Report

ENVIRONMENTAL IMPACT ASSESSMENT FOR THE NEW HARBOUR VILLAGE HOUSING SUBDIVISION

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Introduction

This document presents the findings of an Environmental Impact Assessment of the proposed New Harbour Village housing development to be developed by Gore Developments Ltd., south of Old Harbour in the parish of St. Catherine. Environmental Solutions Ltd. was contracted by Gore Developments Ltd. to carry out an Environmental Impact Assessment, as part of the permitting requirements stipulated by the National Environment and Planning Agency (NEPA).

Proposed Development

New Harbour Village is a subdivision being proposed by Gore Developments Ltd. south of Old Harbour and in close proximity to the Old Harbour exit from Highway 2000. It is bordered by the Old Harbour Bay Main Road on the west, Brampton Farms to the south, and an existing subdivision called Belmont Park to the north. The subdivision will contain 845 two bedroom houses on a minimum of 3,500 sq. ft. lots.

Commercial lots will be provided encircling the central open space and will occupy 14 of these lots. Commercial activities that will be permitted will include small retail businesses. A large lot will be provided for the establishment of a private Basic School. The main entrance will be from the existing Old Harbour Bay Main Road. The main entrance will be a boulevard of 18 m width, with neighbourhoods on either side and a large recreational area at the end of the boulevard.

The total land area to be developed is 52.44 ha, with 7.38 ha set aside as active open spaces which can be used as recreational areas, parks or playing fields. Passive open spaces will comprise 3.18 ha., giving a total of 10.57 ha of open space.

A sewage treatment plant has been designed for construction and will produce tertiary treated effluent that will meet NEPA effluent discharge standards. Specifications of the proposed treatment plant have been provided by Appropriate Technologies Ltd. The sewage treatment plant will be located in the eastern corner of the property and will be

surrounded by large open and usable spaces for recreation and community activities. The plant will be concealed by vegetation.

The drainage concept is to allow for major storm water flows that originate north of the property to flow through the project land without negatively impacting the proposed subdivision. The roads of the subdivision and the drain reservations will be graded to provide unobstructed flow paths that will convey surface flows during extreme rainfall events into the main central watercourse as well as the existing downstream course,. South of the project site is an existing detention feature which would serve to reduce stream velocity and peak downstream discharge.

The subdivision is designed with 200 mm, 150 mm and 100 mm diameter PVC mains and 50 mm supply pipes serving a maximum of 16 lots. The network was modeled to ensure the minimum pressure of 20 psi, which is the recommended pressure at the service connection during peak demand.

An operational well exists on the site and has been tested for both quality and quantity of water available. An application has been submitted to the Water Resources Authority (WRA) for a Water Abstraction Licence. However, water quality tests of the well reveal high levels of chloride and this will require treatment to provide potable water. The treatment system recommended is Reverse Osmosis and the treatment will be undertaken by a separate entity contracted specifically for this purpose.

Permitting and Legislative Requirements

The Environmental Permit and License System (P&L), introduced in 1997, is a mechanism to ensure that all developments in Jamaica meet required standards in order to minimize negative environmental impacts. The P&L System is administered by NEPA, through the Applications Section (formerly the Permit and License Secretariat). Permits are required by persons undertaking new development which fall within a prescribed category. Under the NRCA Act of 1991, the NRCA is authorized to issue, suspend and revoke permits and licences if facilities are not in compliance with the environmental

standards and conditions of approval stipulated. An application for a Permit was prepared and submitted to NEPA. The TOR's for conducting the EIA were prepared based on the generic TOR's for Human Habitation, and submitted to NEPA for review and approval.

Methodology

A multi-disciplinary team of experienced scientists and environmental professionals was assembled to carry out the required resource assessment, generation and analysis of baseline data, determination of potential impacts and recommendation of mitigation measures. An iterative approach among the environmental team members and other project professionals was adopted, and was facilitated by fortnightly or weekly team meetings as required. The EIA team worked very closely with the other project team members including the project manager, engineers and architect.

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

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

- Field studies
- Aerial observation
- Analysis of maps, plans, aerial photos
- Review of reports and background documents
- Structured Interviews
- Laboratory analyses

Detailed methodologies for the physical, biological and socio-economic aspects of the baseline survey are presented in the report.

The Existing Environment

The site (N17.9 ° W 77.1 °) is located off the southern exit ramp of Highway 2000 Toll Road and is accessed by a semi-paved road leading off the main Old Harbour Road to the Old Harbour Bay Road. The site is bound by the Belmont Park Subdivison to the north, aquaculture processing farms comprising fish and shrimp farming to the east and south, and by undeveloped feral lands to the west. The total site area is 52.44 ha. The site is for the most part undeveloped with only a few small concrete dwellings on the property.

The land is bisected by a natural drainage channel (gully) in the eastern section with the land on either side of the gully sloping generally towards it. The higher elevations are found along the northern boundary of the site at approximately 19m asl (62ft), falling some 8.5m asl (28 ft) along the southern boundary. Approximately two-thirds of the land has a general slope of 1(v) in 97(h) whilst the smaller third on the eastern side of the gully is comparable but slightly steeper at 1(v) in 91(h).

The soils map of St. Catherine (1:50,000 Series) obtained from the Ministry of Agriculture indicated that the site is underlain by Lodge Clay Loam (High Salinity Phase). It further indicates that the salinity within the soil increases with depth. A discussion on the origin of the salinity was not proffered but is likely the result of arid conditions in the paleo-climate that leads to the formation of saline evaporite deposits within the alluvial deposits.

The nearest, named surface watercourse to the site is the Frasers Gully, which lies approximately 200m east of the site. On-site a tributary of the Frasers Gully traverses the northeastern third of the site. One other named watercourse – Stony Gully, associated with the drainage system that created the Fraser Gully and its tributary is located further east of the site. West of the site drainage is controlled by The Whim Estate natural drain. Though this drain does not discharge onto or near the subject site it provides significant control to runoff immediately west of the site including accepting water from the Old

Harbour Bay main road. The Whim drain's impact on the site is not material and is therefore not further considered.

The catchment outline is approximately 105ha, and the proposed site is an additional 54ha bringing the total catchment to just under 160ha. The Ministry of Agriculture's soil map indicate that the site soils comprise a moderate draining clay loam. The land use of the area to the north is mostly urban. The total storm runoff due to the catchment for a storm with a 4% chance of occurring in any one year is approximately 51 m^3/s. Given that no site flooding has been recorded in recent memory and that the natural gully will be upgraded to a concrete drain reserve it is unlikely that storm runoff will impact the proposed site negatively once the drains are adequately sized.

