are 50% blocked. The map also shows that water will accumulate within the depression in both cases; however, with the culverts 50% blocked the depth of inundation increase from 0.69 to 1.2 m for the 2 yr rainfall and from 1.59 to 4.34m for the 100 yr rainfall. Details of the depth of inundation and water surface elevations for the two scenarios are presented in ***Table 14***.

Table 14: Comparison of flood extents within depression when culverts are free of debris and 50% blocked

RETURN PERIOD (T) (yrs)	FLOOD EXTENTS WITHIN DEPRESSION			
	Water surface elevation (m) a.m.s.l		Depth of inundation (m)	
	Culverts free of debris	Culverts 50% blocked	Culverts free of debris	Culverts 50% blocked
2	46.42	46.93	0.69	1.20
5	46.61	47.33	0.88	1.60
10	46.79	47.83	1.06	2.10
25	46.96	48.65	1.23	2.92
50	47.11	49.26	1.38	3.53
100	47.32	50.07	1.59	4.34



Map 10: Map showing the flooding extent (100 yr) within the gully


Map 11: Map showing the flooding extent (100 yr) within the depression
N
LEGEND
100yr Flood - Cu Free of Debris
100yr Flood - Cu 50% Blocked
Lancewood Dev Area
Stream Network
Meters
0
125
250
500
38.11
45.73
53.35
60.98
76.22
68.6

DISCUSSION OF BASELINE ASSESSMENT

The results of the hydrologic analysis show that the impact of the development on runoff is very small with less than 1% increases in peak runoff rates except for peak runoffs to the depression, which ranged from 7% for the 100 yr rainfall to 24% for the 2 yr rainfall. These represent in absolute terms increases in the peak runoffs of 0.3m^3/s for all the rain events. Given the marginal increases in peak runoffs resulting from the proposed development, downstream communities and other interests will not be adversely affected.

The flood analysis shows that the development area is not vulnerable to flooding from the Shutes Gully traversing the project site to the west or from the gully to the east of the site. On the other hand, runoff from the project site will inundate the depression, which forms the southern part of the development area. Inundation of the depression is exacerbated due to its enclosure by the Old Harbour Bypass main road with only two (2) 1m diameter culverts for water to flow out.

The analysis shows a depth of inundation of 1.59m for the 100 yr return period rainfall provided that the culverts are free of debris. The depth of inundation increases as the culverts gets blocked reaching 4.34m when the capacity of the culverts is reduced by half. Given that the culverts may never be completely free of debris, it can be expected that the depth of inundation within the depression is likely to be higher than the depths obtained when the culverts are free of debris but lower than the depths obtained when the culverts are 50% blocked for all the return period rainfalls.

In terms of the water surface elevations, water levels associated with the 100 yr rainfall will reach 47.32m and 50.07m when the culverts are free of debris and 50% blocked respectively. These elevations are below the 53.35m contour, which forms the top of the depression. Given that during extreme rainfall events the 1m culverts can be easily blocked by debris, no lots or building of houses should be constructed below the 53 m contour line.

4.1.6 NOISE

Due to the close proximity to the highway and the train line that traverses the property, an assessment of the current ambient noise levels at the Lancewood development site was undertaken.

4.1.6.1 METHODOLOGY

Primary noise data was collected using a Quest Technologies© 2900 Integrating/Logging Type 2 noise meter. The sound calibrator used was a Quest Technologies© QC 10 calibrator that emits 114 dB at a frequency of 1000 hertz. The certificate of calibration is shown in ***Appendix IV.***

The relevant impulse setting was selected for the monitoring of community noise. In this case the slow impulse setting was most appropriate. The A-weighting option was selected for the decibel levels, as this is most commonly used for the measurement of environmental noise especially road noise. Though the A-weighting curve gives a single figure index for the varying sensitivity of the human ear (Therivel and Morris, 2004), it is not the most valid for sound measurement because of the way the human ear actually analyses sound. However it is the standard most widely accepted for this kind of monitoring.

The noise meter was calibrated before each monitoring session. The appropriate decibel range was selected for the expected results. If and where the range was exceeded, a higher and appropriate decibel range was selected and the reading repeated. The time of each reading was recorded, as well as the GPS reading and brief comments documented on the area in which the readings were taken.

Noise readings were taken over a two-day period between Friday November 17th and Saturday November 18th from points along the highway and from points within the site during low and high traffic periods for comparison. The weather on both days was sunny and the air still and so noise from wind and rain was not a factor.

The readings taken in the vicinity of the highway were from approximately 7 metres from the roadway. A two-man team conducted the survey, with one member operating the noise-meter while the second recorded GPS readings and made relevant notes.
Noise readings closest to the highway were taken on Friday November 17th 2006 between 3:00 pm and 4:24 pm. These readings were taken in order to illustrate a noise gradient from the noise source (vehicular traffic) to the quietest periods and points of the site and were also used as quality control/ quality assurance of the noise meter values in real-world situations.

Readings were taken on-site on Saturday November 18th 2006 between 8:00 a.m. and 11:42 a.m. The sites used for air quality monitoring were used as convenient sites for noise data readings as these sites were selected to be representative of a gradient from potential sources of air pollution, i.e. vehicular traffic and the bauxite freight train, which are also significant sources of noise. Other sites were selected for comparison and to represent as much of the site as possible without being unduly repetitive.

4.1.6.2 PRESENT STATUS

In the Lancewood Valley area transportation is the main source of environmental noise pollution, which is from two (2) significant sources; Highway 2000 to the east of the property and another significant though less frequent source of transportation noise, the railway that is traversed by Jamaica Alumina Company (JAMALCO's) Bauxite freight train to the south.

i. Traffic Noise

Road traffic noise is generally a function of the sound generated by the engine of the vehicles, and the friction between vehicle tyres and the road surface. The friction with air may become significant at higher speeds during which the tyres on the road surface becomes a more significant source of noise than the engine noise itself. In the case of Lancewood Valley the topography also contributes to the impact.
Highway 2000 is the major thoroughfare, which links Kingston to the southern parishes of the island and is therefore traversed by large numbers of vehicles including large trucks and buses. This highway borders the property to the east and is set several

meters above the property. In addition to this, the road takes a corner at the point closest to the site and has a gradient before entering a second corner. During the assessment it was observed that vehicles entering the gradient enter low gear either as a prelude to braking as they go downhill, or to acquire more power to go uphill; this was especially the case for larger vehicles.

ii. Railway Noise

The noise caused by the railway can be due to a number of factors including the speed of the train, the condition of the wheels and track and engine noise. In the case of a freight train, the number of cars, whether they are laden or not and the effort the engine requires to pull these cars, also contributes to the magnitude of the noise impact. Despite the acquisition of an ad hoc train schedule from Jamaica Alumina Company (JAMALCO), several attempts to record the noise and vibration from the train proved to be futile. According to the schedule provided the train passes adjacent to the Lancewood property *en route* to the mine/factory a maximum three (3) times per day; between 8:00 am – 9:00 am, 11:00 a.m. to 12:00 noon and 3:00 pm to 4:00 pm. During the entire period of field assessment however, the train was observed only once in a time far outside the schedule provided and at a time when the noise meter was not available to take empirical readings.

Figure 8: *Picture* showing the freight train that passes adjacent to the Lancewood Valley Property daily

4.1.6.3 DISCUSSION OF BASELINE ASSESSMENT

Lancewood Valley at present cannot be described as a noise sensitive community. Its proximity to a major highway, as well as the railway line means that it is subjected to potentially high levels of noise and vibration. No noise standards have been set for Jamaica. The empirical noise data collected however shows that the majority of the site is still within the World Health Organization (WHO) guidelines of 50dB LA_{eq} - 55dB LA_{eq} for outdoor living areas and activities. Even in times of moderate traffic only one site exceeded 55 dB (A) and this site was approximately 5 metres from the highway. The lowest readings measured on site were 30.2 dB (A), which is similar to a bedroom at night. This site was set back from the road and the reading taken at a time with no traffic. For comparison, readings were taken on the highway at off-peak hours of traffic as well as when moderately heavy traffic begun. The highest decibel level recorded was 85 db (A) when a large flatbed truck passed by. As illustrated in ***Appendix IV***, the decibel reading on the highway generally ranged from 70-80 db (A), which is in keeping with street-corner traffic. The closer to the highway the higher the decibel level and it is

expected that this was the same when the train was passing the property. The majority of the existing residents are closer to the roadway than the potential residents will be and therefore the impact is more than the undeveloped parcel of land. These residents have also been subjected to the noise associated with road construction.

Freight trains generally contribute more to the noise impact than commuter trains and it is anticipated that this will be no different for Lancewood Valley. The train was heard for some distance before it actually passed the border of the property. The train also let out several warning blasts of its horn to alert persons and motorists of its passing which adds to the noise impact, though this is an important safety measure. Reference numbers indicate 70 dB (A) as being a reasonable estimate for a freight train at a distance of 30 m (See ***Appendix IV***). This is quite loud but the impact of this noise is reduced somewhat by the apparent infrequency of the train crossing the property.

Looking at reference numbers for street side traffic (Morris and Therivel, 2004; WHO Guidelines for Community Noise) the values of noise recorded at the site fall well within the expected ranges for trafficked areas.

4.1.7 LANDSCAPE AND AESTHETICS

4.1.7.1 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.

4.1.7.2 PRESENT STATUS

The area as it is presently constitutes of an area predominantly covered with vegetation, which is typical of open spaces pastureland and scrub vegetation. From all vantage points within the zone of visual intrusion there is an undeveloped, un-landscaped area, which some persons may view as not aesthetically pleasing.

Figure 9: Picture showing the property from a southern vantage point

4.2 BIOLOGICAL 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 FLORA

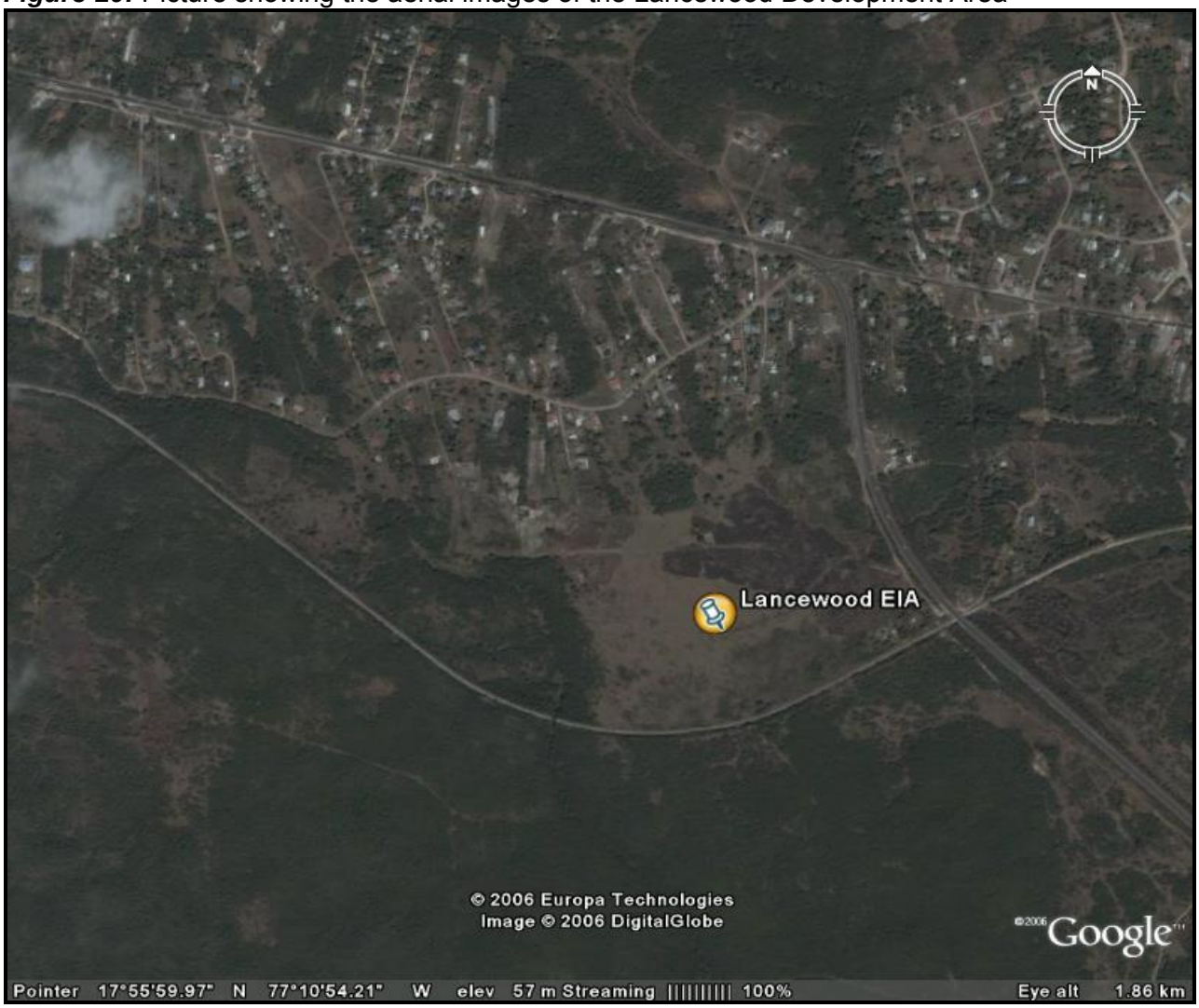
The Floral Assessment was conducted in two phases over a four (4) week period between October and November 2006.

4.2.1.1 PHASE 1 ASSESSMENT

4.2.1.1.1 Methodology

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 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.

Figure 10: Picture showing the aerial images of the Lancewood Development Area



i. Description of the General Area

The area to be developed consists of relatively homogenous open dry scrubland vegetation, which is typical of this region of the island. The northern, eastern and central sections of the area is dominated by open grassed areas interspersed with a few large trees and shrubs, remnants of the impacts of grazing from previous cattle rearing and stray animals that currently graze the property. The southern part of the development can be described as being dominated by herbaceous plants and shrubs with very few mature trees. Initial observations and subsequent photographs showed large tracts of burnt vegetation and ground. It is not known whether the fire or fires were of natural or artificial origins but it was a recent occurrence. There are also areas that suggest that

vehicles drive through the property with some frequency. With no previous observations to refer to it is not known to what extent the ecology of the site has been altered by anthropogenic factors.

ii. Conservation Status of the Area

The analysis of aerial photographs of the area, the Portland Bight Protected Area map showed that the area proposed for development is not designated as a protected or conservation area.

4.2.1.2 PHASE 2 ASSESSMENTS

A *Phase 2* Assessment was undertaken which included a more detailed assessment of the vegetation present at the project site. This stage of the assessment included the identification, the abundance and conservation status of species and their habitats.

4.2.1.2.1 METHODOLOGY

Based on the analysis from the *Phase 1* assessment, the project area was divided into three plots for analysis as follows:

Plot 1: Located on the most southern section of the area to be developed
Plot 2: Encompasses the most northern, central and western parts of the area to be developed
Plot 3: Encompasses the most eastern section of the area to be developed

i Methodology- Plot 1:

Based on the results from the Phase 1 Assessment, the vegetation in this plot appeared to be open shrubland consisting of herbs, shrubs with very little mature trees. For the sampling of this type of plant morphology, a Systematic Sampling Method was employed utilising the Line Intercept Method. This involved the laying of three (3), parallel, forty (40) m transects across the study area. The same compass bearing for each transect was used to ensure that the study area was sampled by a set of parallel transects. Within each plot, species were sampled at intervals of two (2) metres along

each transect and within two (2) metres of either side of each transect. The species were then categorized under the following headings:

- Herbs and Shrubs
- Trees
- Grasses
- Fungi
- Epiphytes
- Ferns
- Other

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 15*** below.

Table 15: Table showing the Semi-Quantitative Abundance Rating Method

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

This process was repeated at forty (40) meter intervals. Vegetation outside the immediate area of influence was also examined and any species of ecological and commercial value recorded.

ii Methodology Plots 2 & 3

Information from the *Phase 1* Assessment showed that *Plot 2* and *Plot 3* consists predominantly of a homogenous patch of open land covered with grass with few herbs and shrubs. It was therefore perceived that whole-area sampling was unnecessary and hence the Random/Stratified Sampling method was used for this part of the assessment. This method of sampling involved the random selection of three (3) 10 m x 10 m quadrats within each plot and sampling within these quadrats. The species were

identified in the field where possible, and photographs and samples were taken of unknown species for later identification. The species were then identified and categorized under similar headings used for identification in *Plot 1* as outlined above. A complete species list of the species observed is located in ***Appendix V***.