The existing pipe culvert at Christine Way that takes the storm runoff onto the site will be replaced by a 3.6m wide by 1.5m high culvert, as the current culvert is clearly inadequate.

Sediment loading of the watercourse is a possibility at any construction site as large tracts of land will be cleared of vegetation. Proper house-keeping must be exercised. Post development very little if any sediment will be mobilized from the site into the watercourse.

Surfaced and Ground Water Quality

The quality of the water in the drainage channel is quite poor, suggesting that the trade effluent from the commercial properties are likely not compliant with the national guideline. The accumulated effect of the poor water quality in the drainage channels could have a negative impact on the coastal zone to which they discharge. The existing water quality conditions, associated odours and discoloured water may be a negative impact on the proposed housing sub-division.

Analysis of the water from the well indicates that the untreated groundwater quality is acceptable with the slight exception of chloride and TDS which show an exceedance of

their respective standards. Chlorides normally give water a salty taste. At what concentrations this becomes noticeable depends upon the individual. In large concentrations chlorides cause a brackish, briny taste that definitely is undesirable. Although chlorides are extremely soluble, they possess marked stability. This enables them to resist change and to remain fairly constant in water unless the supply is altered by dilution or by industrial or human wastes. TDS on the other hand is that portion of solids in water that can pass through a 2 micron filter. The more minerals dissolved into the water the higher the total dissolved solids. Waters with high dissolved solids are generally of inferior palatability. However, the water within the older well has been used as potable supply by the site's previous occupants without complaint.

Air Quality and Noise

The noise levels recorded at the stations selected are currently within the NEPA guidelines for perimeter noise. Only one station had noise levels above the standard, due largely to traffic related noise on the Old Harbour Bay road. Sampling for respirable particulates revealed levels that are well within the recommended ambient guidelines.

Pesticide Residue Analysis in Soil

The results of the pesticide residue analysis conducted on the New Harbour Village soil samples revealed the absence of pesticide residues in all five samples.

Biological Environment

The project site is highly disturbed and does not have natural habitat zones or zonation. There are two main types of habitat, the less disturbed corridor around the stream which is dominated by mature trees typical of secondary growth in this climate and soil. These include Guango and Bastard Cedar (*Guazuma ulmifolia*). The surrounding properties are also highly disturbed and do not therefore provide an easy source for recolonisation of the site with native flora. This in turn is a main limiting factor to the diversity of the fauna such that even though the site has been left relatively undisturbed for several of years the diversity is very limited.

The abandoned pastures are dominated by African Star grass which was cultivated for cattle grazing with a few scattered mature trees and shrubs, mostly Guango and Cashaw (*Prosopis juliflora*). The open grassland nature of the habitat supports a limited number of birds such as seedeaters like Grassquits (Yellow-faced and Black-faced) and Grasshoppers Sparrows. The (*Ammodramus savannarum*) is an endemic sub-species that is particularly abundant on the site and in the surrounding habitats.

The woodland along the banks of the stream is dominated by only three species. The Guango tree, Bastard Cedar and Cashew tree provides the majority of the canopy with several large mango trees scattered among them. The grass was not well developed there and many of the other weeds and shrubs were to be found here as well as along the periphery of the property and along internal paths and roads.

A total of thirty six (36) different species of birds were observed during the four field visits. Only three of Jamaica's 28 extant endemic bird species was observed - including Jamaican Woodpecker (*Melanerpes radiolatus),* Red billed Streamertail Hummingbird (*Trochilus polytmus*) and the Jamaican Mango Hummingbird (*Anthracothorax mango*). Some common endemics such as the Sad Flycatcher (*Myarchus barbirostris)* and Jamaican Tody (*Todus todus*) were not found on the site and none of the rare or forest dependent endemics were present. This is the result of the highly disturbed nature of the site and its environs.

The endangered American Crocodile (*Crocodylus acutus)* which is protected by both national and international legislation, is reported from the lower reaches of the unnamed gully in the area of the microdam. There are no reports of crocodiles coming into the project property via the gully and this was verified by discussions with the caretaker of the property who had worked with the previous property owners for approximately 20 years.

Portland Bight Protected Area

This proposed development is located within the boundaries of the Portland Bight Protected Area (PBPA). It is Jamaica's largest protected area and has been in existence since April 1999. The responsibility for managing Jamaica's proposed system of protected areas belongs to the governments National Environment and Planning Agency (NEPA) and their policy is to delegate some of this responsibility to local non-government organizations. The Caribbean Coastal Area Management (C-CAM) Foundation has been delegated some management responsibilities within the PBPA since 2003.

The PBPA is a multi-use area with several environmental management goals as stated in its management plan (C-CAM 1999). The site of the New Harbour development is not located within or near to any area that is currently designated as highly ecologically sensitive or has been zoned for any sort of special protection under the PBPA management plan. A major management goal of the PBPA is to provide for improved standard of living for its over 50,000 residents (C-CAM 1999) and the availability of quality housing for its residents (who generally fall among the lowest economic group in Jamaica). The developers aim to provide quality, affordable housing solutions, should therefore not be in conflict with any of the goals of the PBPA.

The American Crocodile is the only species of special concern with respect to this development in the PBPA.

Socio-economic Environment

The Old Harbour community that has grown rapidly in size over the last 20 years, having lost much of its light manufacturing sector and important sections of its agricultural economy, the services sector is becoming its primary generator of jobs if not income. Construction is an important employment generating activity and agriculture, mainly fisheries, offers some stability. Crop farming is not intensive, except for a relatively small sugar belt, and considerable hectares of unused agricultural lands lie idle. Large scale agriculture such as was once existed in sugar and tobacco cultivation no longer exists.

Bodles, once the center of the island's cattle breeding and livestock research program is a shadow of its former self and dairy farming, cattle rearing and pen-keeping are now on a much reduced scale.

Large manufacturing (once typified by a now closed textile mill and pulp and paper factory) has declined and a once vibrant industrial park just west of the town, is almost completely dormant. The Old Harbour community has grown rapidly in size over the last 20 years. Having lost much of its light manufacturing sector and important sections of its agricultural economy, the services sector is becoming its primary generator of jobs if not income. Construction is an important employment generating activity and agriculture, mainly fisheries, offers some stability. Crop farming is not intensive, except for a relatively small sugar belt, and considerable hectares of unused agricultural lands lie idle. Large scale agriculture such as was once existed in sugar and tobacco cultivation no longer exists. Bodles, once the center of the island's cattle breeding and livestock research program is a shadow of its former self and dairy farming, cattle rearing and pen-keeping are now on a much reduced scale.

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Public health facilities available to Old Harbour and Old Harbour Bay comprise a single Type 3 clinic located in Old Harbour and a satellite clinic in Old Harbour Bay. A satellite clinic is basically a very limited service (one to three times weekly) of a mobile nature. However three other satellite clinics also serve this part of the parish.

A fire brigade station located in Old Harbour (Area 3) provides services to both Old Harbour and Old Harbour Bay and back-up services throughout the parish as required. It has one unit which carries a limited supply of water, there being no water tender unit assigned to the station. The town is served by fire hydrants but the firemen themselves estimate that only 20% are in working condition.

Issues Identified

Several issues have been identified for the proposed New Harbour Village housing development, that must be taken into consideration at the design, construction and operation phases. These issues have been explored in light of the potential impacts of the project on the existing environment, as well as the environmental attributes and how they may affect the project. The main issues that have been identified are:

1	Drainage/Flooding	Pre and Post stormwater runoff
2	Liquid Waste Management	Approval and licencing of Sewage Treatment Plant Proposed
3	Air Quality	Construction phase dust
4	Water Quality	Surface and ground water
5	Water Quantity	Sustainable yield and long term availability of ground water resources
6	Geology	Erodibility, Soil stability
7	Hazardous Materials	Handling and storage
8	Hazard Vulnerability	Hurricanes, seismic activity, flooding
9	Ecology:	Vegetation and Habitat loss
10	Demographics	Character of communities
11	Traffic:	Egress and Ingress, Old Harbour Bay Main Road
12	Public Health and Safety	Cane field fires and agricultural pesticide use
13	Solid Waste Management	Removal of vegetative matter, removal of domestic waste and construction waste to an approved disposal site;

Potential Impacts and Mitigation Measures

Drainage and Flooding

During the construction phase grading, earthworks and removal of vegetation will expose the top soil to erosion during heavy rainfall events. During construction improperly stockpiled earth materials can also be transmitted to the surface water drainage system,

thus impacting on turbidity, and drainage capacity. The use of heavy equipment on unpaved areas can also lead to a decline in soil stability. Mitigation measures are:

- Vegetation clearance should be phased with the phasing of the construction activities and bare soils should be re-vegetated as quickly as possible.
- Replanting the area with fast-growing trees that are already part of the ecology should be undertaken.
- Stockpiled earth material needs to be secured and covered against inadvertent removal by stormwater.
- Internal roads should be consolidated and haulage trucks should carry loads not exceeding axel limits.
- All existing drainage lines should be kept open

Potential Impacts - Operation Phase

During the operation phase the potential for on site flooding has been considered due to the current flooding experienced at the north of the property from the unnamed gully running through the property. However a major mitigation measure has been implemented to remove the risk of flooding, through the engineering design. The engineer's have designed a significant increase in the drainage channel to allow for maximum flow. A detention pond will retard the flow of water from the property. Homes in close proximity to the gully are elevated to prevent flooding in extreme events.

Mitigation Measures are:

- The proposed drain reserve is designed to accommodate a rainfall event that has a 4% chance of occurring in any one year. However, given the significant limiting control of the Highway 2000 and the railway culverts it is highly unlikely that the total predicted flows will be received on site. The drainage design engineers have therefore taken a fiscally prudent approach to the drainage design based on existing and demonstrated upstream structural flow controls.

- The open space to the east of the drain reserve should be designed to accommodate spill-overs from the drain reserve so as to ensure that the properties in the western boundary are not affected by any extra-ordinary events.

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

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

Sewage Treatment Plant

The Sewage Treatment Plant (STP) has the potential to release unpleasant and/or noxious odours in the event of malfunctioning, and also to release effluent below the required NEPA standard in the event of malfunction. The design engineers have included the main mitigation measures in the treatment process, to ensure that effluent standards meet NEPA's requirements.

Most package plants require electric power to operate and all will require regular maintenance and de-sludging in accordance with the manufacturer's instructions in order to ensure that the system operates effectively and the effluent complies with the consent conditions.

Mitigation measures are:

- Storm water from the STP should not be allowed to discharge to the wastewater treatment system as this effectively reduces the design capacity and can cause solids to be flushed out of the treatment system.

- The final siting of the site STP should be at least 20m from any watercourse.
- Distribution lines that take the primary treated effluent to the central, cluster system should have suitably placed cleanouts so they can be flushed at least twice per year. Pumps, floats and alarms must be checked as part of the regular maintenance.
- No sewage line should be within 50m of the abstraction well head. Additionally, a 50m buffer should be kept around the well head to avoid the possibility of contamination via unforeseen sub-surface breakage.
- Avenues should be considered for effluent discharge re-use for non-potable activities such as greening of adjacent green spaces.
- It is recommended that manhole covers are sealed so that when water is on the road, the manholes do not flood.
- A maintenance agreement with a suitable contractor is essential, and the installation of an alarm to warn of power or plant failure is recommended.

Dust and Noise

During the construction phase air quality is expected to decline as a result of an increase in levels of fugitive dust from cleared land, stockpiled earth materials, dusty roads and gaseous emissions from vehicular exhaust. Respirable particulates are a public health hazard and may otherwise create considerable nuisances to the public.

Noise and dust nuisance related to construction may affect communities within a radius of 160 m. In particular the existing housing schemes at Belmont Park and Bay View Gardens may be affected. The 160 m zone is based on the physical property of sound whose energy is inversely proportional to the square of the distance. At a distance of approximately 160 m and starting from a noise level of 95 dB the sound level would have

been reduced to 68 dB. The recommended WHO standard is 70 dB for daylight hours. The increase in levels of sand and dust is expected to be a short term, reversible, minor impact.

Mitigation Measures are:

- Vehicles should be properly maintained and the exhaust systems should be muffled as required.
- The movement of heavy equipment should be restricted to standard working daytime hours.
- The regular maintenance of vehicles is essential to reduce gaseous emissions.
- Wetting of stockpiles and haulage roads should be conducted on an appropriate schedule and all trucks carrying construction material should be covered. A rigorous wetting programme should be implemented to reduce fugitive dust levels once clearing of vegetation begins.
- Phasing of vegetation clearance to coincide with phasing of construction activities.
- Covering of all stockpiles of earth materials, especially fines and covering of all haulage vehicles carrying fines and cement will be essential.
- A monitoring programme for dust is recommended.
- Adequate communication with residents at Belmont Park and other neighbouring communities is recommended.
- Dust masks should be provided for workers.