4.2.1.2.2 PRESENT STATUS

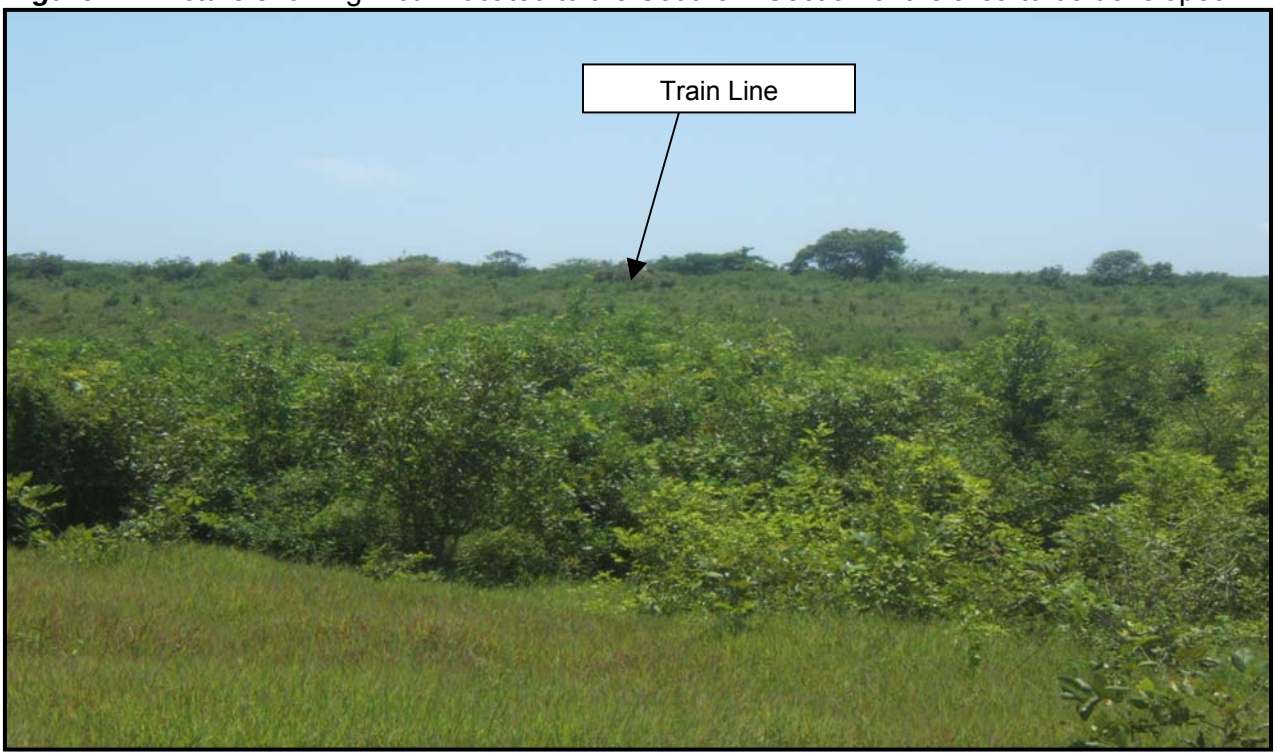
i. Plot 1

Plot 1 is found on the most southern border of the property and gently slopes towards the train line, which demarcates the boundary of the Portland Bight Protected Area, beyond which is a densely forested area (*Direct Observations and review of satellite imagery of the area Google Earth© N 17^0 55.912', W 077^0 10.602'*). The vegetation type in this section of the project area can be described as forb vegetation consisting of mostly herbs and shrubs. It may also be described as semi-natural that is, the vegetation type has been modified by human influences such as cattle rearing, but largely consists of native species and appears to have a similar structure and functioning to a natural type (Morris and Therivel 2001).

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).

This area was dominated by *Lantana* sps. Broom weed (*Sida acuta),* Guava (*Psidium guajava*), Rosemary (*Croton linearis*) and Devils Horsewhip (*Achyrandnes indica*). Rarely observed in this plot, Castor Oil (*Ricinus cummunis*), Trumpet trees (*Cecropia peltata)*, and Cowitch (*Tragia volubilis*).

***Figure 11*:** Picture showing *Plot 1* located to the Southern Section of the area to be developed



ii Plot 2:

Plot 2 represents the most disturbed areas of the property and can be described as open grassland. This area is generally the flattest portion of the property and is dominated by African Star Grass (*Cynodon nlemfuensis),* which is found in most cattle rearing pastures. Within this plot are clumps of Cashaw Macca (*Prosopis juliflora*) and a few Mango Trees. Herbs such as Yellow Allamanda (*Allamanda cathartica*) and Broom weed (*Sida acuta)* were observed randomly throughout this plot.

Figure 12: Picture showing Yellow Allamada (*Allamanda cathartica*) observed on the property

Figure 13: Picture showing the vegetation type on *Plot 2*

Figure 14: Picture showing the vegetation type on *Plot 2*

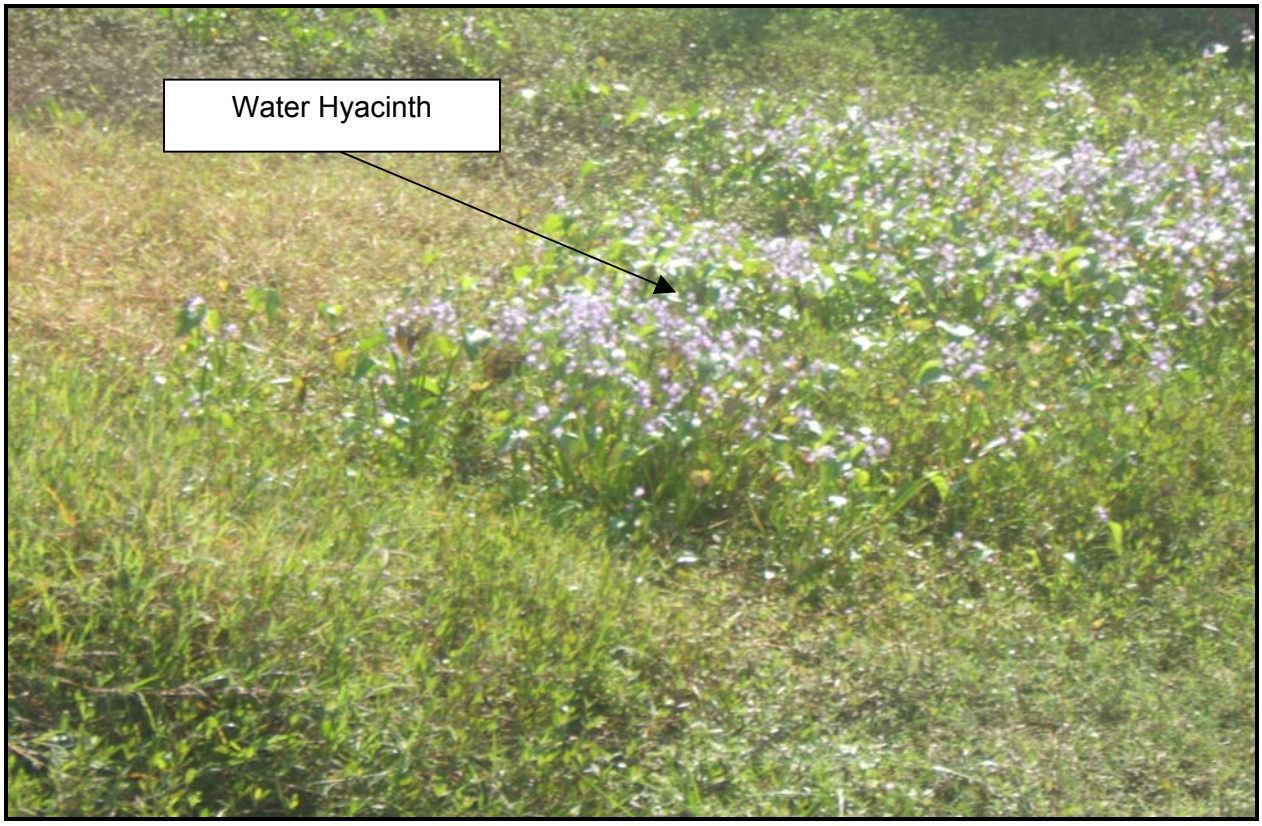
iii. Plot 3:

Plot 3 is found on the most eastern section of the property, which is adjacent to Highway 2000 and located in the reservation for the highway (See ***Appendix II***) The vegetation in this plot is similar to that of *Plot 2*. However the clumps of Cashaw Macca (*Prosopis juliflora*) in this area are much denser than those observed in *Plot 2*. There are also many more occurrences of herbs such as Yellow Allamanda (*Allamanda cathartica*) and Broom weed (*Sida acuta).* Rosemary (*Croton linearis*), Guava (*Psidium guajava*), Sweet sop (*Annona squamosa*), Devils Horsewhip (*Achyrandnes indica*) and *Lantana sps*. as well.

Figure 15: Picture showing the vegetation type on *Plot 3*

A depression area was also observed in this area where water seemed to pond frequently. This was evidenced by the presence of Water Hyacinth (*Eichhornia crassipes*), which colonised a small portion of the area.

Figure 16: Picture showing the colony of Water Hyacinth (*Eichhornia crassipes*) observed in *Plot 3*



4.2.1.2.3 CONSERVATION STATUS OF SPECIES OBSERVED

***i. Endemic Species*:** No endemic species were observed during the assessment. All species identified are introduced, or native and are found abundantly and commonly in similar habitats.

ii. Rare Threatened or Endangered Species: No rare, threatened or endangered plant species were observed during the survey of the area.

iii. Invasive Alien Species: During the assessment only one invasive alien species, Water Hyacinth (*Eichhornia crassipes*) was observed.

4.2.2 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 parts:

- Assessment of Avifauna
- Assessment of Butterflies
- 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.

4.2.2.1 AVIFAUNA

4.2.2.1.1 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 October 21, 2006 and November 5, 2006 starting at 6:30 am and 6:00 am respectively.

Table 16: Table showing Identification Key for Avifauna

TYPE OF BIRD	SYMBOL
Introduced species	I
Endemic Species	E
Resident Species	R
Breeding Resident (Summer Migrant)	BR
Non-breeding Resident (Winter Migrant)	NBR

The abundance for the birds identified during the assessment was determined by the scale as shown in ***Table 17*** below.

Table 17: 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

4.2.2.1.2 PRESENT STATUS

Twenty (20) species of birds representing nine (9) families were observed over the two days of surveys (See ***Appendix V***). These are as follows:

i. Endemics

Only one (1) endemic species (Jamaican Euphonia) was observed at the site, and these were more closely associated with the edge of the survey area where they move back and forth between the study site and the adjoining residential areas.

ii. Residents

Of the twenty (20) species observed, fifteen (15) of these are classified as residents. This includes the White-winged Dove and the Bananaquit, which were also noted to be more closely associated with the edge of the study area.

iii. Migrants

The time of year the survey was conducted was approximately two (2) months into the migrant season for wintering birds and hence a large number of non-breeding residents

(winter migrants) are expected on the island. Conversely, the breeding residents (summer migrants) namely the Black-whiskered Vireo (*Vireo altiloquus*) and Gray Kingbird (*Tyrannus dominicensis*) would have already left the island. Despite the large number expected, only four (4) migrant species were observed at the development site, and these were all uncommon except for the Prairie Warbler which was fairly common (***Appendix V***). This suggests that the survey area is not a preferred habitat for wintering birds.

The results from the survey of avifauna are exceptionally poor, which is attributed to the high level of disturbance and uniformity of the area, which limits the number of available niches. The surveyed area is mainly grassland type vegetation with outcroppings of Cashaw Macca (*Prosopis juliflora*) and other scrub-like plants. This is the main reason for the absence of many common resident species such as the woodpeckers, vireos, cuckoos and more flycatcher and hummingbird species found in nearly all wooded areas on the island.

The dominant species observed in the area were the Common Ground Dove, Cattle Egret, Smooth-billed Ani, Northern Mockingbird and the Yellow-faced Grassquit. These are highly ubiquitous species and their dominance again, is illustrative of a poor habitat type.

4.2.2.1.2 Conservation Status of Species Observed

i. Endemic Species*:* Only one species the Jamaican Euphonia, of the twenty species identified is endemic to Jamaica.

ii Rare Threatened or Endangered Species*:* No rare, threatened or endangered species were observed during the survey of the area.

iii Invasive Alien Species*:* No invasive animal species were observed during the assessment

4.2.2.2 BUTTERFLIES

4.2.2.2.1 METHODOLOGY

Butterfly observations were conducted over a two (2) day period. A reconnaissance visit to the area was conducted on September 23, 2006 (8:40 a.m. – 10 a.m.) while comprehensive sighting data and other information was gathered on October 21, 2006 (8:35 a.m. – 11:00 a.m.). Three (3) persons conducted observations that included digital photography, empiric observations and looking at the underside of leaves to determine the presence of the various life cycle stages of Lepidoptera.

Butterflies are sometimes difficult to identify in the field when comparing still photographs to live individuals, so a number of field guides were used [e.g. Martin Brown (1972) and Garraway and Bailey (2005)] to cross reference identifications.

It is a difficult proposition to use mainly sighting data from adults on the wing to determine butterfly diversity. However, this methodology does capture much of the qualitative elements necessary to determine the health of the habitat. The sighting methodology cannot be used to infer the numerical abundance but rather the relative abundance of species and genera.

Weather conditions during the two (2) sighting days were party cloudy to sunny. Since butterfly metabolism is closely linked to the prevailing conditions, butterfly activity would have been relatively high on these days thereby increasing the reliability of the sample data.

4.2.2.2.2 PRESENT STATUS

Reconnaissance observations indicated that a relatively diverse fauna of butterflies could be found within the vicinity of the proposed development. This observation was supported by the detailed observations conducted on October 21, 2006.

Twenty one (21) species of butterflies were observed during the assessment. The fauna documented represents a diverse group that includes members found in disturbed and urban habitats, such as the White Peacock (*Anartia jatrophae jamaicensis*), and more

uncommon members with more (locally) restricted habitats, such as the Jamaican Gillipus (*Danaeus gillipus jamaicensis*). At least one endemic species, the Evan's Jamaican Skipper (*Polygonus leo hagar*) was observed. It is possible that a second endemic species Perkin's Blue (*Leptotes perkinsae*) which is sometimes confused with the Cassius Blue, may be present. [*Many of these tiny blue butterflies are exceedingly difficult to identify on the wing*.] At least three (3) endemic subspecies may be present. These are the Jamaican Gillipus (*Danaeus gillipus jamaicensis*), the Jamaican Polydamas (*Battus polydamas jamaicensis*) and the Jamaican White Peacock (*Anartia jatrophae jamaicensis*), The latter two subspecies are common in urban and disturbed habitats.

There is relatively high diversity among the butterflies observed within the sample area (See ***Appendix V***), and none of the species observed are not considered rare or threatened. However, this high diversity does suggest that nearby areas may support an even more diverse fauna. Examination of the satellite imagery for the vicinity south of the proposed development site (Google Earth© N 17^0 55.912', W 077^0 10.602') indicates the presence of dense forests. Also noted on the images were what appeared to be vestigial roads which infiltrated this area, suggesting that perhaps at least some this area (south of the railway line) represents regenerated forests. Even if this is the case, the precautionary principle should apply and efforts should be made to mitigate the effects of any development on the forested areas nearby.

4.2.2.2.2 Conservation Status of Species Observed

i. Endemic Subspecies: Three endemic subspecies were observed during the assessment. This included the Jamaican Gillipus (*Danaeus gillipus jamaicensis*), the Jamaican Polydamas (*Battus polydamas jamaicensis*) and the Jamaican White Peacock (*Anartia jatrophae jamaicensis*),

ii Rare, Threatened, Protected or Endangered Species*:* No rare, threatened or endangered or protected species were observed during the survey of the area.

4.2.2.3 OTHER MACRO-FAUNA

4.2.2.3.1 METHODOLOGY

The assessment of the macrofauna barring avifauna and butterflies were conducted simultaneously with the assessment of the flora. The advantage of this was that line transects were already being laid for the plant ecology survey. By creating a width of 2m from the line transect a quadrat (5m x 5m) was effectively laid and at the same time animal species were observed within this survey area. Animals were divided into five categories as follows:

- Vertebrates
- Reptiles
- Amphibians
- Gastropods
- Insects

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 V***.

4.2.2.3.2 MAMMALS

4.2.2.3.2.1 PRESENT STATUS

The largest animals observed on site were donkeys (*Equus asinus)* and goats (*Capra aegagrus*). These donkeys were harnessed and were probably left on the site closest to where the owners happened to be at that time. No more than three (3) donkeys were ever seen on the site during the survey period and these animals were only observed to the north-east of the property closest to one of the communities bordering the property.

Initially, only a few goats were observed on the site. These like the, donkeys were left to graze. Over the next few weeks the number of goats increased and at the end of the survey period large herds of goats occupied the property. The increase in the goats may have been directly related to the increase in vegetation recovery after the fire. As plants and vegetation cover increased, more goats were observed.

Figure 17: Picture showing goats that were seen grazing on the property

4.2.2.3.2.2 Conservation Status of Species Observed

i. Endemic Species: No endemic species were observed during this assessment.

ii. Rare, Threatened or Endangered Species*:* No rare, threatened or endangered species were observed during the survey of the area.

iii. Invasive Alien Species*:* No Invasive Alien species were observed.

4.2.2.3.2 REPTILES

4.2.2.3.2.1 PRESENT STATUS

Lizards were the only reptiles observed during the survey period. These reptiles tend to be ubiquitous in the Jamaican environment, especially the iguanoid *Anolis sp*. The Anolis species identified was the *Anolis lineatopus*. These lizards are small, carnivorous reptiles and generally feed on insects. These lizards were found on the *Lantana sp*. shrubs that supported all the butterflies and by extension the dragonflies of the area. The lizards were not as abundant in number as the climate got hotter, though this can be expected as reptiles are poikilothermic and so tend to regulate their core body temperature by a combination of internal processes and external factors. These lizards were rarely observed on the ground.

4.2.2.3.2.1.2 Conservation Status of Species Observed

i. Endemic Species: The only species of lizard (*A. lineatopus)* identified is endemic to Jamaica.

ii. Rare, Threatened, Protected or Endangered Species*:* No rare, threatened or endangered species were observed during the survey of the area.

4.2.2.3.3 AMPHIBIANS

4.2.2.3.3.1 PRESENT STATUS

No species of amphibians were identified during the assessment of fauna. Species within this class of animals generally require a moist/wet habitat for their survival. Throughout the Lancewood Valley property there is only one area, in the depression that could support these species. No species of amphibians were however observed in this area.

4.2.2.3.4 GASTROPODS

4.2.2.3.4 .1 PRESENT STATUS

A few small empty shells were photographed and pointed to the presence of snails in the area, although only one was observed. This individual was too high in the trees to

make any sort of positive identification. The diameter of the shells did not exceed half an inch in length.

4.2.2.3.4 .1 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.

ii. Rare, Threatened, Protected or Endangered Species*:* No rare, threatened or endangered species were observed during the survey of the area.

4.2.2.3.5 INSECTS

4.2.2.3.5.1 PRESENT STATUS

Dragonflies belong to the Order Odontata. Apart from butterflies, dragonflies which belong to the sub order Anisoptera were the most abundant type of insects observed at the site. Dragonflies are very high and fast flyers and so it is generally very difficult to get close enough to catch or critically examine an individual however. On several occasions during the survey period dozens of individuals were seen flying quite high in the sky. There seemed to be no obvious occurrences of predation despite the fact that several butterflies and moths were present. It is quite possible that the dragonflies were observed during a period of mating and this accounted for large numbers of individuals seen, as the mating period for dragonflies are know to last for several weeks or even longer. Female dragonflies lay their eggs in or near water. The larval stage of dragonflies, called nymphs, are aquatic and are known to last for several weeks to months. An area of the property is distinct for the ponding that occurs and is dominated by Water Hyacinth (*Eichhornia crassipes*) plants. The dragonflies were seen almost exclusively around this area during the survey period and it is quite likely that this area is the primary breeding ground for these insects.

Dragonflies are insectivorous and are known to feed on bees, butterflies and mosquitoes and even other dragonflies. This may be another reason for the abundance of individuals as the area surrounding the water hyacinths supported a lot of the fauna,

especially, insects, found on the site. Dragonflies are known to control the populations of several pest species such as mosquitoes and the loss of dragonflies in the area may have implications for nuisance species and for what can become nuisance species. This important predator may be keeping the population of mosquitoes low in the area and therefore reducing the risk that mosquitoes pose as a vector to the existing residents.

Individuals of the order Orthoptera were represented by grasshoppers. The differences in the grasshoppers and crickets can sometimes be hard to distinguish, but crickets tend to be nocturnal at any rate and the species observed were active in the mid-morning to afternoon. These were noted in the more disturbed areas of the property where there was more bare ground and less vegetation. They were also seen most near the road and areas more likely to be traversed by human and vehicular traffic and littered with human refuse. Their darker colouration allowed them to blend in with the habitat of their choice, but several individuals were approached and even crawled or perched on the clothing of members of the survey team. This may indicate the level of disturbance that the remaining fauna have become accustomed to.

Other species of Arthropods were observed but these were mostly outside of the areas of highest species abundance. Of particularly abundance closer to the highway were jewelled or spiny spiders (*Astracantha minax*). These spiders are identified by their colourful abdomens and spines. They are relatively small to medium sized spiders with relatively short legs. The spider was found regularly in and between the Cashaw Macca (*Prosopis juliflora*) in orb-shaped, insect trapping webs.

The Order Diptera, known as true flies consists of flies, mosquitoes and gnats. All these representatives of Diptera were noted at the site. These individuals are looked at as pests with flies and mosquitoes being important vectors for several diseases. The mosquitoes from brief observations seemed more likely to be *Aedes aegypti* or *Culex* sp. A few individual flies were observed and seemed to be the common housefly (*Musca domestica*) although there were some much larger species of flies that were harder to identify.

The order Hymenoptera contains several social insects including ants, bees and wasps. Several species of ants were noted in the area. Most were associated with the few Mango trees on the property. Fewer individuals of bees and wasps were noticed. Several bumblebees (*Bombus* sp.) were observed also.

At the trunks of several trees were the telltale mounds of duck ants or termites. These were noticed at the south of the property and mostly around the railway where the vegetation could be described as denser than the remainder of the property. These can be considered nuisance species and will be discussed later in the chapter.

4.2.2.3.5.2 Conservation Status of Species Observed

i. Endemic Species: No endemic species were observed during the assessment

ii. Rare, Threatened, Protected or Endangered Species*:* No rare, threatened or endangered species were observed during the survey of the area.

4.2.2.4 NUISANCE SPECIES

4.2.2.4.1 PRESENT STATUS

Nuisance species can be defined as any organism, indigenous or invasive, that may have a negative impact whether environmental, economic or otherwise in a given habitat. In this definition is a level of subjectivity. Mosquitoes were present at the site and are common pests among human populations. These are certainly nuisance species as they are vectors for diseases such as Dengue Fever and more recently Malaria, which was considered eradicated from Jamaica. The economic and social toll that this disease can take is considerable.

For any structure the treatment of its foundation for termites is very important. Economically termites can wreak havoc on the investment of a home by destroying anything with wood or plant based material. Houseflies are also vectors for several diseases including typhoid, cholera, Salmonella, bacillary dysentery, tuberculosis, anthrax, ophthalmia, and parasitic worms. The larval stage of the fly, maggots can infect wounds of mammals.

Lizards are considered by most Jamaicans to be nuisance species although they in fact, may have a lot to do with the control of dangerous vectors of disease such as houseflies. This has a lot to do with perception and therefore despite the ecological benefits of lizards it is unlikely that a lot can be done to change the attitude of most residents. Spiders also suffer from a similar reputation. Cobwebs in the home are a sign of an untidy house rather than a clean or balanced habitat. Many people are allergic to the stings of bees and wasps and their symptoms can range from swelling and mild irritation to anaphylactic shock and in the most extreme, untreated cases even death. With a health implication such as this these can be looked at as nuisance species.

Although mosquitoes, houseflies are the true nuisance species any ecological imbalance can create a situation in which a previously benign species becomes ecologically, economically or medically injurious.

4.3 ECOLOGICAL FUNCTIONS OF THE STUDY AREA

4.3.1 ECOLOGICAL GRADIENTS AND INTERACTIONS

The study area represents a highly disturbed ecosystem with a few communities, habitats and niches. There appears to be no ecological gradients and the area can be described as a mosaic of homogeneous vegetation type.

Despite the disturbance animal interactions including predation and symbiosis were observed. These animals also play a very important role in the operation of the area as an ecosystem. Grasshoppers are herbivorous insects and are a source of food for lizards and birds. Spiders are predatory arthropods and several of the webs observed had trapped small to medium sized flying insects. These predators are also indicators for the general health of the environment and although they are known for eating a wide range of prey they are very important in the control and regulation of insect populations.

Both bees and wasps aid in pollination. Bees are adapted to feeding on nectar and to gathering pollen and by this way are great pollinators. A few Bumblebees were observed at the property. These are at least threatened in many countries because they are not as economically viable as honeybees, despite being effective pollinators. Habitat

destruction is the chief culprit as well as pesticide use but the latter is unlikely to be the case in the parish of Clarendon where bees have great economic value for honey production and so pesticides are used more carefully. Wasps are far less efficient pollinators though they do play a role. Wasps however tend to be predatory or parasitic. 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.

Termites are ecologically important as detritivores that break down plant material and aid in the recycling of nutrients in the environment. They also help in soil formation and create habitats for other species.

4.3.2 INDICATOR SPECIES

The results from the assessment of flora and fauna are indicative of the low ecological importance of the area. Out of the three (3) plots assessed during the floral assessment, only one plot, (*Plot 1*) showed any level of species diversity which itself was very low. The remainder of the plots were relatively homogenous with little or no species diversity being observed. No endemic, rare, endangered or protected plant species were observed which indicates the low level of ecological importance of the area.

This low level of species diversity was also evidenced in the assessment of avifauna. This is indicated by the absence of many common resident species such as the woodpeckers, vireos, cuckoos and more flycatcher and hummingbird species found in nearly all wooded areas on the island. The dominant species observed in the area were the Common Ground Dove, Cattle Egret, Smooth-billed Ani, Northern Mockingbird and the Yellow-faced Grassquit which are highly ubiquitous species and their dominance illustrates a poor habitat type.

Butterflies are also a good indicator of ecological importance of an area. The species diversity of this group within the Lancewood Valley development area was generally high however based on the assessment it was perceived that the high diversity observed in the development area may be supported by the nearby densely forested

area located to the south of the property and that the butterflies are attracted to the area for foraging on the numerous *Lantana sps* that are found throughout the property.

4.3.3 FACTORS INFLUENCING THE ECOLOGY OF THE STUDY AREA

The main factor which has influenced the ecology of the Lancewood Valley area is its climate namely rainfall and temperature. The rainfall experienced in this area when compared to other areas in the island is very low for most of the year. For most of the year the average monthly rainfall is between 40 – 50 mm. Rainfall levels over 150 mm in a month are only experienced in September and October. The temperatures experienced in this area tend to be higher than other areas as well reaching highs of 32.4°C in the summer months. These factors make the area dry and hot and not many plants are adapted to survive in these circumstances. Reports from the geological assessment show that the soil composition in the area is not very thick, likely not exceeding approximately 1 m in areas of greatest soil cover. These factors accounts for the low plant species diversity, which was observed at the project site.

Apart from butterflies, the animal species diversity was also low. This can be explained by the low percentage of cover provided by the plant species. There are therefore not many available niches for these animals to occupy.

Natural occurrences such as bush fires and anthropogenic influences (cattle rearing) have also played an important factor in ecological attributes of the study area. Due to these factors the area seems to be constantly in primary succession for most areas. Over the eight-week period of ecological assessment bush fires, on more than one occasion had significantly ravaged plots and vegetation seemed to be constantly regenerating. (Please see ***Figures 18*** below). These bush fires were likely influenced by the climatic conditions or may have been influenced by human activities. It was difficult to tell however.

Figure 18: Picture showing the damage to the area caused by bush fires

4.3.4 THE FUTURE DESCRIPTION OF THE DEVELOPMENT AREA WITHOUT THE PROPOSED DEVELOPMENT

The animal composition within the Lancewood Valley area is as a direct result of the vegetation type that is presently there. Without a drastic change in the vegetation type to one with larger and more varied trees, it is not expected that the faunal composition of the area will change. The bird species in particular are intrinsically linked to the type and diversity of the vegetation along with other environmental factors such as temperature and humidity etc. If the vegetation is mainly of one type, then we would be see only some generalist species along with any species that are specialized for that type of habitat. Conversely a more diverse habitat would be inhabited by species from all the various feeding guilds, such as nectar feeders, fruits and seed feeders, insect gleaners, flycathers, predators etc. The vegetation appears to be somewhat similar to nearby disturbed habitats of Harris Savannah characterized by mainly shrubs and short trees. So a change would not occur naturally in any foreseeable future but more be induced by man, which is most unlikely.

5. 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.

5.1 METHODOLOGY

The assessment of the Socio-economic setting of the study area involved the collection of primary and secondary data.

One of the primary research tools used to glean socio-economic data from the existing residents of the community was a questionnaire or structured interview (See ***Appendix VI***). For the purpose of this evaluation, local conditions focused on those on the site itself and those within a 2 km radius (See ***Map 4)*** from the site while those on a national level focused on the island-wide conditions. Informal discussions were also held with residents of Lancewood Valley, Sandy Bay, Lancaster Hall, Inverness and Sand Bay Halt during the month of November 2006.

The questionnaire is an inexpensive survey tool that is appropriate for circumstances in which resources are limited. Since the questions and answers tend to be relatively simple the data gathered from questionnaires is relatively easy to compile in comparison to other survey types.

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 their responses. In cases where the expressed opinion of the participant was most appropriate the question posed tended to be open allowing full expression.

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 the impacts they believe any development may have on their quality of life.

Secondary data collection was carried out through desktop research and data from the Statistical Institute of Jamaica (STATIN), the Ministry of Education (MOE) and the Planning Institute of Jamaica (PIOJ).

5.1.1 SOCIAL STRUCTURE

5.1.1.1 DEMOGRAPHY

The total population of the study area is approximately 6,079. This number includes the combined populations of Lancewood Valley, Lancaster Hall, Inverness, Sandy Bay, Rosewell and Sand Bay Halt. The total population of Clarendon is 237, 024. This means that the population of the study area represents approximately 2.6 % of the parish population.

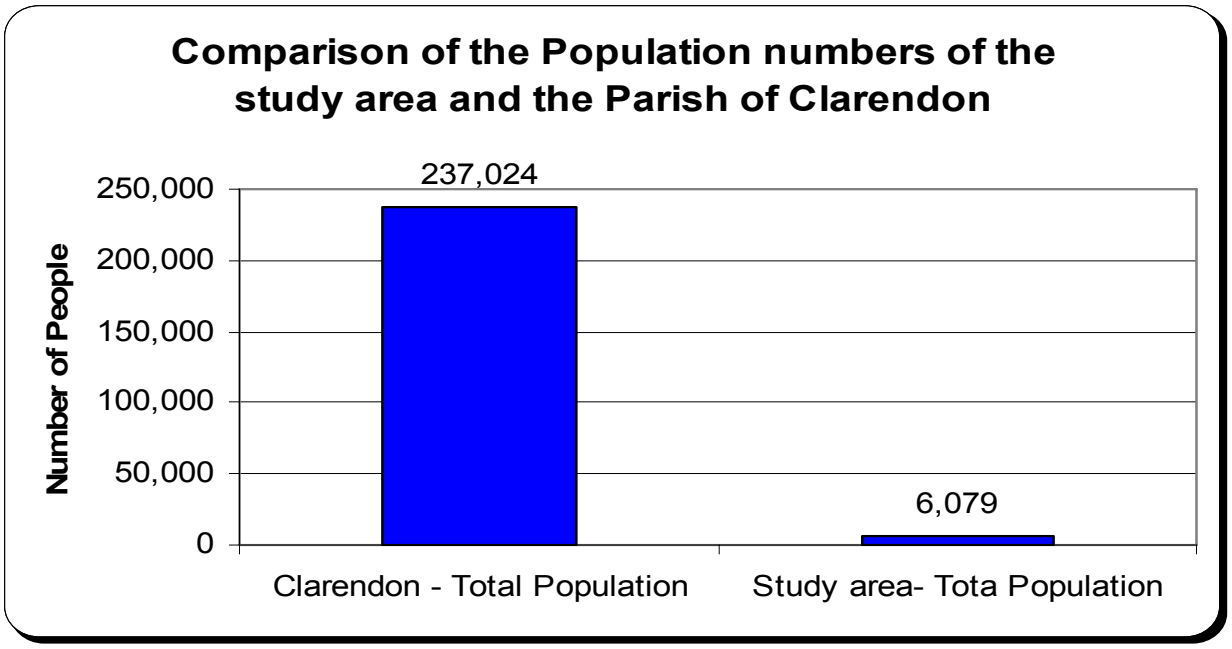
The total female population of the study area is 3,056 and the total male population is 3,023. Therefore, the females make up slightly more than half the population of the study area at 50.3%. At the parish level however, males make up a marginally greater portion of the population at 50.5%. It should be noted that 58% of the respondents to the questionnaire were females and this percentage reasonably conforms to the population split of the study area.

The 2001 census data from the Statistical Institute of Jamaica (STATIN) show that approximately 36.9% of the population of the study area is less than 15 years of age. This is higher than the national figure of 32.3% of the population being less than 15 years of age. In contrast to this 9.6% of the population of the study area is over the age of 60. This shows closer agreement with the national figure of 10.2%.

Using the figures from the 2001 census, and comparing this with the previous island-wide population census in 1991, it is possible to present a crude estimation of the rate of growth of the study area over this ten-year period. The study area shows an 81% increase in population over the past ten years or an average rate of growth in population

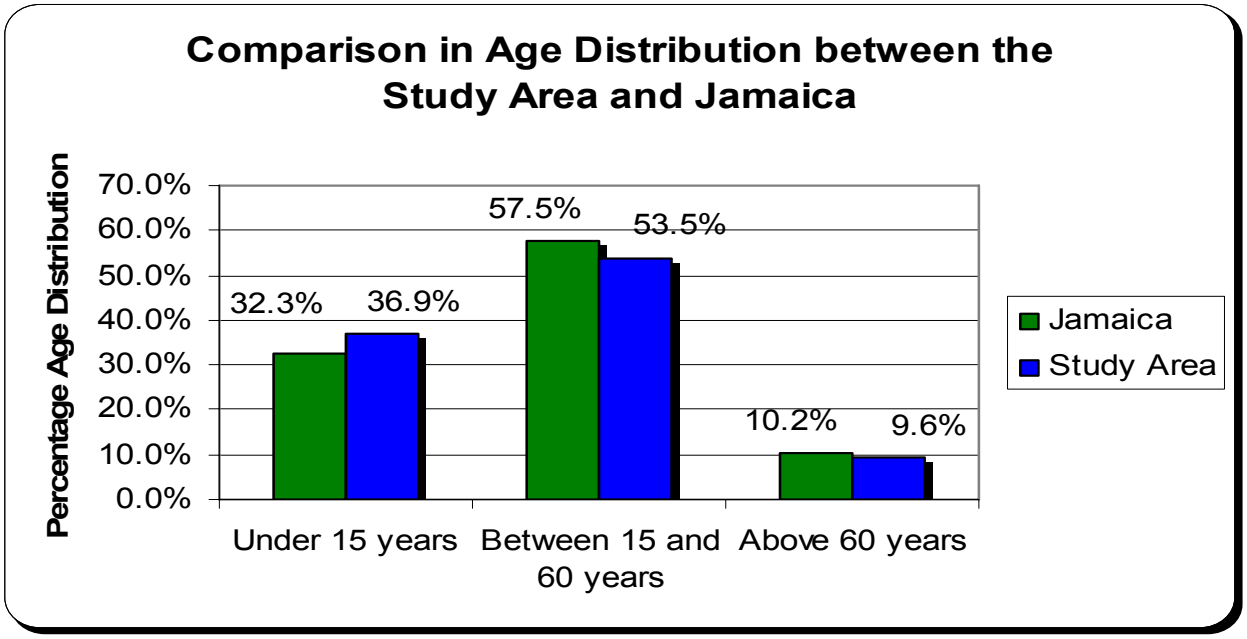
of 8.1% per year. At the parish level the rate of population increase is roughly 12% for the same period or a yearly growth rate of approximately 1.2%. The rate of population growth for the period 1991 to 2001 is 9.53%.