No impacts are expected from dust or noise during the Operation Phase. Additionally, impacts of reduced air quality to residents, from increased levels of particulates during the reaping season for sugar cane, are not expected. Sugar cane plantations are not in extremely close proximity to the proposed site.

Water Quality

Loose stockpiles of earth materials and unvegetated top soil can be washed into the unnamed gully during heavy rainfall events. During the construction phase stormwater

run-off can carry large sediment loads which increase turbidity in the coastal waters. This would be a shot-term, irreversible impact if not mitigated. During construction, oil and grease and hazardous material should be managed in properly designated areas, and disposed of appropriately off-site.

Mitigation measures are:

- Cover or berm stockpiles of earth material
- Stockpiles should be situated at least 30m away from drainage channels
- Adequate siltation control devices should be deployed where earth movement occurs close to waterways.
- Precautionary engineering measures (such as cut-off trenches, etc) should be implemented to reduce sediment laden run-off and prevent it from reaching, existing drains and natural gullies. Nothing which could cause pollution, including silty water, should enter such any watercourse.

In the operation phase the water quality of the unnamed gully is not expected to decrease due to the use of a Sewage Treatment Plant. The STP will be constructed with a biological nitrogen and phosphorus removal step within closed-loop reactors.

Mitigation measures are:

- Establishment of a new STP must be after receipt of a permit from NEPA for construction of same, and a license for the discharge of effluent.
- The current discharges of effluent into the unnamed gully should be stopped. This is not the responsibility of the developer, but of the regulatory agencies responsible for enforcement.

Soil Erosion and Sediment Loading

During the construction phase, the clearing of vegetation can result in large trails of land having soil exposed. During heavy rainfall events soil can be washed into drainage channels. Slope stability is not expected to be at risk as the land is flat.

If good construction practice is exercised the risk of sediment loading will be minimized

to acceptable levels. Some disturbance will be inevitable during the development of the drain reserve but this will be short-term and can be mitigated.

Mitigation measures are:

- Mitigation measures as presented in Section 6.2.4 for surface water quality should be applied.
- Additionally the natural drainage will be upgraded to a concrete lined drain reserve.
- An Erosion Management Plan should be prepared, if the permit is issued to the developer, for submission to NEPA before land clearing activities begin.

Potable Water Supply

National Environment and Planning Agency require the owners and operators of the commercial entities discharging to this drain to conform to the National Trade Effluent Regulations.

The potable water source, as proposed is the existing well on site. The water quality of the well shows high chlorides and some bacterial content. Treatment of the water would be required to meet potable water standards. The high chloride content would make the taste unpalatable. Environmental Health Unit must approve the quality of the water after treatment before it is made available for public consumption.

The data shows that nitrate and faecal coliform bacterial levels are low and within the World Health Organisation (WHO) drinking water standards, 50 ppm and 0 mpn respectively. Total coliform bacterial levels are however higher than the drinking water standard.

Chloride levels are consistently higher than the standard (250 ppm) while sodium levels exceeded the standard (200 ppm) thrice in five sampling exercises. Chloride levels are not significantly higher than the standard but with additional abstraction from the well to satisfy the project demands these levels could increase further. Sodium levels when

elevated exceeded the standard by approximately thirty five percent. Similarly as for chloride with increased abstraction these levels may well increase.

Total dissolved solids levels (921 ppm) is just inside the WHO standard of 1000ppm, this was a one off sampling exercise for this parameter and on that sampling exercise sodium levels were within the sodium standard. The data suggests that on those occasions when sodium levels were significantly elevated that it is likely that TDS levels could be higher than the standard.

Mitigation Measures are:

- Proper design and management of the proposed New Harbour Village Sewage Treatment Plant consistent with the national sewage regulations to ensure no groundwater contamination.
- An effective sterilization programme (chlorination/uv/ozonolysis) should be sufficient to take these levels well within the drinking water standard.
- The establishment of a Reverse Osmosis Treatment Plant as designed will treat the water by removing chlorides and ensuring potable quality that meets the taste standard locally.

Handling & Storage of Hazardous Material

Worker health and safety, as well as the environment can be impacted by the improper storage and handling of hazardous material.

Mitigation Measures are:

- All temporary fuel, oil and chemical storage must be sited on an impervious base within a bund and secured. The base and bund walls must be impermeable to the material stored and of an adequate capacity. Storage at or above roof level should be avoided.
- Leaking or empty oil drums must be removed from the site immediately and disposed of via a licensed waste disposal contractor.

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

Biological Impacts

The clearing of vegetation will result in the modification or removal of existing habitats for fauna. However, there are no rare, threatened or endangered fauna reported from the site.

Crocodiles have not been reported in the unnamed gully as far up as the project site. However, the possibility exists that they could travel up should not be excluded.

Mitigation Measures are:

- Landscaping in the development should occur to replace vegetation lost, and this could encourage the re-establishment of dislocated bird species. This is especially important for migratory species that are likely to use the habitat.
- Sensitization of construction workers to the likelihood of encountering crocodiles.
- If a crocodile is sighted, NEPA should be informed immediately.

Socio-economic Impacts

To the extent that the Project comprising 845 units is responding to a projected need for 10,400 new houses annually [1] (St. Catherine and Clarendon) it must be seen as a necessary and even urgently needed development. In relation to its likely impact on the human environment it presents a difficult, if frequently posed, challenge, for decision making. The social capital in Old Harbour and most certainly Old Harbour Bay, is inadequate to support this project. Nevertheless the Project itself will contribute to the mitigation of sprawl, which is major indicator and cause of social disintegration.

In relation to the benefits of income and employment generation and the upgrading of shelter, the Project is likely to contribute an overall net benefit to the communities, but

[1] The Portmore to Clarendon Park Highway 2000 Corridor Development Plan 2004-2005.Preliminary Draft Vol 1 Main Report Sept. 2004.

the extent of the benefit will clearly depend on a focused effort at upgrading the supporting social infrastructure currently available.

The construction phase will see an increase in the number of persons entering the area for casual labour. This will, in the short term, alter the character of the area. Concerns have been raised by members of adjacent communities that this could affect the security of the area. Traffic is expected to increase with the movement of construction workers and haulage vehicles.