Figure 19: Graph Showing the Comparison of the Population numbers of the study area and the Parish of Clarendon



Source: STATIN (2001)

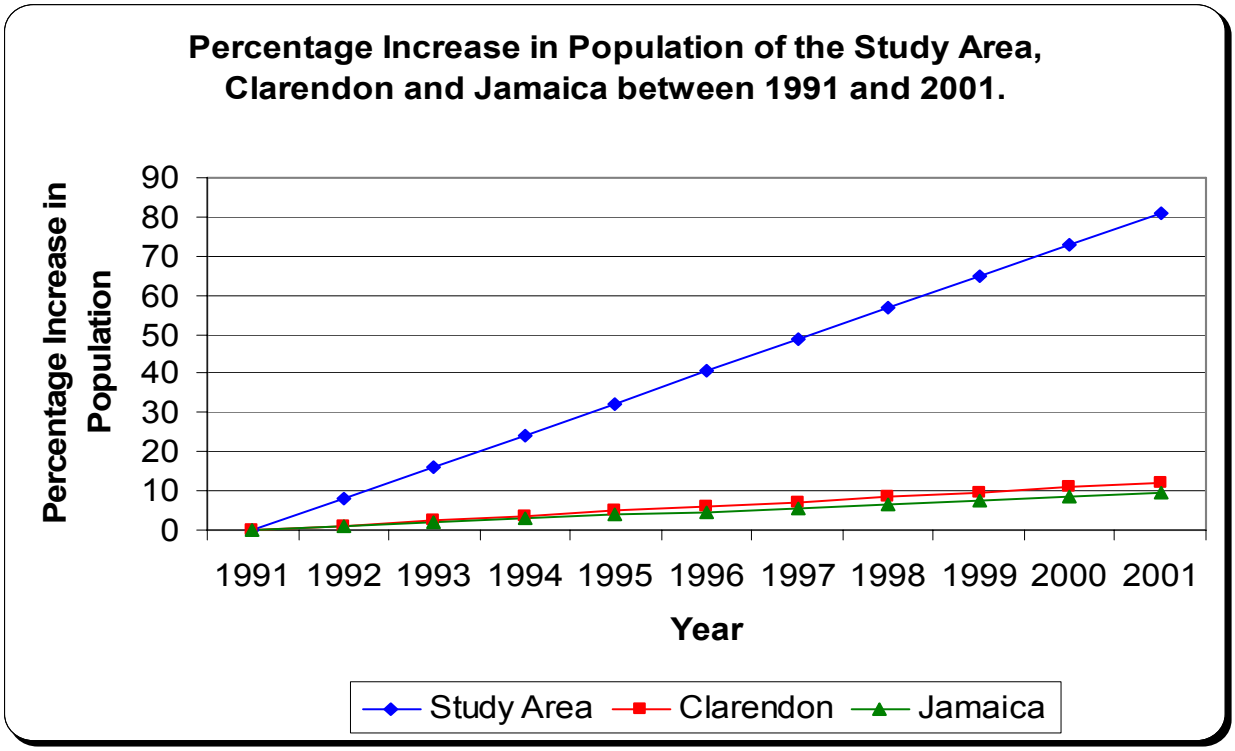
Figure 20: Graph showing the Comparison in Age Distribution between the Study Area and Jamaica



Source: STATIN (2001)

The rate of increase of the parish is greater than that of the island over the same period. It is easier for a smaller population to register a significant increase with the addition of a relatively small number of persons. Nonetheless, an increase of 81% over a ten-year period is very large. It is quite possible that with urban sprawl there and improved roads the area has experienced a relatively large influx of persons. Since the survey the south coast leg of Highway 2000 has opened and it is quite possible that this rate of rapid growth has been maintained or even accelerated. At the present growth rate one can expect that the population of the study area will be almost 11,500 persons by the year 2012.

Figure 21: Graph showing the Percentage Increase in Population of the Study Area, Clarendon and Jamaica between 1991 and 2001.



Source: STATIN (2001)

5.1.1.2 EMPLOYMENT AND INCOME

The unemployment rate for the active population of the island of Jamaica is approximately fourteen percent (14%). This compares with a significantly lower unemployment rate of nine percent (9%) for the parish of Clarendon. The only employment data that could be garnered for the study area came from the answers to

the interviews of residents. Employment figures at the community level were not available for the writing of this assessment.

Just over seventy-six percent (76.4%) responded that they had jobs. These ranged from construction workers, caterers, drivers, domestic workers, farmers and shopkeepers. The remaining respondents reported having itinerant jobs that more or less supported themselves and their dependents. Although, employment did not seem to of major concern to those polled, it is difficult to separate the economic outlook from persons' views on the employment. Although most are employed and Clarendon on a whole has a better employment rate than the island average it is generally a question of the level of income. Most of the respondents were self-employed and therefore their income was dependent on the disposable income of others. During difficult economic periods they make less money and there is always the desire for more opportunity if this is directly related to improved earnings.

Respondents were not forthcoming about their earnings over any given period. In the few cases where those surveyed were willing to divulge that information the figures and time periods were so variable that it was agreed that a reasonable and useful average could not be used as representative of the study area.

5.1.2.3 CRIME AND VIOLENCE

The majority of the respondents, eighty-two percent (82%), did not consider crime to be a problem in the area. The remainder cited praedial larceny and petty theft among their concerns, as well as reports of occasional gun crimes in adjacent communities. Given the large number of goats roaming in the community, reports of praedial larceny are no surprise.

5.1.2.4 TRAFFIC

Within the community of Lancewood there is no major vehicular traffic. This, is in stark contrast to the situation a few metres from the community where there is a major artery for vehicular traffic; Highway 2000. The highway allows existing residents access to other areas of the parish and parts of the south coast of Jamaica. Cars do not usually

need to venture further in the community than the outskirts and this is where the residents commute. The bad roads in the community keep the traffic to a minimum.

Although the traffic is low all residents wish good roads. Respondents were no different and they hoped that with the development comes an improvement to the road network of their respective communities.

5.2 INFRASTRUCTURE

5.2.1 HOUSING

As at 2001 there were 1646 houses in the study area. Of these, ninety-seven percent (97%) were separate or detached dwellings. Data for the parish of Clarendon indicates that ninety-three percent (93%) of houses are separate or detached. The majority of houses in the parish, eighty percent (80%) are concrete structures, and ninety-two percent (92%) had roofs of metal sheeting.

The toilet facilities for the houses in the study area showed that in 2001 approximately forty percent (40%) had access to water closet toilet facilities, whether under separate or shared circumstances. Approximately fifty-seven percent (57%) of households used pit latrines as their toilet facilities. This figure also included separate and shared facilities among households. The remaining percentage either had no facility or there was no report made for the statistics. Most of the persons who responded to the survey within the area reported that they had indoor toilets within their homes.

Housing availability did not seem to be a problem within the Lancewood Valley area. About sixty percent (60 %) of the persons interviewed said they owned their own home. The remaining forty percent said they rented homes within the area. These persons reported that it was not difficult to find a place to rent within the community. They reported that rent ranged from $8,000 - $ 10,000 for a two-bedroom house.

5.2.2 ROAD NETWORK

The residents of Lancewood Valley and the surrounding communities face a paradox in their transportation situation. They are in close proximity to the South coast leg of Highway 2000, which is a new road in very good condition. As you enter the surrounding communities however the road conditions deteriorate considerably and movement by motor vehicle is hampered considerably.

5.2.3 UTILITIES

5.2.3.1 Electricity

All the houses in close proximity to the development site (Lancewood Valley) reported that they have access to electricity or have electricity in their homes.

5.2.3.2 Water

Ninety percent (90%) of respondents said that they had access to piped water from the National Water Commission (NWC). The remainder said that they had indoor plumbing but that their water service from the NWC was unreliable or non-existent and received their water supply from tanks.

5.2.3.3 Telecommunication Services

Fixed line services are available in the Lancewood Valley area over 50 % of the respondents said they had fixed lines in their homes.

Most respondents said they also relied on cellular service (Digicel, Cable and Wireless and Miphone) for their telecommunication needs.

5.3 SOCIAL SERVICES

5.3.1 EDUCATION

5.3.1.1 Primary Education

Only two (2) primary education institutions are located within the study area: the Green Park Primary and Junior High School located 1 km from the proposed site and the Rosewell All-age located 1.9 km from the proposed development site. Other schools close to the area include the Freetown Primary School located 5 km from the proposed site and the Cross Primary and Junior High school located 4 km from the proposed site.

Outside of these schools, Mineral Heights Primary School and Hazard Primary School are approximately 7 km from the site of development, while May Pen Primary School is located approximately 9 km away from Lancewood Valley.

Table 18 Table showing the characteristics of the Primary Schools within 5 km of the project area

CHARACTERISTICS	SCHOOL			
	Rosewell All-Age	**Green Park Primary and Junior High**	**Freetown Primary**	**Cross Primary and Junior High**
Type of School	Co -Ed	Co -Ed	Co -Ed	Co -Ed
School Organisation	Whole Day	Shift	Whole Day	Shift
Local	Rural	Urban		Urban
Class	I	III	II	IV
Capacity	140	325	225	505
Number of students enrolled	98	752	397	787
% Attendance	82	68	76	72
Number of Teachers	4	30	14	44
Student/Teacher ratio	33:1	31:1	36:1	35:1

Source: MOE (2003)

Based on the responses from persons that had children that went to primary school in the area showed that most parents sent their children to either Green Park primary or Cross Primary and Junior High. Despite the close proximity of Rosewell Primary, none of the respondents said they sent their children to this school, the reason for this could not be ascertained.

None of the schools in the area showed signs of being overcrowded as both operate on a shift basis to accommodate the number of students that are enrolled.

5.3.1.2 High/Secondary/Technical Schools

There are no secondary, high or technical schools found in the study area. There is only one technical high school in the parish of Clarendon and this is Vere Technical which is found approximately eighteen (18) kilometres away from Lancewood Valley. This still makes it the closest technical high school for existing and potential residents as the next closest is Jose Marti Technical High School in St. Catherine.

The closest high schools are Central High School, Glenmuir High School and Denbigh High School. All three (3) are in May Pen and its environs, which is approximately nine (9) kilometres from Lancewood Valley. Interestingly, several of the respondents to the questionnaires also mentioned Old Harbour High school as a secondary educational institution that was used by children in the Sandy Bay district. Old Harbour High School is found approximately 7.5 kilometres away from the study site. Although the town of Old Harbour is in the adjoining parish of St. Catherine, it is actually closer to the study site than May Pen and the high schools found there. It may be of note that the roads that take one from Lancewood to May Pen are generally in good condition where as Old Harbour roads may be considerably less so. A small number of the respondents mentioned Clarendon College as the school their children attended. Clarendon College is approximately 27 km from the study site and this is a fair distance to travel when there are several high schools that are much closer. Although it was not expressly mentioned, perhaps there exists a perception that the quality of education is better at Clarendon College or perhaps it was the alma mater of one of the parents and this was the reason that the children were attending this school.

Of the five secondary/high/technical schools close to the project site, only Old Harbour High showed signs of overcrowding based on the capacity of the school, the enrolment and the percentage attendance.

Table 19: Table showing the characteristics of the secondary and technical schools in the project area

CHARACTERISTIC	SCHOOLS				
	Central High	**Denbigh High**	**Glenmuir High**	**Vere Technical**	**Old Harbour High**
Gender	Co-Ed	Co-Ed	Co-Ed	Co-Ed	Co-Ed
School Organisation	Shift	Extended Day	Whole Day	Whole Day	Shift
Local	Urban	Urban	Urban	Urban	Urban
Class	IV	IV	IV	IV	IV
Capacity	1575	1125	1215	1575	1350
Number of Students Enrolled	1800	1473	1298	1265	2307
Percentage Attendance	75	89	91	72	82
Number of Teachers	108	69	80	78	130
Pupils/ Teacher Ratio	19:1	25:1	18:1	17:1	20:1

Source: MOE (2003)

About fifty percent (50%) of the respondents indicated that secondary education was the highest level achieved. Thirty-six percent (36%) of those surveyed listed primary or all-age education as the highest level of education attained. Fourteen percent listed tertiary/ vocational education as the highest level of education achieved.

5.3.1.3 Tertiary Institutions

There are two (2) tertiary educational institutions in the parish of Clarendon; Knox Community College and the privately run May Pen Business College. The Knox Community College is primarily located in Spaldings, Clarendon which is about 40 km away from Lancewood Valley, although it operates three other campuses in May Pen, Cobbla and Mandeville. The College offers pre-university arts and sciences, secretarial studies and farm management courses culminating in certificates, diplomas, and associate and bachelors degrees. *The Economic and Social Survey of Jamaica, 2005* records the number of students enrolled at this community college as approximately 1,114. May Pen Business College offers courses in business administration and secretarial studies.

None of the respondents interviewed in the survey said they attended any of these schools.

5.3.1.4 Vocational Institutions

There are two vocational schools in the parish of Clarendon. These include the St. Anna's Academy which is located in May Pen, approximately 9 km from the Lancewood Valley area. The other is the Ebony Park HEART Academy, which is located in Toll Gate, which is approximately 25 km from Lancewood Valley area.

5.3.1.5 Special Education Schools

Clarendon Group for the Disabled is the only educational institution dedicated to the needs of challenged students. It is located in May Pen (9 km from the proposed development site) and specially caters to the visually impaired. None of the respondents were apparently physically challenged or indicated that their children were or mentioned that they had children enrolled in this institution.

5.3.2 TRANSPORTATION

The community is not large and it seems that most people get around within the community by walking. Most respondents mentioned taxi as their main source of transportation. They mentioned that the taxi service from the community to larger urban areas such as May Pen was quite regular and were reportedly satisfied with the reliability of the service.

5.3.3 HEALTH SERVICES

The major hospital in Clarendon is the May Pen Hospital. This is situated some 9 km away from the study area. The Sandy Bay/ Green Park Clinic is within a kilometre or so of the study area and the Denbigh Health clinic is in the environs of May Pen.

All respondents reported using the May Pen Hospital when seeking medical assistance. Twenty percent (20%) reported using their own private doctors in addition to the hospital and about thirty-five percent (35%) used either the Sandy Bay clinic or the Denbigh clinic in addition to the hospitals. The level of health care sought seemed to be directly related to severity of the health concern. For check ups and for management of chronic illness those who were able went to private doctors, while others went to the clinic. If the health issue was deemed major then the respondents used the hospital. The distance between the study area and May Pen Hospital was never mentioned as a deterrent to the use of the institution.

5.3.4 POSTAL SERVICES

All of the respondents mentioned that the closest available post office was May Pen. Most listed this as a problem that they hoped the development would help to rectify this problem. The distance to retrieve their mail seemed to be the main grouse among respondents.

5.3.5 EMERGENCY SERVICES

5.3.5.1 Fire Services

The closest Fire Station to the study area is the May Pen Fire Station, which is located approximately 10 km from the project site.

5.3.5.2 Police Station

The closest Police Station to the study area is also located in May Pen. Residents within the Lancewood Valley area expressed their concerns about a police post not being closer to the area.

5.3.6 WASTE

5.3.6.1 Solid Waste

Based on interviews with resident's garbage is collected in the area by the Metropolitan Parks and Market at least once per week. This is disposed of at the solid waste disposal site located at Riverton Landfill, which is operated by the National Solid Waste Management Authority (NSWMA).

5.3.6.2 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 COMMUNITY'S PERCEPTION OF THE PROJECT

All the respondents polled within the Lancewood Valley area were aware of the project and its status to varying degrees. As the assessment moved further away from the study area this awareness decreased. Most respondents seemed to have a favourable view of the project although some of the respondents did not know what to make of it. For the most part those polled seemed willing to adopt a 'wait and see' attitude before expressly stating that the project would be of any great benefit to the community.

In general the members of the community would like to see a rise in the standard of living that is available to them. Development of and improvement in the social amenities that are available to the residents are of great importance. Perhaps the wariness of the community members is related to their perception that the highway being in such close proximity would have improved their standard of living and this has not occurred to the extent that they would have hoped. It is evident however that cautious optimism remains and there is still the hope that if the development is successful that it will at least provide some opportunities such as jobs for the existing residents.

6. ANALYSIS OF ALTERNATIVES

The alternatives with respect to the project from an environmental and socio-economic standpoint are discussed in this section. This includes a discussion on the project activity alternatives and the project design alternatives.

6.1 THE 'NO ACTION' SCENARIO

If the study area is left in its current state without the development, it can be predicted that it will remain a highly disturbed area due to the high level of anthropogenic and natural occurrences of bush fires that affect the area.

From a socio-economic perspective the "no action" option may not be the best alternative. Lancewood Valley and its surrounding communities are in need of community growth and development, which a housing development such as the one proposed may be able to provide directly and indirectly. Considering the political climate of the country, the area may be subject to squatting if left undeveloped.

6.2 PROPOSED SUBDIVISION

The area with the proposed housing development may see some change in its environmental attributes (physical and biological). Ecologically there will be an insignificant loss of habitat and species diversity in the area. Drainage patterns, soils quality and general geology of the area will not be affected by the subdivision.

From a Socio-Economic perspective the proposed housing development would contribute significantly to a partial national, regional housing shortage. In addition numerous jobs would be created by the development either directly or indirectly as well as community growth and development for Lancewood Valley and its surrounding communities.

6.3 AGRICULTURE

The potential for certain agricultural practices such as produce is limited due to the climate in the are. There is however potential for cattle and goat rearing. The returns on

these practices however have been marginal due to the instances of praedial larceny. Intensive cattle and goat farming may also cause surface water contamination due to the presence of a watercourse on the property. Agriculture is therefore not a suitable alternative.