Mitigation Measures are:

- Communities should be made aware of the project and the construction schedule so that they may be aware of potential increase in human interactions.

- Proper use of construction signs, detours, and flaggers should be implemented as appropriate.

- JNHT be enabled to inspect the site before it is cleared for construction, and that to facilitate inspection select areas be cleared by the developer. JNHT should also hold a watching brief over the duration of the construction phase.

- Impetus needs to be given to the dialogue between government and developers in relation to realistic ways of integrating the provision of some basic social services into project design. Precedent has already been set.

- In relation to the Project, consideration could be given to accommodating a satellite clinic within that group of units earmarked for communal services. Medical waste collection and disposal to be the responsibility of the Ministry of Health.

Traffic is expected to increase during the operation phase.

Mitigation Measures are:

- Installation of 'Traffic Ahead' signs along Old Harbour Bay main road.
- Installation of additional lanes in the vicinity of the development.
- GOJ agencies are primarily responsible with cooperation from the developer.

Health and Safety

The area within which the project is sited is prone to flooding as a result of inadequate drainage channels. The overflow of this highly polluted water into residences and public areas is a cause for concern.

Should the waters of the drainage channel overflow onto the New Harbour Project Site, then consequent to the polluted nature of the water there would likely be health and safety issues that may affect the residents.

Mitigation Measures are:

- Proper design and management of the proposed New Harbour Village sewage treatment plant consistent with the national sewage regulations.
- National Environment and Planning Agency requiring the owners and operators of the commercial entities discharging to this drain to conform to the National Trade Effluent Regulations.
- The proposed drainage designs for the project should be adequate to ensure that waters from the drainage channel do not overflow into the residences.

Positive Impacts

Several positive impacts are expected from the development of New Harbour Village, as proposed.

During the construction phase employment will be generated for skilled and unskilled labourers as well as some professionals. Employment opportunities should continue for the duration of the project. Opportunities will be created for the supply of various types of construction materials which is expected to be 3 years.

In the operation phase 845 housing solutions will be provided in the New Harbour Village. Public perception has indicated a need for the housing and anticipation for this new development.

In extreme rainfall events flooding occurs at the north east of the property and the adjacent Belmont Park Housing subdivision. The existing drain is under capacity to carry the flow. The engineering design for the drainage for this project will include improvement of that drain by increasing the capacity through increase of depth to 3.6 m and elimination of a 90 degree turn to crease two 45 degree turns. This will be a significant improvement of the drain and will reduce the flooding events currently experienced. This will be a positive impact that will be experienced off the property.

An existing pool of water to the east of the property flows into a micro dam which is off the property. This will be drained and water routed directly to the new dam.

Flooding on the Old Harbour Bay main road is reported during heavy rainfall events. The water flow from the property will be retarded by the creation of a detention pond which will assist in providing a net reduction of flow to the main road.

Outline Monitoring Programme

If a permit is granted for the proposed development, and before site preparation and construction activities begin, a Monitoring Programme should be prepared for submission to NEPA, for their approval. The Monitoring Plan should include several components, including an inspection protocol; parameters to be monitored; frequency of monitoring and reporting procedures. The duration of the monitoring programme should be for the entire construction period, with monthly reporting. The Monitoring Programme cannot be prepared in detail before the permit is received from NEPA as Terms and Conditions of the permit must be taken into consideration, and included in the monitoring programme as appropriate.

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1.0 Introduction

This document presents the findings of an Environmental Impact Assessment of the proposed New Harbour Village to be developed by Gore Developments Ltd., south of Old Harbour in St. Catherine. Environmental Solutions Ltd. was contracted by Gore Developments Ltd. to carry out the Environmental Impact Assessment (EIA) as part of the permitting requirements stipulated by the regulatory agency, the National Environment and Planning Agency (NEPA) in respect of the proposed development.

1.1 Purpose

Gore Developments submitted an application for a development permit to the National Environment and Planning Agency (NEPA) on April 10, 2006. The application was accompanied by a Project Information Form (PIF) and supporting documentation. On May 25, 2006 NEPA responded to that application with a request that an Environmental Impact Assessment (EIA) be conducted on the proposed development, based on their review of the permit application (Appendix I). The Subdivision application was received by NEPA on May 18, 2006. NEPA supplied Generic Terms of Reference for Human Habitations and indicated issues that should be addressed in the EIA. These issues have been incorporated into the specific Terms of Reference for New Harbour Village. These Terms of Reference were submitted to NEPA for their approval on June 15, 2006 and a response was received from them on August 21, 2006 with comments. The final TORs were approved in letter dated September 1, 2006, with subsequent additions on September 6, 2006.

The approved TOR's are given in Section 2.0, and the document as approved by NEPA is presented in **Appendix II,** while correspondence from NEPA is included in **Appendix I.**

1.2 Description of the Project

New Harbour Village is a subdivision being proposed by Gore Developments Ltd. south of Old Harbour and in close proximity to the Old Harbour exit from Highway 2000 (Figure 1.2 a). It is bordered by the Old Harbour Bay Main Road on the west, Brampton

Farms to the south, and an existing subdivision called Belmont Park to the north. The subdivision will contain 845 two bedroom houses on a minimum of 3,500 sq. ft. lots (Figure 1.2 b).

Commercial lots will be provided encircling the central open space and will occupy 14 of the lots. Commercial activities that will be permitted will include small retail businesses. A large lot (1/2 acre) will be provided for the establishment of a private Basic School. The main entrance will be from the existing Old Harbour Bay Main Road. The main entrance will be a boulevard of 18 m width, with neighbourhoods on either side and a large recreational area at the end of the boulevard.

The total land area to be developed is 52.44 ha, with 7.38 ha set aside as active open spaces which can be used as recreational areas, parks or playing fields. Passive open spaces will comprise 3.18 ha., giving a total of 10.57 ha of open space.

Figure 1.2 a: Site Location Map

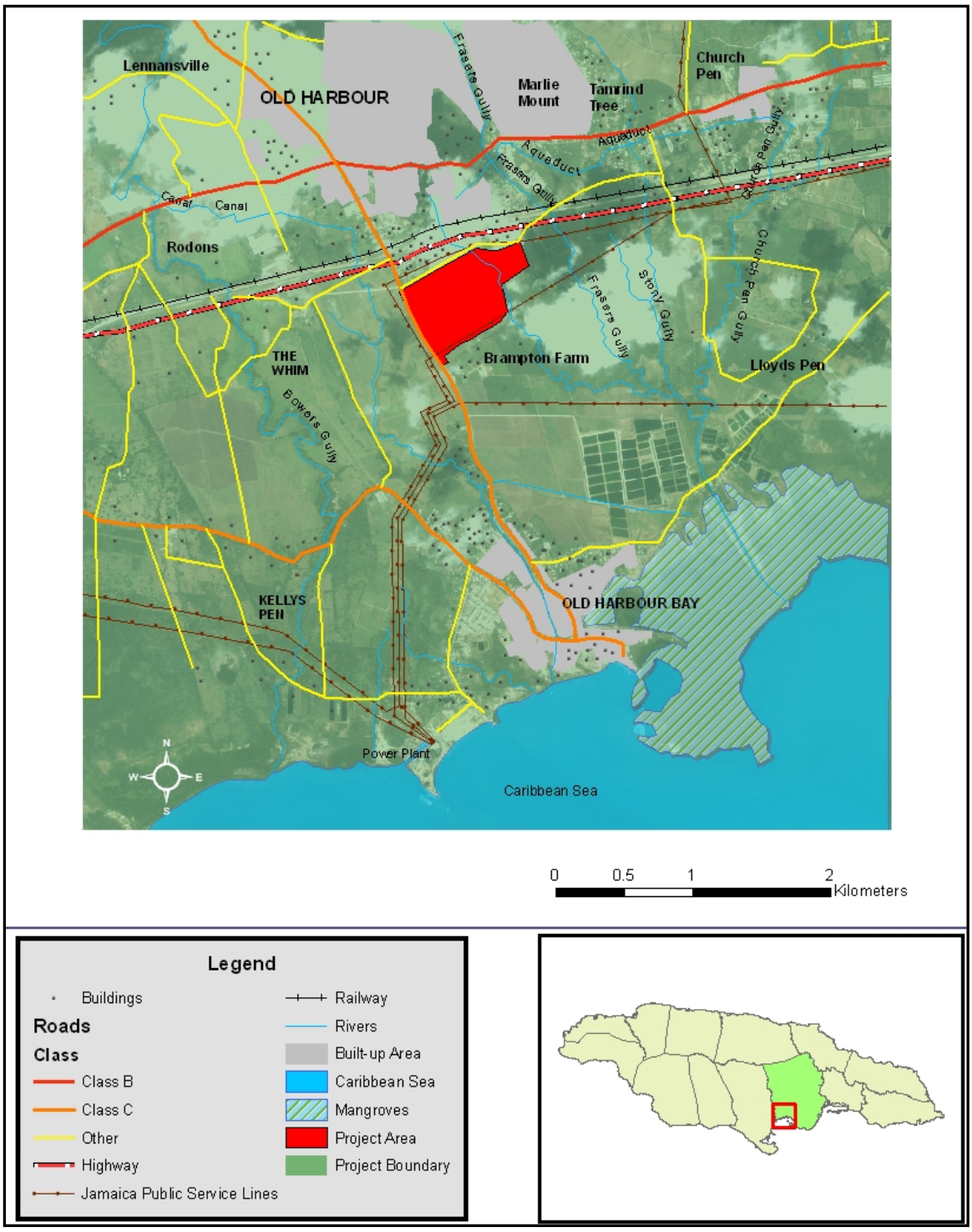
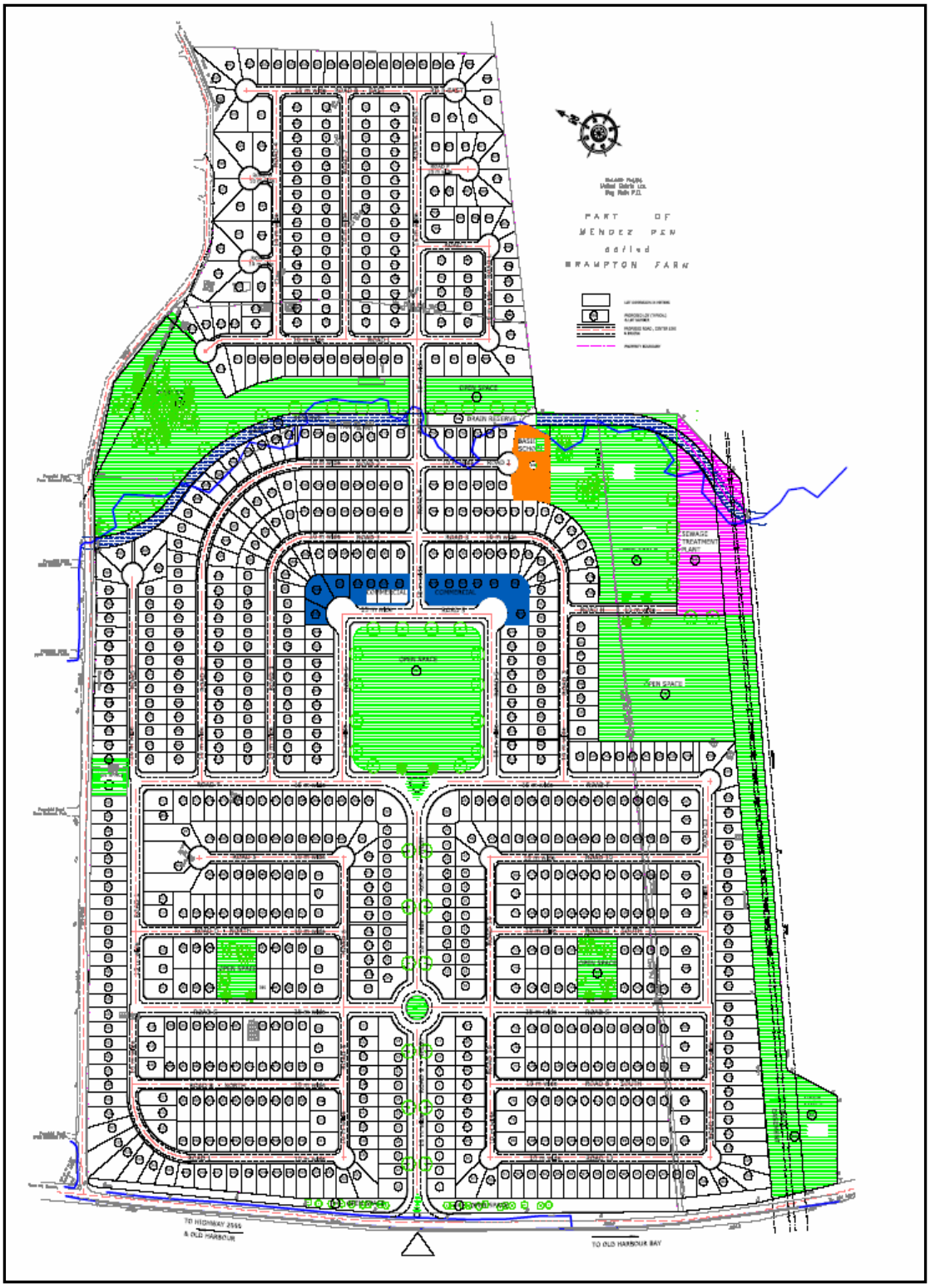