6.4 THE CHOSEN ALTERNATIVE

After careful consideration of the environmental and socio-economic impacts that may arise from the project, the proposed subdivision has been chosen as the most suitable alternative of the three project activity alternatives analysed. The 'No Action" alternative is the best from an ecological point of view although no species of high conservation value will be lost. The other two alternatives assessed would have varied negative environmental impacts, which however can be mitigated. From a socio-economic perspective the subdivision will have the most positive impact on Lancewood Valley and its surrounding communities.

7. 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. These mitigation measures have been summarised and the added cost to the developer of each mitigation measure estimated.

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, Construction and Post Construction phases of the development.

7.1 PHYSICAL IMPACTS

7.1.1 CLIMATE

A. SITE PREPARATION AND CONSTRUCTION PHASES

The Lancewood Valley area is covered by very little trees, and therefore the removal of this vegetation will have little or no impact on the climate in the area.

Mitigation Measures:

- All mature trees present must be maintained and not be removed during this phase of the development.
- Ensure that the road system implemented throughout the development and access roads to the development involves appropriate signals and signs to ensure the smooth flow of traffic. This will reduce the idling of vehicles and therefore minimise the emissions in the area.

B. POST - CONSTRUCTION PHASE

The increase in the population after the construction of the development will mean increase in the traffic in the area. Increased traffic means increased release of exhaust from cars, which contribute to global warming. Assuming the minimum one car per household, the traffic in the area will increase by one hundred and twenty one (121) cars over a period of time. This phase of the development may therefore have a long term, minor negative impact on the climate locally, nationally and globally.

Landscaping will be done throughout the development during this phase. Research has however shown that the vegetation can positively affect cloud formation and precipitation through their impact on evaporation and convection. Vegetation also acts as carbon sinks for greenhouse gases. These activities can therefore positively impact on the climate of the area.

Mitigation Measures:

- Incorporate as far as possible natural vegetation typical of the area during the landscaping of the development.
- Although the proper maintenance of vehicles by potential occupants of the development is not the responsibility of the developer it must be impressed upon the potential residents to maintain their vehicles regularly.

7.1.2 AIR QUALITY

Nitrogen Dioxide (NO_2) is a product of combustion processes (e.g. from vehicle exhaust, power plants) and is closely associated with other pollutants including particulate matter. It is toxic and is a precursor of ozone. Most atmospheric NO_2 is emitted as nitrous oxide (NO), and is oxidized to NO_2 by ozone (O_3). Sulphur dioxide (SO_2) is emitted from power plants and diesel vehicles, as well as from industrial boilers, metal smelters and paper manufacturing. Sulphur dioxide and nitrogen oxides cause acid rain.

NO_2 and SO_2 may cause adverse health effects, via 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. 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. The fugitive dust has the impact of being a nuisance as well as fine particulates (< $10_{\mu m}$ measured as PM_{10}) may cause respiratory distress or illness (asthma, bronchitis) and therefore dust generated from the site preparation and construction activities is likely to have a major negative short-term local environmental impact.

Movement of heavy construction vehicles and the increase in traffic may cause an increase of local greenhouse gas emissions. It is also expected that construction of roads will cause the on-site release of noxious fumes due to the processing of asphalt. The impacts although negative, may be short term, but not significant.

Mitigation Measures:

- The clearing of vegetation must be carried out on a phased basis; that is only areas designated for construction during the necessary phase of development must be cleared to minimise the dust that may be generated.

- The area to be designated as a green space will be covered with sod to eliminate the dust to be generated from this area. This area will only be cleared within a week before the sod is to be laid.

- 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 of aggregate, sand and cement to prevent spillage.
- o Extra care must be taken to reduce dust in periods when wind speed are greatest which is between June and July, e.g. extra wetting of the compound to suppress dust.
- o Plant large trees on perimeter of compound to create a natural windbreak, which will also serve the purpose of being a screen shielding the construction activities from public view.
- 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.
- o Where possible 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. POST – CONSTRUCTION PHASE

Assuming that there will be one car per household, the increase in traffic may increase by approximately one hundred and twenty one (121) vehicles over a period of time. The long-term effects of increased traffic in the area will cause an increase in Carbon Monoxide, SO_x and NO_x, which are greenhouse gases that contribute to the

degradation of the ozone layer and are key factors in the production of acid rain. This phase of the development may have a minor, long term, negative impact on the air quality at a local, national and global level.

Mitigation Measures:

- Although the proper maintenance of vehicles by potential occupants of the development is not the responsibility of the developer, it must be impressed upon the potential residents to maintain their vehicles regularly.

- 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. This may necessitate the alteration of the existing roadway, which have implied impacts.

7.1.3 WATER QUALITY & QUANTITY

7.1.3.1 WATER QUALITY

A. SITE PREPARATION AND CONSTRUCTION PHASES

The development may have a minor, negative, long-term impact on surface water quality during the Site Preparation phase of the development. This will be as a result of the possible storage of hazardous substances on the site such as diesel and motor oil onsite for the operation of machinery and stand-by generator as well as the storage of aggregate and asphalt for the construction of roads.

Inappropriate disposal of sewage during this phase of the development may have an impact on the surface water as well.

Mitigation Measures:

- If diesel and motor oil is to be stored, 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 project activities and signs indicating the storage of these substances erected.

- Provide workers at the development site with chemical toilets during this phase of the development. A reasonable ratio would be eight (8) workers per chemical toilet.
- Store all raw materials away from the vicinity of watercourses located on the property to avoid contamination of this area.
- General refuse must be transported and disposed of appropriately at the designated disposal site at Riverton Landfill by a licensed contractor.
- Install a proper drainage system to control rain/storm water runoff on the site.
- Implement the recommended sewage treatment method which involves a Septic Tank / Tile Field for each lot.

B. POST-CONSTRUCTION PHASE

The development may have a major long-term impact on the surface water quality. This watercourse empties into a river located within the Portland Bight Protected Area and this increases the relevance of the mitigation of these impacts. Improper sewage

The activities involved in maintaining the open space which are around the development site may also have a significant, negative, long term impact on water quality as fertilizers and pesticides may be utilised in the maintenance of this area.

There will be no impact on groundwater quality.

Mitigation Measures:

- Ensure that the sewage treatment facilities are properly maintained.
- Regularly maintain the drainage system, which controls the storm water runoff at the site.
- Ensure that general refuse is collected regularly and is transported and disposed of appropriately at the designated disposal site at Riverton Landfill by a licensed contractor.

7.1.3.1 WATER QUANTITY

A. SITE PREPARATION AND CONSTRUCTION PHASES

Lancewood Valley and its surrounding communities do not face a water supply problem and therefore there is adequate water available to meet the needs during these phases of the development. This phase of the development will therefore have no impact on the water supply in the area.

Mitigation Measure:

- Although water supply is readily available, it is important for the developer to implement measures to conserve water as much as possible during these phases of the development.

B. POST- CONSTRUCTION PHASE

With the proposed subdivision the population in the area may increase by as much as seven hundred persons, which will increase the demand on water supply in the area. This however will not have any impact on this water supply, as there is sufficient water available in the area to adequately supply the development. Although water supply is not a problem in the area, residents must make an effort to conserve on water.

Mitigation Measures:

- The developer should encourage residents to gutter all houses and encourage residents to recycle water for landscaping purposes.
- The developer should encourage residents to install water saving devices (faucets, toilets etc.) into their home design.

7.1.4 SOILS AND GEOLOGY

A. SITE PREPARATION AND CONSTRUCTION PHASES

The activities involved in the site preparation and construction phases 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 and this will leave considerable areas of soil exposed to the elements, which may result in soil erosion.

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:

- Remove as little vegetation as possible from the development site and revegetate cleared vegetation as soon as possible. These areas must be cleared in phases.
- Install appropriate drainage systems to direct water away from slopes.
- Avoid as far as possible the traversing of bare soil by vehicles to reduce soil compaction.
- Designate a main access route for heavy machinery.
- Utilise sod layers in the open area, which will reduce the effect of soil erosion when grass is being established.
- Avoid activities in these phases in period when wind velocities are highest which is between June and July.
- Avoid activities in these phases in periods of heavy rainfall, which are September and October.
- 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

- In the event of a spill the contaminated soil must be removed and disposed of at a licensed landfill.
- Ensure that general refuse is collected regularly and is transported and disposed of appropriately at the designated disposal site at Riverton Landfill by a licensed contractor.

B. POST – CONSTRUCTION PHASE

With the introduction of vegetation and paved areas to the proposed subdivision there will be no impacts to the soil quality and geology of the area during this phase of the assessment.

Mitigation Measures:

- Stipulate that houses to be constructed within the subdivision must be guttered as runoff from roofs may typically cause accelerated soil erosion around the margins of buildings. (Residents can collect water which may be utilised for irrigation of landscape).

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:

- Designate a main access route for heavy machinery.
- Utilise impervious material for areas that require paving to increase run-off.
- Ensure that the drainage plan proposed is implemented as stipulated on the plan.

- o Phase the clearing of vegetation on slopes.
- o Ponding may occur in the depression area and therefore this should be retained as a green area for recreation and possible for a detention of storm water.
- o Paved areas should be kept to a minimum to reduce runoff to the depression.
- o No lots or building of houses should take place below the 53m contour.
- o Keep paved areas to an absolute minimum and encourage the use of permeable material for parking lots etc. to allow infiltration into the ground.

B. POST-CONSTRUCTION PHASE

The Post-Construction Phase 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 Measures:

- o Keep paved areas to an absolute minimum and encourage the use of permeable material for parking lots etc. to allow infiltration into the ground.

7.1.6 NOISE & VIBRATION

Noise pollution can be considered any unwanted sound, usually of anthropogenic origin. This description of course, incorporates the subjectivity of what a receiver may find a nuisance. Furthermore, a sound that may be insignificant or even pleasurable as is the case with music at lower decibel levels can become not only a nuisance but even have long-term health impacts with prolonged exposure at significantly higher decibel levels. The association of hearing loss and chronic exposure to noise is well established.

A. SITE PREPARATION AND CONSTRUCTION PHASES

These phases of the development may have a significant negative, short-term impact on ambient noise levels of the area. Site preparation will require the cutting of an access road to accommodate the movement of vehicles related to construction and the movement of goods and materials for construction of houses and support structures like roads, electrical wires, and water and sewage conduits. Construction of houses involves

noise associated with drilling, hammering and welding. Most construction equipment available is not silenced and this can be injurious to labourers as well as a nuisance to existing residents. At 7 metres, a grader can be as loud as 94 db (A) and an un-silenced pneumatic drill up to 90 db (A). This phase will see the greatest increase in noise pollution. It will be relatively short-term but the major sources will be from vehicles involved in site clearing and excavation such as graders and bulldozers as well as vehicles for construction activities like cement mixers. During the site clearing and construction phase a number of measures may be undertaken by the developers to reduce the impact of noise on the existing and potential residents as well as the workers involved in the project.

Mitigation Measures:

- Access roads should be cut that are exclusively used for the transportation of workers, goods and materials. This road should be sited in such a way that the noise from this movement affects as few of the existing residents as possible.
- Where possible silenced machinery and instruments should be employed to reduce the impact of noise on the existing residents and workers.
- 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.
- 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.
- 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
- Construction hours should be limited to the hours of 8:00 to 6:00 p.m. daily.
- The delivery of raw materials must be limited to 8:00 a.m. and 6:00 p.m.

B. POST - CONSTRUCTION PHASE

The operation phase of the project is indefinite. The expected increase in population and attendant vehicular traffic will probably be the most significant addition to the noise impact during this phase. A properly planned development will mean well-constructed roads that allow free flowing traffic within the proposed community. Most of the mitigation methods will be dependent on the residents.

The close proximity to the trainline, which borders the property, will also create a noise impact to the housing development.

Mitigation Measures:

- 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.
- Properly maintained vehicles and well-inflated tyres to reduce the friction will produce less noise.
- Where carpooling and public transportation is feasible, it should be encouraged to reduce traffic.
- Create a reservation within the subdivision within the vicinity of the trainline to offset the noise impact from this activity.
- Construct a high wall, which separates the subdivision from the trainline. This wall should be free of holes and apertures to reduce the propagation path of the noise that is generated from this activity.
- A vegetation screen should also be created in the vicinity of the trainline. For this to be effective trees must be tall and dense. The developer therefore needs to begin this tree planting early in construction phase, in order for this to have an effect during post- construction.

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:

- Remove as little vegetation throughout the site as possible.
- Conduct vegetation clearance on a phased basis.
- Re-vegetate cleared areas as soon as possible.
- Plant vegetation screens to reduce the visual effect of this stage of the development.
- Place caveats on titles of the properties so that the construction of homes within the subdivision will be carried out in a uniform fashion.
- 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.

B. POST - CONSTRUCTION PHASE

The development area is presently in ruinate. Implementing landscaping throughout the development may have a major positive long-term on the aesthetics of the area. The upgrade of the roadways to the development may increase the aesthetics appeal of the general Lancewood Valley area.

A nicely landscaped and uniform housing development, especially from the zone of visual intrusion from the Highway will have an aesthetic appeal. This can be enhanced with implementing the mitigation measures outlined below.

Mitigation Measures:

- Incorporate as far as possible the natural vegetation throughout the site.

- Incorporate fruit trees, ornamentals and flowers throughout the development. Ensure that these plants however are not classified as Invasive Alien Species.

7.2 BIOLOGICAL IMPACTS

7.2.1 FLORA

a. Site Preparation and Construction Phases

The development will have a minor long-term negative impact on the ecology of the area. This will be caused by several factors. The most important of these will however be by land clearance. Vegetation will be cleared from over 25 hectares of land, which is a considerable amount of clearing. Most of the vegetation to be cleared does not have any ecological significance however with 70 % being grass.

Because of the low species diversity and plant cover, the vegetation supports a low species diversity of fauna, which also makes the impact that the development will have on the flora of the area less significant.

Mitigation Measures:

- Only clear vegetation that is absolutely necessary for the construction activities
- Retain all mature trees during this phase of the development

B. POST-CONSTRUCTION PHASE

It is assumed that on the completion of the development occupants will introduce flowers, fruit trees and other ornamentals to the area. While landscaping will be undertaken post construction, it is expected that this will positively impact on the ecology of the area.

Mitigation Measures:

- Avoid the use of invasive alien species in the landscaping of the property.

7.2.2 FAUNA

7.2.2.1 AVIFAUNA

A. SITE PREPARATION AND CONSTRUCTION PHASES

The Lancewood Valley area shows a high level of disturbance with a low species diversity of birds and few available niches. This phase of the development may have a minor short-term negative impact during these phases of the development. During this time birds may be displaced to the nearby open woodlands and residential areas. This however will only be temporary, as the birds would be expected to return and make use of the new landscape.

Mitigation Measures:

- These activities can be undertaken at a time outside the breeding season (March to June) and would force the any migrant birds to find alternate areas for nesting instead of having nest failures being a direct result of the vegetation clearance.
- Incorporate as much of the natural vegetation into the development as possible.
- 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.

B. POST CONSTRUCTION PHASE

With the completion of the project bringing landscaping additions such as ornamental and fruit trees as well as flowers, it is expected to have a strong positive impact on the avifauna of the area. Residential areas, although highly disturbed and occupied by man, often attract a large number of different species of birds. This is because man has so modified the environment in effect creating more food sources and roosting areas for birds, in effect creating more niches and a more dynamic habitat.

Mitigation Measure:

- Incorporate ornamental and fruit trees as wells as flowers throughout the development. This will attract birds to the area.

7.2.2.2 BUTTERFLIES

A. SITE PREPARATION AND CONSTRUCTION PHASES

None of the butterflies observed at the project were threatened in their distribution, the area does support species diversity in this fauna but this was thought to be supported by the densely forested areas close to the proposed development site.

The clearing of vegetation, which usually takes place in site preparation, may have a major negative impact on all aspects of the life cycle of the butterflies, which is approximately 30 days. All Lepidoptera rely on the leaves of plants, usually the underside, as the place for laying and attachment of eggs.

Mitigation Measure:

- Plant native shrubs and herbs throughout the development such as *Lantana sps.* to encourage the butterflies to remain in the area.

b. POST-CONSTRUCTION PHASE

This phase of the development may have a positive impact on these species. Most of the butterflies observed in this area can be found in most urban settings throughout the country and in disturbed environments.

Mitigation Measure:

- Incorporate fruit trees and flowers throughout the development may attract more species and individuals to the area.

7.2.2.3 OTHER MACROFAUNA

A. SITE PREPARATION AND CONSTRUCTION PHASES

This phase will have the greatest impact on the faunal composition of the development site. Initially site preparation will involve the clearing of vegetation and levelling of features of land that act as specific habitats for various animals in the area. The *Lantana sp.* supports a wide variety of the butterfly species found in the area as well as the animals that prey on them including lizards and dragonflies that are also found in abundance at the site. Similar areas include a stand of water hyacinths found on the site, which is also a habitat for many of the butterfly species. This impact will be negative and long-term. It is important to note however that no rare, threatened protected and endangered species were observed during the assessment. Only one endemic species of lizard was observed and these are not threatened in their distribution. This therefore reduces the significance of this impact.

The knock-on effect of vegetation clearance, dust and noise from construction activities will possibly remove all but fauna most adapted to highly disturbed environments, at least for the short term. This most likely will mean an increase in nuisance species, either already present and or the introduction of further nuisance species; especially as the predator-prey relationships and reproductive regimes are disturbed. It should be noted, however, that many of the species present have already displayed a tolerance for a highly disturbed ecosystem. There was major disturbance when the highway was being constructed although without knowing what the species composition was before it is impossible to discern to what extent the site has shown a level of recovery.

There is very little that can be done to mitigate this phase. It is likely that the developer will have to prove that support infrastructure is in place to aid in the selling of lots. This will mean roads and excavation for water mains, electricity and telecommunications. It is probable that this will be effected in one phase rather than in several phases. If it is done on a limited and phased basis then the impact can be mitigated by creating fewer disturbances to the entire site. This solution is still however limited in its scope because it represents the preparation for the permanent alteration of various habitats.

Mitigation Measures:

- If possible, introduce site clearing on a phased basis to allow species opportunity to relocate to suitable nearby habitats and to reduce the shock to the various habitats that would be disturbed.
- 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.

B. POST-CONSTRUCTION PHASE

An increase in human activity as persons move into the development will cause traffic to increase, increased noise to the environment, and may create minor though negative changes to the air quality. These factors coupled with the loss of vegetation will have a major long-term impact on the fauna currently on the site. With the site permanently altered there exists the opportunity for mitigation measures that may have a larger and longer impact than in the site preparation and construction. The Portland Bight Protected Area is in close proximity to the site and it is hoped that when this relatively undisturbed area can support the species that are displaced by human activity. Mitigation measure may have some slight rehabilitative effect on the development site however even in the post construction phase.

Mitigation Measures:

- The planting of native species in lots should allow for the possible re-colonization by some of the species as well as adding to the aesthetic appeal of the development.
- The reservation of green spaces 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.

8. 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.

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 post construction phases of the project.

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 will not have any impact on the demography of the area, as there is no evidence of overcrowding in the community. The developer is however encouraged to recruit as far as possible local workers.

B. POST – CONSTRUCTION PHASE

At the present growth rate one can expect that the population of the study area will be almost 11,500 persons by the year 2012 this is without the development. The average household size of 4 - 5 persons in three and four bedroom houses would cause an increase in the population by approximately seven hundred and twenty six (726) persons with the completion of the entire development. This will not affect the demography of the area however.

It is assumed however that the development will not significantly affect the age and sex structure of the area.

Mitigation Measures:

- Give locals first purchasing options within the development.
- The Local Planning Authority must play an important role in ensuring that the community growth in the area is monitored and implemented in an orderly manner.

8.1.2 EMPLOYMENT AND INCOME

A. SITE PREPARATION AND CONSTRUCTION PHASES

The parish of Clarendon has an unemployment rate that is considerably lower than that of the island of Jamaica. The level of growth of the parish is also significantly higher than that of the island and this is especially so for the study area. Any available jobs will provide an immediate positive impact on the employment and income situation at the level of the study area as well as at the regional level. 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. 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.

The construction phase will use several skilled workers including carpenters, electricians, plumbers, masons, roofing specialists and painters in addition to several

unskilled labourers. Once the lots are sold the building responsibilities will be under the purview of each lot owner or whoever the lot may be subsequently leased or sold to. The contractor that is chosen by individuals may well hire the workers that he has worked with before. This may also mean that labourers, whether skilled or otherwise do not necessarily come from the area or even the parish depending on his local ties. It is also likely that materials for construction that can be obtained from the area or parish would be used if only because the cost of transportation becomes increasingly expensive with distance. Nonetheless both phases should have a positive short-term impact on employment and income of the community and the parish by supplying personnel and materials for the project. The use of any and all support services for the development such as hardware stores, furniture stores, truck drivers to transport raw and finished products, artisans that provide services like grill-making and woodwork will all benefit in the short term.

Mitigation Measures:

- As much as is possible it is recommended that persons from the nearby communities be employed to work on the construction site. This will ensure that the community gets the most benefits from the development.
- As far as possible source raw material to be used in development from local suppliers.
- Identify a specific area on the project site for vending type activities.

B. POST - CONSTRUCTION PHASE

With the short-term labour finished, any impact on employment at this stage will be a minor positive. With houses comes the need for upkeep and maintenance of services. That will mean that although infrequent, there will still be the need for services of plumbers, electricians, domestic help and other skilled workers. Furthermore, with more individuals there will be demands on social services and the provision of these services will lead to greater employment and or increased income. Those expected to benefit would be shopkeepers, supermarkets, haberdasheries and other similar vendors as well commercial banks and credit unions in the area.

Mitigation Measure:

- The Local Planning Authority must play an important role in ensuring that the community growth in the area is monitored and implemented in an orderly manner.

8.1.3 CRIME AND VIOLENCE

A. SITE PREPARATION AND CONSTRUCTION PHASES

Violence at construction sites in Jamaica is a common problem. These phases of the development may have a minor negative, short term effect on the levels of crime and violence in the area.

Mitigation Measures:

- 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.
- Despite the added expense it is recommended that there be adequate security present at the site at all times.

B. POST - CONSTRUCTION PHASE

A major long -term negative impact of the proposed development could be the issue of the attraction, particularly at the outset, of thieves and burglars to the area. This may have the added impact of increasing the level of crime and violence in the wider community as well.

Mitigation Measure:

- Residents must be encouraged to implement measures to protect property. This could take the form of neighbourhood watches, burglar bars, security guards, and dogs.

8.1.4 TRAFFIC

A. SITE PREPARATION AND CONSTRUCTION PHASES

This phase of the development will have little impact on the traffic of the area, as traffic is currently not a problem in the community of Lancewood Valley. The inflow of heavy-duty vehicles and vehicles transporting workers may slow the traffic that flows into the area and along access roads, but this will not be significant. It is therefore considered that this phase of the development will have a minor negative impact on traffic of the area. The upgrading works that will be undertaken to the access roads may cause an increase in traffic delays but this too, although negative, will be minor.

Mitigation Measures:

- Place flagmen along road network to regulate the traffic during road upgrade.
- As far as possible employ persons from the community to reduce the increase in vehicles that will transport workers.
- Place warning signs informing persons of the upgrading works.

B. POST – CONSTRUCTION PHASE

Traffic does not seem to currently be a major problem in the Lancewood Valley area, but the increase in traffic that would accompany a successful subdivision may turn out to be a nuisance to an area that does not see a lot of traffic at this point. Assuming one car per household, this would mean an increase of one hundred and twenty one cars to the area. This however will be a minor negative impact as traffic is currently not a problem in the area.

Mitigation Measures:

- Carry out improvement on the access roads to the development, ensuring that these improvements should be conducted to withstand and allow for the increase in traffic that is expected from the development.
- A traffic system that involves appropriate signals and signs to ensure the smooth flow of traffic must be implemented.

- The Local Planning Authority must play an important role in ensuring that the community growth in the area is monitored and implemented in an orderly manner.

8.2 INFRASTRUCTURE

8.2.1 HOUSING

A. SITE PREPARATION AND CONSTRUCTION PHASES

The project as it stands involves the selling of housing lots and this operation is on a relatively small scale. It is anticipated that at this phase of the development the labourers that are needed for this project will be, as much as possible, taken from the surrounding communities. In this manner there will be no need to house these labourers, whether in a temporary fashion or more permanent basis. Where this is not possible or if labour of a skilled nature may not be available in the communities, arrangements will be made for these workers to commute. This should not be difficult as the road to the site of development is a major artery for the south coast and is in excellent condition. It is therefore not expected that there will be any impact, whether positive or negative, on the current housing situation of Lancewood Valley and the surrounding communities.

B. POST - CONSTRUCTION PHASE

With a growth rate of approximately 8.1% per annum in the population of the study area as well as an approximate growth rate of 1.2% per annum for the parish of Clarendon, both of which are significantly higher than the national growth rate, there is an apparent need for housing solutions. Furthermore the introduction of a highway has meant that the commute from Clarendon and especially the study area, to larger urban centres such as Kingston and St. Andrew, Portmore, Spanish Town and May Pen has become significantly easier. This in turn has made rural and suburban areas that were previously unattractive because of their distance from these urban centres more desirable as housing in these areas becomes increasingly expensive because of its scarcity. It is expected that the development should have a positive long-term impact on the housing

situation in the area. Should this project be successful it may signal the beginning of the conversion of several areas zoned for agriculture into residential areas, as well as the extension of urban areas in the parish. There are benefits to these possibilities but also some caveats to this situation. Unbridled urban sprawl can mean that social amenities cannot support the influx of persons and social services may begin to suffer. It is therefore important that the Parish Council monitors this development to make sure that the need for housing in the parish does not lead to uncontrolled development.

Mitigation Measures:

- The developer must offer locals the first purchasing options for houses within the development.

- The developer must liaise with the Local Planning Authority, with respect to advertising of the development so that the area may get most of the benefits from the development.

8.2.2 ROAD NETWORK

A. SITE PREPARATION AND CONSTRUCTION PHASES

These phases of the development may have a major negative impact on the 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.

Mitigation Measures:

- The developer must liaise with the Local Planning Authority to 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.
- 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. POST - CONSTRUCTION PHASE

The post-construction phase of the project may have a major negative impact on the road network in the area. This is because of the increase in population that will put a strain on the road that needs improvement currently.

Mitigation Measures:

- Ensure that roads are regularly maintained.
- Ensure that road improvement works are properly conducted in order to minimise the level of maintenance.

8.2.3 UTILITIES

8.2.3.1 ELECTRICITY

A. SITE PREPARATION AND CONSTRUCTION PHASES

These phases of the development will not have an impact on the electricity supplying the area. This phase of the development will include the installation of street lights throughout the development.

Mitigation Measure:

- Install light fixtures that have been fixed with light sensors to reduce electricity consumption.

B. POST – CONSTRUCTION PHASE

With the addition of approximately one hundred and twenty one (121) houses to the area, there will be an increase in electricity consumption. This will have minor, negative national and global long-term impacts. The energy crisis is looming and therefore the increase in consumption of electricity will put an added strain on the already strained situation. This may also have the knock-on impact of contributing to having national and global air quality as energy production is a major green house gas contributor.

8.2.3.3 TELECOMMUNICATIONS

A. SITE PREPARATION AND CONSTRUCTION PHASES

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

B. POST-CONSTRUCTION PHASE

The development may have a major positive impact on the level of telecommunications in the area. The increase in housing may encourage the addition of services such as ADSL to the area.

Mitigation Measure:

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

8.3 SOCIAL SERVICES

8.3.1 EDUCATION

A. SITE PREPARATION AND CONSTRUCTION PHASE

The education system within the area will not be affected by these phases of the project, as there will be a minimal influx of in migrants to the study area.

B. POST - CONSTRUCTION PHASE

The post construction phase of the project is not likely to have an impact on the education system in the study area. The two main primary schools in the area do not show signs of massive overcrowding. Also there are other schools in the area that are under populated. The high schools within the area also do not show evidence of overcrowding.

Mitigation Measure:

- The Local Planning Authority must play an important role in ensuring that the community growth in the area is monitored and implemented in an orderly manner.

8.3.2 TRANSPORTATION

A. SITE PREPARATION AND CONSTRUCTION PHASES

Accessing public transportation is currently not a problem in the Lancewood Valley community. The access to the site is also located along a major thoroughfare. Therefore this stage of the development will have no impact on the access to transportation in the study area.

B. POST- CONSTRUCTION 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.

Mitigation Measure:

- The developer must liaise with the Local Planning Authority to improve the road network, which provides access to the project area

8.3.3 HEALTH SERVICES

A. SITE PREPARATION AND CONSTRUCTION PHASE

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. Accidents may however happen on the site and these are to be anticipated so that the effects may be reduced if they do occur.

Mitigation Measures:

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

B. POST - CONSTRUCTION PHASE

The post construction phase of the project may have a minor negative long-term impact on the Health Services in the area. After the construction of the project the population in the study area may increase by approximately seven hundred and twenty six (726) persons, which may put a strain on the health services.

Mitigation Measure:

- The developers must liaise with Local Government to construct another Health Clinic within 2 km of the project area.

8.3.4 POSTAL SERVICES

A. SITE PREPARATION AND CONSTRUCTION PHASES

These phases of the development will have no impact on the Postal Services of the area.

B. POST-CONSTRUCTION PHASE

The inflow of additional persons in the area will have a minor negative long-term impact on the current postal services in the area.

Mitigation Measure:

- Liaise with the Jamaica Post Company Ltd to construct a Postal Agency/Office within 2 km of the Lancewood Valley area. This could also support the surrounding communities and therefore deter residents from travelling to May Pen to retrieve their mail which will therefore reduce the implied impacts.

8.3.5 SOLID WASTE DISPOSAL

A. SITE PREPARATION AND CONSTRUCTION PHASES

A significant amount of debris will be generated during these stages of the development. Increased vending due to the increase in the number of workers in the area may also contribute to this short-term major negative impact.

Mitigation Measures:

- 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.
- Ensure that vending during these phases of the development is localised.
- Provide garbage receptacles around the project site.

B. POST-CONSTRUCTION PHASE

This phase of the development may have a major, long-term negative impact on the solid waste generation in the project area. With the increased population there will be an increase in the amount of solid waste generated in the Lancewood Valley community. This means that domestic pests such as rats (*Rattus norvegicus* and *Rattus rattus*) may be attracted to the site. Although these were not observed at the site during the survey period it is unlikely that these pests were not present in the surrounding communities. Rats are vectors for many diseases including leptospirosis, which very recently was a problem in the parish of Clarendon. 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.

Mitigation Measures:

- The developer must liaise with the Local Parish Council to ensure that there is adequate and timely garbage collection in the community.
- This garbage must be collected by a licensed garbage disposal company and deposited at the Riverton landfill.
- Encourage members of the community to embark on composting of waste, which can be used in the maintenance of the green area and for general use throughout out the landscaping efforts of the community.

9. 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 Post-Construction 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.

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.

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 makes it more susceptible to the occurrence of a fire, which may spread rapidly. This will be especially increased during periods when wind speeds are greatest which is in the months of June and July.

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:

- Keep a fully equipped first aid kit on the project site.
- 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.
- 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.
- Ensure that all machinery used on the site is properly maintained and inspected before use.
- Install a suitable, approved fire extinguisher at an accessible, conspicuous and unobstructed point.
- Place conspicuous warning signs where hazardous or flammable substances will be stored.
- Place information signs around the project site, which list the numbers of the person responsible for handling emergencies on the site, the May Pen Fire Department, and the May Pen hospital.
- 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. POST - CONSTRUCTION PHASE

Once the development has been completed the population concentration in the area will increase. The installation of electricity and the use of flammable systems within each home increase the probability of the occurrence of a fire or explosion in the area.

Mitigation Measures:

- 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.

9.2 ACCIDENTS

Accidents may be caused from the malfunction of mechanical and electrical machinery used during the Site Preparation and Construction phases of the development as well as human error. These accidents often happen unexpectedly and unintentionally and can result in the loss of life and injuries, as well as damage to property.

A. SITE PREPARATION AND CONSTRUCTION PHASE

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.

Mitigation Measures:

- Keep a fully equipped first aid kit on the project site.
- 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.
- 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.
- Place information signs around the project site, which list the numbers of the person responsible for handling emergencies on the site, the May Pen Fire Department, and the May Pen hospital.
- 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.

- o Ensure that all machinery operating at the project is regularly serviced and maintained.
- o Ensure that persons operating equipment on the site are capable and trained to do so.
- o Ensure that the areas surrounding the gully that traverses the property is securely fenced so as to reduce the risk of an accident occurring in this area.
- 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

B. POST-CONSTRUCTION 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.

Mitigation Measure:

- 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.

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 at a considerable distance from the coast and therefore the effects will be less than those experienced in coastal areas of the island.

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:

- Relocate all mobile machinery and equipment to suitable storage facilities.
- Ensure that any loose roofing material is securely fastened prior to the hurricane.
- Keep a logbook and record all damage that may have occurred after the hurricane.
- Do not use electrical or mechanical machinery after the hurricane without proper inspection.
- Remove all stockpiled material (aggregate and sand) and move to proper storage facilities.
- Evacuate all project personnel from development site.

B. POST-CONSTRUCTION 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 increase infrastructure may exacerbate the effects that may be caused by a hurricane and/or tropical storm.

9.3.1.2 FLOODING

Due to the scale of the project and the project location a flood impact assessment was undertaken for the site. This has been discussed in Hydrogeology Assessment found in ***Section 4 & 7.1.5.***

9.3.1.3 LIGHTNING STORMS

Jamaica is occasionally affected by lightning storms, which can not only damage property, but also injure and kill humans. The probability of lightning storms in the area is moderate but measures have to be put in place to offset the effects of these lightning storms if they do occur.

A. SITE PREPARATION AND CONSTRUCTION PHASES

The effect of lightning storms in this stage of the development will be moderate.

Mitigation Measures:

- Ensure that staff members at the construction site are aware of the measures to be implemented during a lightning storm.
- 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.
- Place a fully equipped first aid kit on the project site
- 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 May Pen's Bay hospital.

- Keep an emergency log to document any occurrences of any 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. POST-CONSTRUCTION PHASE

The magnitude of the effect of lightning storms during this phase of the development will be high.

Mitigation Measure:

- Encourage occupants of the development to be properly wired and grounded and fixed with lightning attenuators.

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.

A. SITE PREPARATION AND CONSTRUCTION PHASE

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 activities outlined below the effects of an earthquake can be reduced.

Mitigation Measures:

- Keep a fully equipped first aid kit on the project site.
- 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.
- Ensure that employees are aware of the precautions to take during an earthquake.
- Ensure that staff at the construction site is aware of the measures to be implemented during an earthquake.

- 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.
- 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 May Pen hospital.
- Keep an emergency log to document any occurrences of any 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.

9.3.2 LANDSLIDES

Most of the project area is relatively flat and thus the overall landslide potential is low. A slightly greater potential exists along the relatively steep slopes bordering the highway. However, these slopes are presently heavily vegetated offering increased stability.

a. Site Preparation and Construction Phase

Mitigation Measures:

- 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. CONCLUSIONS AND RECOMMENDATIONS

Two alternatives to the proposed project were analysed and based on the environmental and socio-economic assessment the proposed subdivision was the chosen alternative.

From an environmental perspective although negative impacts were identified, mitigation measures have been recommended which may decrease with much success these negative impacts.

The proposed development, in a socio-economic sense, is the most advantageous scenario in that it is the likeliest to benefit the existing residents with much needed infrastructure such as proper roads, and jobs both directly and indirectly related to the construction and post construction activities of the development. With a population growth rate of 8.1% per annum in the project area there will certainly be a need for housing within the area.