Figure 1.2 b: Layout of New Harbour Village



1.2.1 Sewage Treatment

A sewage treatment plant has been designed for construction and will produce tertiary treated effluent that will meet NEPA effluent discharge standards. Specifications of the proposed treatment plant have been provided by Appropriate Technologies Ltd. (June, 2006), and are given in Appendix III. The sewage treatment plant will be located to the north east of the property (see Figure 1.2b) and will be surrounded by large open and usable spaces for recreation and community activities. The plant will be concealed by vegetation.

The system will include an anaerobic inlet chamber with two anoxic chambers followed by two aeration basins and two clarifiers. A sludge digester and a bank of drying beds will also be included as part of the system to allow for more efficient sludge management.

Combined biological nitrogen and phosphorous removal will be achieved with the Closed Loop Reactor, (CLR) Process, with the addition of an anaerobic and anoxic stage ahead of the aeration basin. This method combines BOD_5 removal with de-nitrification and phosphorous removal (Appropriate Technologies Ltd., 2006).

The eight basic components of the plant are:

1. A Grit/Trash Chamber
2. An Anaerobic Chamber
3. Two Anoxic Chambers
4. Two Closed Loop Reactors (Oxidation Ditches)
5. Two Spiraflo Clarifiers
6. A Chlorine Contact Chamber
7. A Digester
8. Two Drying Beds

The effluent discharge will be as follows:

Table 1.2.1: Proposed Effluent Parameter and NEPA/NRCA Standards

Parameters	Influent (mg/l)	Effluent (mg/l)	NRCA Standard	Reduction (%)
BOD 5	250	20	20	92
COD	1500	100	100	93
TSS	250	20	20	92
Nitrates	27	2	10	92
Phosphates	5	4	4	80
Feacal Coliform	1,000,000	< 1 (MPN/100 ml)	<1000	99

The table above shows the expected influent quality, and the anticipated effluent quality for the completed waste water treatment process compared with the NRCA sewage effluent regulations for discharge to surface water systems.

1.2.2 Drainage Plan

Drainage issues on the property are related to occasional flooding from a 36" diameter pipe culvert, off the property, in the vicinity of the Belmont subdivision. This culvert leads into the stormwater drain that runs under the parochial road. The culvert overtops occasionally resulting in localized flooding (Plate 1.2.2). In the engineering works Foreman Chung and Sykes (2006a) propose to replace this pipe culvert with a box culvert 3.6 m wide by 1.5 m high, thereby increasing the capacity.

Plate 1.2.2: Drain on north parochial road *(Source: Foreman Chung and Sykes, 2006a)*

At the north-eastern boundary of the property a drain will be created to receive surface water run-off. This drain will be extended from the storm water drain that currently runs through the property and will add a water feature along with a large open space to the subdivision.

The drainage concept as designed by Foreman Chung and Sykes (June 2006a) (Appendix IV) is to allow for major storm water flows that originate north of the property to flow through the project land without negatively impacting the proposed subdivision. The roads of the subdivision and the drain reservations will be graded to provide unobstructed flow paths that will convey surface flows during extreme rainfall events into the main central watercourse as well as the existing downstream course. South of the project site is an existing detention feature which would serve to reduce stream velocity and peak downstream discharge.

Open and recreational areas are sited around the main central drain. At the discharge of the central main drain are two large parks that can serve to detain water if excessive flows or blockages were to occur. (Foreman, Chung, Sykes, 2006a, Appendix IV).

1.2.3 Water Supply & Distribution

The water distribution and sewerage design for the New Harbour Village has been prepared by Foreman, Chung & Sykes Consultants Ltd. (June 2006b) and is included in Appendix V.

The subdivision is designed with 200 mm, 150 mm and 100 mm diameter PVC mains and 50 mm supply pipes serving a maximum of 16 lots. The network was modeled to ensure the minimum pressure of 20 psi, which is the recommended pressure at the service connection during peak demand.

Fire flow requirements have also been taken into consideration and the Needed Fire Flow (NFF) has been assured. The Fire Flow used for this housing subdivision is two streams from a hydrant anywhere in the subdivision.

An operational well exists on the site and has been tested for both quality and quantity of water available. The well log data is given in Appendix XI. An application has been submitted to the Water Resources Authority (WRA) for a Water Abstraction Licence.

Water quality results are presented in detail in Section 5. However, water quality tests of the well reveal high levels of chloride and this will require treatment to provide potable water. The treatment system recommended is Reverse Osmosis and the treatment will be undertaken by a separate entity contracted specifically for this purpose.

1.2.4 Water Treatment - Reverse Osmosis

A full description of the proposed water treatment system has been prepared by IG Consulting (July 2006) and is presented in Appendix III. Reverse Osmosis (RO) systems are used throughout the world, and is proven technology. The system would reduce the levels of Total Dissolved Solids (TDS) from 921 mg/l detected to an acceptable level of 500 mg/l or a more desirable level of 300 mg/l. The process has a reject of approximately 98% of the salts. 25% of the water is rejected and 75% is available for use. The 25% reject will require licensed disposal.

The treatment and supply of potable water will be taken over by a private utility company, that has a licence from the OUR for operating such a facility. The National Water Commission (NWC) has indicated no objection to a private utility company taking over the operation and maintenance of the plant as the Commission will not operate an RO plant (Appendix III). The private utility will also take over the operation of the sewage treatment plant (STP).

The effluent from the RO Plant will be piped to the discharge point of the STP and both effluent streams will be disposed of simultaneously. Applications to NEPA for the water treatment facility were submitted on August 4, 2006.