There are the several recommendations however, that represent caveats to the proposed development.

i. The project should be implemented on a phased basis to minimize all negative impacts. These include the loss of the natural environment and the changes in environmental impacts such as noise and air pollution that will inevitably follow site preparation and construction activities. All aforementioned mitigation measures should be implemented throughout the project for a seamless transition from pre- to post- development and operational phases of the project.

ii. The hydrogeological study and its implications on potential inundation of the project site especially of lots below the 53 m contour line.

iii. The necessary improvement in social infrastructure that should accompany a new housing development must extend to the existing residents of Lancewood Valley. A feeling of basic social equity is crucial.

iv. A comprehensive monitoring plan has to be implemented to ensure that existing residents as well as labourers are not exposed to unacceptable levels of noise, air

pollution and any effluent or otherwise negative impacts that will affect health, safety, property or livelihoods. The monitoring plan should have in its scope both the construction and post construction phases of the development. In addition to this the monitoring plan should seek to ensure that mitigation measures are being implemented and where necessary amended for the good of the natural and human environment.

11. DRAFT MONITORING PLAN

This section of the report aims to present a draft-monitoring plan for the environmental and socio-economic mitigation measures proposed for the development. This monitoring plan will ensure that the mitigation measures recommended are implemented and are effective and also will 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 years is shown in ***Table 20*** below.

11. 1 ENVIRONMENTAL PARAMETERS

11.1.1 AIR QUALITY

The development may have a negative impact on the air quality in the area during the pre-construction, construction and post-construction phases of the development. The main impacts will be due to the increase in dust and the increase in the number of motor vehicles in the area. It is therefore necessary to monitor the PM_{10}, No_x and So_x levels in the area at different intervals of the development to ensure that these remain within the National Ambient Air Quality Standards as outlined in ***Table 18*** below.

Table 18: Table showing the Jamaica National Ambient Air Quality Standards

POLLUTANTS	STANDARDS μg/m^3					
	Annual		24 hr		1 hr	
	1^0	2^0	1^0	2^0	1^0	2^0
PM_{10}	50		150			
SOx	80	60	365	280	700	
NOx	100					

Source: NAAQS (2002)

11.1.2 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 it can be up to 55dB LA_{eq} in some circumstances.

11. 1. 3 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.

11.2 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 impacts. The implementation schedule for the monitoring of these parameters is shown in ***Table 20*** below.

11.3 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 20*** below.

TABLE 20: 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
Noise and Vibration																	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

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APPENDICES

APPENDIX I: TERMS OF REFERENCE

TERMS OF REFERENCE FOR THE LANCEWOOD VALLEY SUBDIVISION DEVELOPMENT, CLARENDON ENVIRONMENTAL IMPACT ASSESSMENT AS ISSUED BY THE NATIONAL ENVIRONMENT AND PLANNING AGENCY

I. BACKGROUND

The area to be developed is located at Part of Lancewood Valley Clarendon. The proponent intends to subdivide approximately 75 acres ~ 30 hectares of land into one hundred and twenty one residential lots ranging from 1023 square meters to 8407 square meters.

II. TERMS OF REFERENCE

The Terms of Reference as stipulated by the National Environment and Planning Agency (NEPA) are as follows:

OBJECTIVES:

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. Assess public perception of the proposed development.
3. Outline the Legislations and Regulations relevant to the project.
4. Predict the likely impacts of the development on the described environment, including negative, positive, long term, short term, direct, indirect and cumulative impacts, indicating their relative importance to the design of the development's facilities.
5. Predict the hazard vulnerability and associated risk of the development.
6. Identify mitigation action to be taken to minimise adverse impacts and quantify associated costs. Make recommendations to enhance any positive impacts identified.
7. Design a Monitoring Plan which should ensure that the mitigation plan is adhered to.
8. Describe the alternatives to the project that could be considered at that site.

SCOPE OF WORK

To ensure that a thorough Environmental Impact Assessment (EIA) is conducted, it is expected that the following tasks will be undertaken:

Task 1: Description of the Project

A comprehensive description of the project will be provided, including the number of lots to be developed indicating the areas to be reserved for construction, 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. The report will also include a description go the various hazards to which the project is vulnerable, both natural and man-made.This will involve the use of maps, site plans, aerial photographs and other graphic aids and images, as appropriate, and include information on location, general layout and size, as well as pre-construction, construction, and post construction plans.

Task 2: Description of the Environment

The consultant will generate baseline data, which will be used to describe the study area as follows:

i) Physical Environment
ii) Biological Environment
iii) Socio-economic and cultural constraints

The methodologies employed to obtain baseline and other data will be clearly detailed. This baseline data will include:

(A) Physical

i) A detailed description 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. A detailed hydrologic assessment will be included, detailing the pre and post development runoff and impat on surrounding drainage systems.

ii) **Water quality** and quantity of any existing wells, rivers, ponds, or streams within 5 km of the development. Quality Indicators will include, but not necessarily be limited to, nitrates, phosphates, faecal coliform, and suspended solids.

iii) Climatic conditions and air quality in the area of influence, NO_x and SO_x, particulate matter, wind speed and direction, precipitation, relative humidity and ambient temperatures

iv) Noise levels of undeveloped site and the ambient noise in the area of influence.

v) Obvious sources of pollution existing and extent of contamination.

vii) Availability of solid waste management facilities.

(B) Biological

A detailed description of the flora and fauna of the area will be presented with special emphasis will be placed 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

It will be necessary to determine the present and projected population structure; 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, medical services and facilities; cultural peculiarities, aspirations and attitudes will be explored. The proximity to urban growth centres will also be identified. The historical importance of the area will also be examined. While this analysis is being conducted, an assessment of public perception of the proposed development will be conducted. This assessment may vary with community structure and may take multiple forms such as public meetings or questionnaires.

A public presentation will be conducted to alert the stakeholders about the project and its associated implications. This will be conducted on the completion of the EIA.

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 will include at minimum, legislation such as the Natural Resources Conservation (NRCA) Act, the Housing Act, the Town and Country Planning Act, Building Codes and Standards, Development Orders and Plans, the Public Health Act, Clean Air Act and the appropriate international convention/protocol/treaty where applicable.

Task 4:- Identification of Potential Impacts

The major environmental and public health issues of concern and their relative importance to the design of the subdivision will be identified and assessed. The potential impacts as they relate to, (but are not restricted by) the following will be included in this assessment:

- Change in Drainage pattern
- Flooding potential : A flood impact assessment will be conducted to evaluate the impact of the development on the environs and the impact of the developed cause by flood levels in nearby manmade/natural channels inclusive of depression and sinkholes. This will also include a evaluation of the

impact of normal and extreme flows within the gully to ensure that lots are not negatively impact by flooding.
- Landscape impacts of excavation and construction
- Loss of natural features, habitats and species by construction and operation
- Pollution of potable, surface and ground water: This will address the issue of the method of sewage treatment, the discharge of final effluent and the potential impact on the selected method on water resources.
- Air pollution
- Capacity and design parameters of proposed sewage treatment facility.
- Socio-economic and cultural impacts.
- Risk assessment including earthquake impact and technological hazard impacts
- Noise
- Solid waste
- The Carrying Capacity of the proposed site

There will be an indication of the significant positive and negative impacts, direct and indirect impacts, long term and immediate impacts. Any avoidable as well as irreversible impacts will also be identified. The extent and quality of the available data, explaining significant information deficiencies and any uncertainties associated with the predictions of impacts will be characterised.

Task 5: Identification of Mitigation Measures

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. The financial and economic values of the mitigating measures identified will be quantified where possible.

Task 6: Monitoring Activities

A monitoring plan will be designed to monitor implementation of mitigatory or compensatory measures and project impacts during construction and occupation/operation of the units/facility.

An outline monitoring programme will be included in the EIA, and a detailed version submitted to National Environment and Planning Agency (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 will include:

- Introduction outlining the need for a monitoring programme and the relevant specific provisions of the permit license(s) granted.
- The activity being monitored and the parameters chosen to effectively carry out the exercise.

- The methodology to be employed and the frequency of monitoring.
- 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.
- Frequency of reporting to NEPA

The Monitoring report should also include, at minimum:

- Raw data collected. Tables and graphs are to be used where appropriate
- Discussion of results with respect to the development in progress, highlighting any parameter(s), which exceeds the expected standard(s).
- Recommendations
- Appendices of data and photographs if necessary.

Task 7: Analysis of Project Alternatives

The alternatives to the project including the no-action alternative will be examined. This examination of project alternatives will 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 **Environmental Impact Assessment (EIA) report** and will reflect the headings in the body of the TOR, as well as references. Two 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.

The Terms of Reference approval letter from the National Environment and Planning Agency is shown below.

NATIONAL ENVIRONMENT & PLANNING AGENCY

10 & 11 Caledonia Avenue, Kingston 5, Jamaica W.I.; Tel: (876) 754-7540/3 Fax: (876) 754-7595-6 Hotline: 1-888-991-5005
E-mail: ceo@nepa.gov.jm, Web Site: http://www.nepa.gov.jm

Ref. No.: 2005-13017-EP00234

April 19, 2007

Ms. Sara Simpson
Senior Partner
ENVIROCONJA
4 Springvale Avenue
Kingston 10

Dear Ms. Simpson,

Re: Amended Terms of Reference for Environmental Impact Assessment – Subdivision of Lands: Part of Lancewood Valley, Clarendon by Ernest McFarlane

Reference is made to your letter dated April 17, 2007 regarding the captioned project.

The Agency accepts the captioned terms of reference and upon completion of the Environmental Impact Assessment, please submit eight (8) hard copies and an electronic copy which will be circulated to other relevant agencies for their comment.

Your speedy response is appreciated.

Yours sincerely,

.....
Marc Rammelaere
For Chief Executive Officer/Government Town Planner

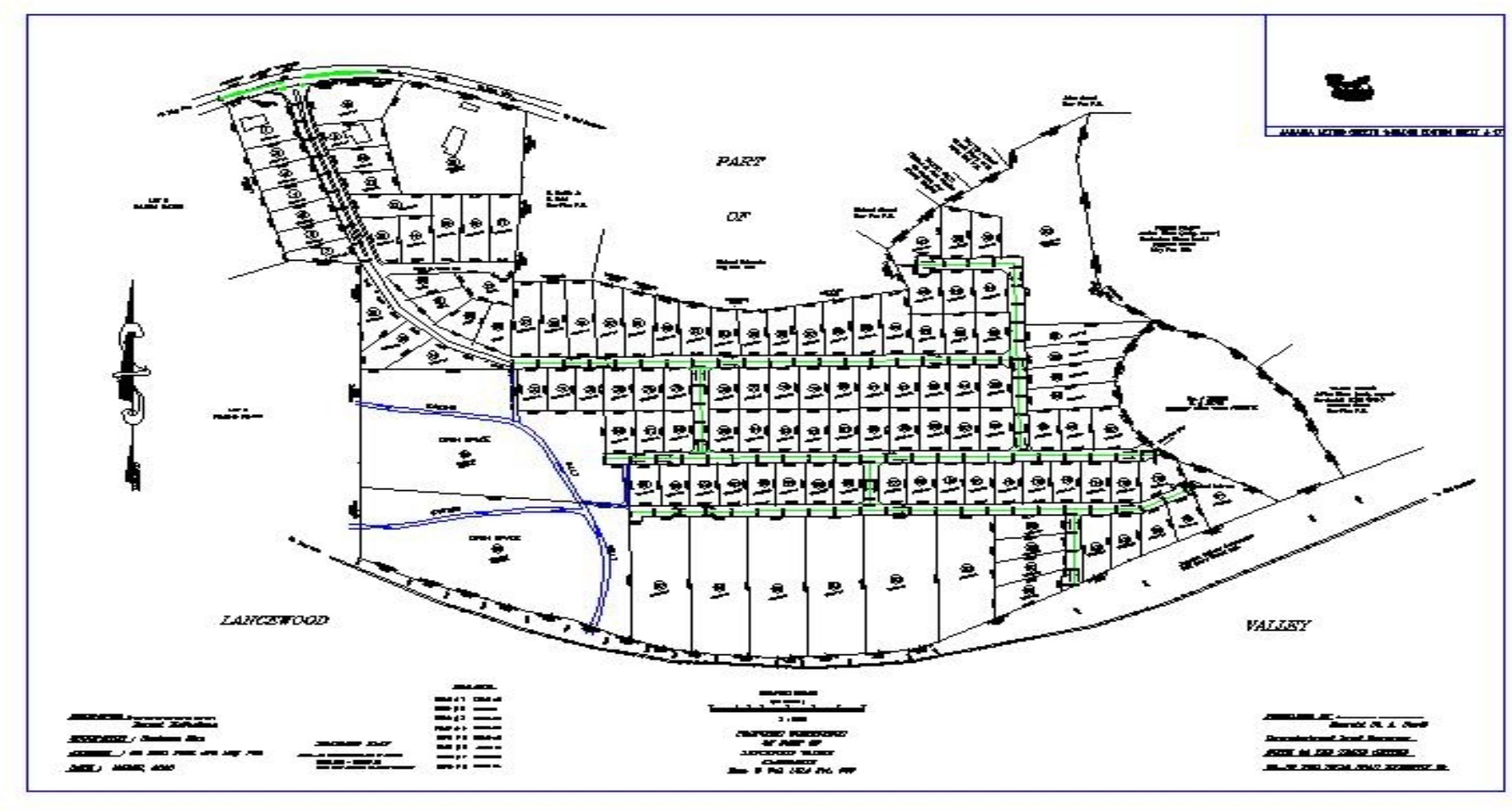
Cc: Ms. Frances Blair – Manager, Applications Secretariat Branch, NEPA
Mr. Ernest McFarlane - Proponent

MR/tc

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

APPENDIX II:
SITE LAYOUT PLAN OF THE PROPOSED DEVELOPMENT

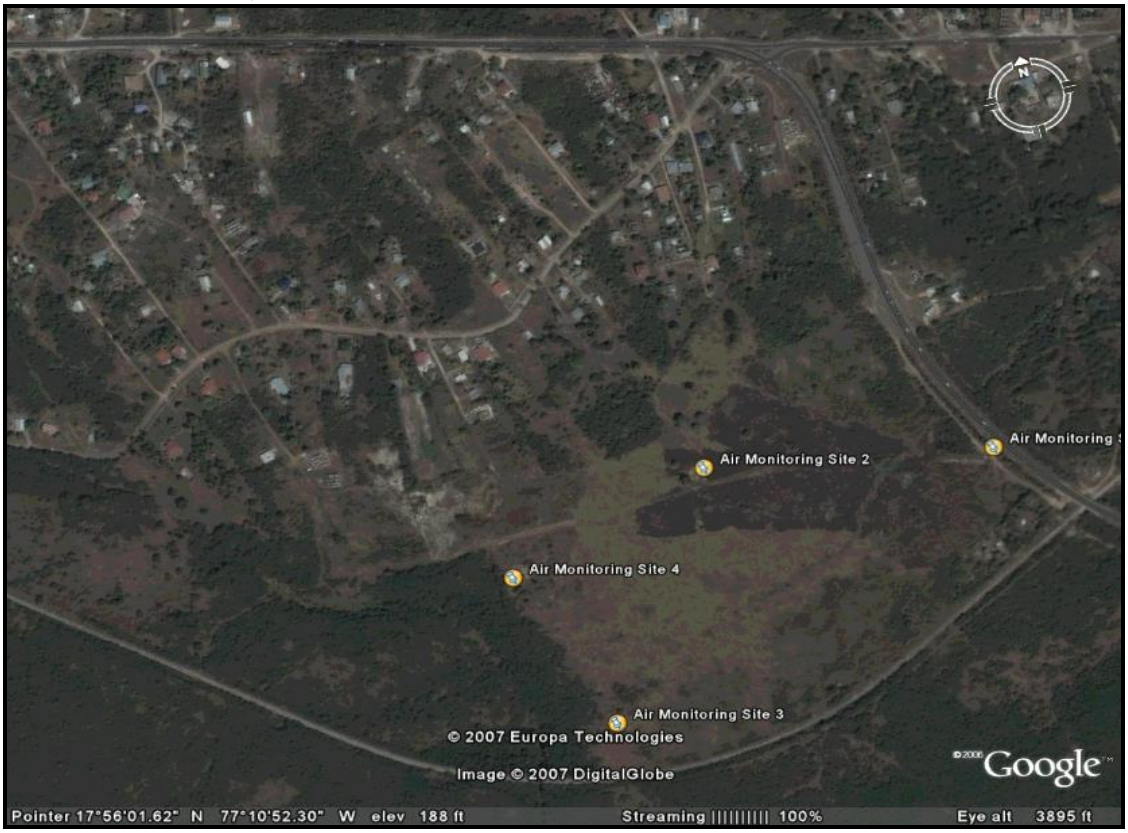


APPENDIX III: AIR QUALITY ASSESSMENT

Table I: Table Showing the GPS Coordinates for the sampling of Air Quality at the Lancewood Development site.

Site 1	N17º 55.942' W77º 10.601'
Site 2	N17º 55.972' W77º 10.791'
Site 3	N17º 55.816' W77º 10.891'
Site 4	N17º 55.928' W77º 10.933'

***PICTURE I*: AIR QUALITY SITES MONITORED**



APPENDIX IV: NOISE ASSESSMENT

Calibration Certificate For Noise Meter

Certificate of Calibration

Model:	QC-10	**Date of Calibration:**	15 Nov 2005
Serial Number:	QIE110058	**Due Date:**	15 Nov 2006

Quest Technologies does hereby certify that the above listed product meets or exceeds the requirements of the following standard(s):

ANSI Standard for Sound Calibrators S1.40-1984
IEC 942-1988 for Sound Calibrators

Test Conditions:

Temperature:	18-25 °C
Humidity:	20-80 %R.H.
Barometric Pressure:	950-1050 mBar

Calibrated Per Procedure: S056-981

Reference Standard(s):		**Measurement Uncertainty:**
Device:	Due Date:	Uncertainty estimated at 95% Confidence Level (k=2)
Fluke 45	24 Mar 2007	+/- 1.4% AC Voltage, +/- 0.1% DC Voltage
Philips PM 6666	24 Mar 2007	+/- 0.001% Frequency
B & K Ensemble	6 Oct 2006	+/- 3.4% Acoustic (0.3dB)

Calibrated and Reviewed By: Catherine Veith
Catherine Veith Electronic Assembler

This report certifies that all calibration equipment used in the test is traceable to NIST, and applies only to the unit identified above.
This report must not be reproduced except in its entirety without the written approval of Quest Technologies.

Quest recommends annual calibration for this product.

QUEST TECHNOLOGIES, INC.
1060 Corporate Center Drive • Oconomowoc, Wisconsin 53066-4828
800-245-0779 • 262-567-9157 • Fax 262-567-4047 • Internet Address: www.quest-technologies.com

058-387 Rev. C

***TABLE II*: Table showing the Highway Noise Meter Readings**

Site	GPS Reading	dB (A)	Comments
Highway	N17º 56.092' W77º 10.642'	46.3	Ambient , no cars passing immediately, community activity
Highway	N17º 56.092' W77º 10.642'	48.3	Ambient , no cars passing immediately, community activity
Highway	N17º 56.092' W77º 10.642'	71.2	Cars passing (3)
Highway	N17º 56.092' W77º 10.642'	73.2	Cars passing (7)
Highway	N17º 56.092' W77º 10.642'	73.4	Several pickup trucks and cars passing, community activity
Highway	N17º 56.092' W77º 10.642'	74.4	Light truck passing, braking, low gear
Highway	N17º 56.092' W77º 10.642'	75.8	Single Large truck passing by in low gear, braking, cars,
Highway	N17º 56.092' W77º 10.642'	75.8	Large bus passing, in low gear, braking, cars,
Highway	N17º 56.092' W77 º 10.642'	79.2	Large Semi-Cab with Trailer passing in low gear, braking
Highway	N17º 56.092' W77º 10.642'	79.4	Mid-sized Delivery truck
Highway	N17º 56.092' W77º 10.642'	80.3	Mid-sized Delivery truck, several other lighter vehicles in low gear
Highway	N17º 56.092' W77º 10.642'	84.3	Dump truck passing, several other lighter vehicles in low gear
Highway	N17º 56.092' W77º 10.642'	85.0	Large Flat bed truck, passing in low gear, cars

***TABLE IV*: Table showing the On-Site Noise Meter Readings**

Site	GPS Reading	dB (A)	Comments
Gate To the Entrance of Site	N17º 55.985' W77º 10.908'	34.7	Ambient, baseline for existing community
Air Monitor Site 1	N17º 55.942' W77º 10.601'	39.5	Ambient reading, near highway, no cars passing
Air Monitor Site 1	N17º 55.942' W77º 10.601'	61.2	Light traffic, several cars passing
Air Monitor Site 2	N17º 55.972' W77º 10.791'	41.3 – 44.7	Under Mango Tree, birds chirping, traffic passing at higher readings
Air Monitor Site 3	N17º 55.816' W77º 10.891'	30.2-35.5	Near railway, little traffic at low readings, more traffic at higher readings
Air Monitor Site 4	N17º 55.928' W77º 10.933'	36.8 – 40.4	Ambient, birds chirping at low readings, light traffic at higher readings
Rocky Slope Near Road	N17º 55.946' W77º 10.641'	36.3 – 54.2	Light traffic at lower readings, fairly heavy traffic at higher readings
Water Hyacinth Area	N17º 55.947' W77º 10.670'	36.1 – 44.8	Light to moderate traffic throughout range of readings
Pasture Land, Mid Site	N17º 55.851' W77º 10.596	35.2	Light traffic
Gully Area, Railway	N17º 55.788' W77º 10.935'	33.1	Light traffic

Table V: Table showing the sources and estimated noise levels for each noise

SOURCE	M	dB (A)
Threshold of pain for humans		140
Ship siren	30	130
Jet engine	61	120
Jack hammer		100
Inside sports car		80
Freight train	**30**	**70**
Vacuum cleaner	3	70
Freeway	**30**	**70**
Small (l0 kW) windturbine	37	57
Large transformer	61	55
Small (10 kW) wind turbine	100	55
Wind in trees	12	55
Light traffic	**30**	**50**
Average home		50
300 kW windturbine	200	45
30-300 kW wind turbines	500	45
Soft whisper		30

Source: *Handbook of Noise Measurement,* General Radio, European Wind Energy Assoc., and Bergey Windpower Co.

APPENDIX V: ECOLOGICAL ASSESSMENT

LIST OF FLORA OBSERVED

COMMON NAME	SCIENTIFIC NAME	RELATIVE ABUNDANCE
SHRUBS		
Guava	*Psidium guajava*	O
Castor Oil	*Ricinus cummunis*	R
Wild Sage	*Lantana sp.s*	A
Rosemary	*Croton linearis*	A
Cashaw Macca	Prosopis juliflora	A
Yellow Allamanda	*Allamanda cathartica*	F
Sweet sop	*Annona squamosa*	O
HERBS		
Devils Horsewhip	*Achyrandnes indica*	A
Broom weed	*Sida acuta*	A
TREES		
Trumpet Tree	*Cecropia peltata*	R
Mango	*Mangifera indica*	O
GRASSES		
African Star Grass	*Cynodon nlemfuensis*	D
OTHER		
Cowitch	*Tragia volubilis*	O
Water Hyacinth	*Eichhornia paniculata*	R

LIST OF AVIFAUNA OBSERVED

COMMON NAME	SCIENTIFIC NAME	STATUS	ABUNDANCE
Herons, Egrets and Bitterns	**Ardeidae**		
Cattle Egret	*Bubulcus ibis*	R	Common
American Vultures	**Cathartidae**		
Turkey Vulture	*Cathartes aura*	R	Uncommon
Falcons and Caracaras	**Falconidae**		
American kestrel	*Falco sparverius*	R	Uncommon
Pigeons and Doves	**Columbidae**		
White-winged Dove	*Zenaida asiatica*	R	Uncommon
Zenaida Dove	*Zenaida aurita*	R	Uncommon
Common Ground Dove	*Columbina passerina*	R	Common
Cuckoos, Roadrunners and Anis	**Cuculidae**		
Smooth-billed Ani	*Crotophaga ani*	R	Common
Hummingbirds	**Trochilidae**		
Vervain Hummingbird	*Mellisuga minima*	R	Fairly common
Tyrant Flycatchers	**Tyrannidae**		
Stolid Flycatcher	*Myiarchus stolidus*	R	Uncommon
Loggerhead Kingbird	*Tyrannus caudifasciatus*	R	Uncommon
Mockingbirds, Thrashers and Allies	**Mimidae**		
Northern Mockingbird	*Mimus polyglottus*	R	Common
Emberizids	**Emberizidae**		
Prairie Warbler	*Dendroica discolor*	NBR	Fairly common
American Redstart	*Setophaga ruticilla*	NBR	Uncommon
Common Yellowthroat	*Geothlypis trichas*	NBR	Uncommon
Palm Warbler	*Dendroica palmarum*	NBR	Uncommon
Bananaquit	*Coereba flaveola*	R	Uncommon
Jamaican Euphonia	*Euphonia jamaica*	E	Uncommon
Yellow-faced Grassquit	*Tiaris olivacea*	R	Common
Greater Antillean Bullfinch	*Loxigilla violacea*	R	Uncommon
Grasshopper Sparrow	*Ammodramus savannarum*	R	Fairly common

LIST OF BUTTERFLIES SPECIES OBSERVED

Common Name	**Scientific Name**	**Abundance**	***Initial Time of Sighting***
White Peacock	*Anartia jatrophae jamaicensis*	Abundant	8:35am
Buckeye	*Junonia genoveva*	Abundant	8:46am
Common Tailed Skipper	*Urbanus proteus*	Uncommon	10:00am
Watson's Cane Skipper	*Panoquina sylvicola woodruffi*	Uncommon	9:13am
Evan's Jamaican Skipper	*Polygonus leo hagar*	Rare	9:41am
Cassius Blue	*Leptotes cassius theonus*	Occasional	9:47am
Roy's Skipper	*Astraptes anaphus anausis*	Uncommon	10:07am
Cuban Swallowtail	*Papilio andraemon*	Uncommon	9:23 am
Tropical Fritillary	*Euptoieta hegesia hegesia*	Rare	8:47am
Tropical Silverspot	*Agraulis (Dione) vanillae insularis*	Occasional	9:10am
The Sleepy Orange	*Eurema nicippe*	Rare	10:02am
Oileus	*Pyrgus oileus*	Abundant	9:05am
Dorcas	*Mestra dorcas*	Frequent	8:37am
Monarch	*Danaeus plexipus*	Rare	9:09am
Gillipus	*Danaeus gillipus jamaicensis*	Abundant	8:53am
Julia	*Dryas julia delila*	Frequent	9:08am
Maerula	*Anteos maerula maerula*	Occasional	8:45am
Jamaican Goatweed Butterfly	*Anaea troglodyta*	Uncommon	9:28am
Malachite	*Spiroeta stelenes stelenes)*	Uncommon	9:58am
Zebra	*Heliconius charitonius simulator*	Rare	9:37am
Jamaican Albatross	*Appias Drusilla castalia*	Frequent	8:32am

LIST OF MOTH SPECIES OBSERVED

Common Name	**Scientific Name**	**Abundance**	***Initial Time of Sighting***
Bella Moth	*Uthethesia bella*	Rare	8:59am

LIST OF OTHER MACRO-FAUNA OBSERVED

COMMON NAME	**SCIENTIFIC NAME/ORDER**	**CONSERVATION STATUS**
MAMMALS		
Donkey	*Equus asinus*	Introduced
Goat	*Capra aegagrus*	Introduced
REPTILES		
	A. lineatopus	Endemic
INSECTS		
Dragon Fly	Order Odontata Suborder – Anisoptera	Introduced
Grasshopper	Order Orthoptera Sub -Order Caelifera	Introduced
Mosquito	*Aedes aegypti/ Culex* sp	Introduced
Housefly	*Musca domestica*	Introduced
Bumblebee	*Bombus* sp	Introduced
Flea	*Ctenocephalides canis*	Introduced
Ticks	*Ixodes sp*	Introduced
Spiny Spiders	*Astracantha minax*	Introduced

APPENDIX VI:
SOCIO-ECONOMIC ASSESSMENT

SOCIO – ECONOMIC SURVEY: LANCEWOOD VALLEY EIA

1. DATE: _____

2. COMMUNITY: _____

3. NAME: _____

4. ADDRESS: _____

5. GENDER: ☐ M ☐ F

6. EDUCATION:
- ☐ Pre-primary
- ☐ Primary
- ☐ All –age
- ☐ Secondary/High School
- ☐ Vocational School
- ☐ College Certificate
- ☐ Post Secondary Certificate
- ☐ University Degree

7. OCCUPATION: _____

8. What is the size of your household and occupation?

NAME	M/F	Age	Occupation	Last School Attended	Approximate income (if employed)

9. Do you have any problems getting your children into school?

☐ Y ☐ N

If yes What are the problems?

_____

_____

10. Where is the source of your water supply?

_____

11. Is this supply regular?

☐ Y ☐ N

If no what is the alternative supply?

_____

_____

12. Do you have electricity?

☐ Y ☐ N

13. What is your means of transport?

☐ Car
☐ Bus
☐ Taxi
☐ Walk Secondary/High School
☐ Bicycle
☐ Motorbike
☐ Other

13. When you are sick where do you seek Health Services?

_____

___

14. Are you aware of the Lancewood Valley Development that has been planned in your community? ☐ Y ☐ N

If yes What do you know about the development?

_____

15. Do you now use the property in any way? ☐ Y ☐ N

If yes how do you use the property?

_____

16. 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?

_____
_____
_____

17. What are some of the things about the community that you would you like to enhance?

_____
_____
_____
_____

18. What do you know of the history of the property (Flooding, natural disasters, general information)?

_____
_____
_____
_____

APPENDIX VII: IMPACT ASSESSMENT MATRIX

ENVIRONMENTAL IMPACT ASSESSMENT MATRIX

PROJECT ACTIVITIES	IMPACT	
	SITE PREPARATION/ CONSTRUCTION PHASE	POST-CONSTRUCTION PHASE
PHYSICAL ENVIRONMENT		
CLIMATE		
Clearing of Vegetation	O	O
AIR QUALITY		
Clearing of Vegetation	- Lt, L	N/A
Increased Traffic	- Lt, L	- Lt, L
WATER QUALITY		
Storage of Hazardous Substances	- Lt, L	N/A
Sewage Disposal	- Lt, L	-- Lt, L,
SOIL & GEOLOGY		
Use of Heavy Machinery	-- St, L	N/A
Clearing of Vegetation	-- St, L	N/A
Storage of Hazardous Substances	-- Lt, L	N/A
HYDROGEOLOGY		
Use of Heavy Machinery	-- Lt, L	N/A

Alteration of Drainage Pattern	- Lt, L	-- Lt, L
NOISE AND VIBRATION		
Use of Heavy Machinery	-- Lt, L	N/A
Increased Traffic	- St, L	- St, L
LANDSCAPE AND VISUAL		
Clearing of Vegetation	- St, L	N/A
Landscaping and vegetation reintroduction	N/A	++ Lt, L
BIOLOGICAL ENVIRONMENT		
FLORA		
Clearing of Vegetation	- Lt, L	N/A
Increase in Population	N/A	O
FAUNA: AVIFAUNA		
Clearing of Vegetation	- Lt, L,N,G	N/A
Noise and Vibration	- Lt, L,N,G	- St, L
Increase in Population	N/A	O
FAUNA: BUTTERFLIES		
Clearing of Vegetation	- Lt, L	N/A
Noise and Vibration	- Lt, L	- St, L
Increase in Population	N/A	O
Landscaping	+ Lt, L	+ Lt, L
FAUNA: OTHER MACRO-FAUNA		
Clearing of Vegetation	- St, L	N/A
Increase in Population	N/A	O

NUISANCE SPECIES		
Clearing of Vegetation	- St, L	N/A
Increase in Population	O	-- Lt, L

KEY:

++ Major Positive	-- Major Negative	+ Minor Positive	- Minor Negative
St Short Term	Lt Long Term	O No Impact	N/A Not Applicable
L Local	N National	G Global	

SOCIO ECONOMIC IMPACT ASSESSMENT MATRIX

PROJECT ACTIVITIES	IMPACT	
	SITE PREPARATION /CONSTRUCTION PHASE	POST – CONSTRUCTION PHASE
SOCIAL STRUCTURE		
LAND USE		
Change of land use	- Lt, L	N/A
COMMUNITY STRUCTURE		
Project Activities	- St, L	N/A
Increase in Population	++ Lt, L,N	++ Lt, L,N
DEMOGRAPHY		
Project Activities	O	N/A
Increase in Population	O	- Lt, L
EMPLOYMENT AND INCOME		
Project Activities	++ St, L,N	N/A
Increase in Population	++ St, L,N	++ Lt, L,N
CRIME		
Project Activities	- St, L	N/A
Increase in Population	- St, L	-- Lt, L
TRAFFIC		
Project Activities	- St, L	N/A
Increase in Population	- St, L	- St, L
INFRASTRUCTURE		

HOUSING		
Project Activities	O	++ Lt, L,N
UTILITIES: Electricity		
Project Activities	O	N/A
Increase in Population	O	-- Lt, L,N,G
UTILITIES: Water		
Project Activities	-- Lt, L	N/A
Increase in Population	O	-- Lt, L
UTILITIES: Telecommunications		
Project Activities	O	N/A
Increase in Population	O	++ Lt, L,N
SOCIAL SERVICES		
EDUCATION		
Project Activities	O	N/A
Increase in Population	O	-- Lt, L
TRANSPORTATION		
Project Activities	O	N/A
Increase in Population	+ St, L	++ Lt, L
HEALTH		
Project Activities	- St, L	N/A
Increase in Population	-- Lt , L	-- Lt, L

POSTAL SERVICES		
Project Activities	O	N/A
Increase in Population	O	-- Lt, L
RECREATIONAL SERVICES		
Project Activities	O	N/A
Increase in Population	O	- Lt, L
SOLID WASTE		
Project Activities	-- Lt, L	N/A
Increase in Population	-- Lt, L	-- Lt, L

KEY:

++ Major Positive	-- Major Negative	+ Minor Positive	- Minor Negative
St Short Term	Lt Long Term	O No Impact	N/A Not Applicable
L Local	N National	G Global	

HAZARD IMPACT ASSESSMENT MATRIX

HAZARD	PROJECT ACTIVITIES	
	SITE PREPARATION/ CONSTRUCTION PHASE	POST-CONSTRUCTION PHASE
TECHNOLOGICAL HAZARDS	+ O	+ O
ACCIDENTS	+ O	+ O
EARTHQUAKES	+ O	+ O
HURRICANES	+ O	+ O
FLOODING	+ O	+ O
LIGHTNING STORMS	+O	+O

Key:

+ Great Probability **+ Moderate Probability** **O High Magnitude** **O Moderate Magnitude**

APPENDIX VIII: PROJECT TEAM

The project team for the conduct of the EIA comprised of the following persons:

- Johann Antoine BSc Zoology, MSc Natural Resources Management
- Sara Simpson BSc. Botany, M.A. Environmental Impact Assessment and Management
- Dr. Gavin Gunther: BSc. Geology, PhD. Geology
- Leslie Hoo-Fung: BSc. Analytical Chemistry
- Jevcon Engineering