1.2.5 Site Office and Construction Yard

During construction the existing entrance to the property, from the parochial road that leads off the Old Harbour Bay Main Road, will be used as the construction entrance. The site camp will be located at the existing house on the property, which was the residence of the former owner. The house itself will be used as offices and the construction camp will be sited adjacent to it.

1.2.6 Phasing of the Project

The construction of the project is proposed in five phases as indicated on the subdivision layout (Roman Numerals given on Figure 1.2.6) and indicated below:

Phase I	Main Boulevard, Southwest and Sewage Treatment Plant
Phase II	Northwest
Phase III	West Central and some Commercial Lots
Phase IV	Northeast
Phase V	East Central

Within each phase the order of construction will be done according to the Upper Case Letters as indicated in Table 1.2.6, progressing from Letter A to Letter F, where applicable. A generalized plan of the phasing is shown in Figure 1.2.6, and details of the number of units within each phase are given in Table 1.2.6.

Figure 1.2.6: General Phasing of Project

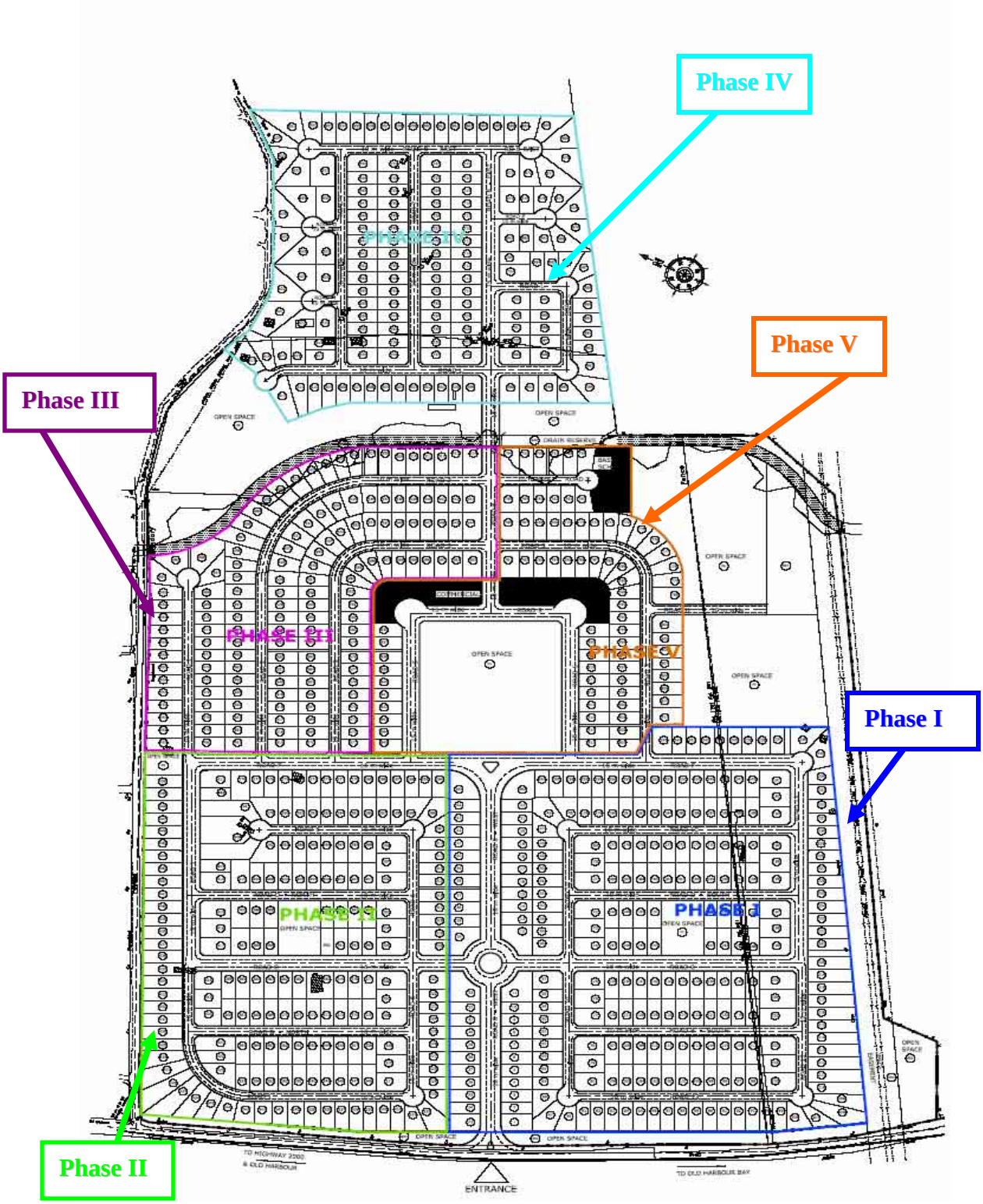


Table 1.2.6: Units within each Project Phase

GDL - New Harbour Village Construction Sequence				
Phase	**Block**	**Lot #**	**No. of Lots**	**Total Lots**
I	A1	1-40	44	
	B1	45-80	36	
	C1	81-128	48	
	D1	129-166	38	
	E1	167-190	24	
	F1	191-234	44	
	G1	235-263	29	
TOTAL YEAR 1				**263**
II	A2	264-299	36	
	B2	300-332	33	
	C2	333-376	44	
	D2	377-410	34	
	E2	411-450	40	
TOTAL				**187**
III	A3	451-480	30	
	B3	481-496	31	
		515-529		
	C3	497-514	32	
		530-543		
	D3	544-593	50	
TOTAL				**143**
IV	A4	594-616	23	
	B4	617-650	34	
	C4	651-673	23	
	D4	674-690	25	
	E4	699-721	23	
	F4	722-753	32	
TOTAL				**160**
V	A5	754-792	39	
	B5	793-811	19	
	C5	812-845	34	
TOTAL				**92**
TOTAL NO. UNITS IN PROJECT 3 YEARS 4 MONTHS				**845**

2.0 Terms of Reference

The Terms of Reference for the EIA are based on the generic Terms of Reference for Human Habitations as provided by NEPA, and have been modified to reflect the specific aspects of the project and issues of the site, including those raised by NEPA.

The Environmental Impact Assessment will:

1) Provide a complete description of the existing site proposed for development and will 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 and public health issues of concern through the presentation of baseline data which will include physical, biological, social and cultural considerations.
3) Assess public perception of the proposed development.
4) Outline the Legislation and Regulations relevant to the project.
5) Predict the likely impacts of the development on the described environment, including direct, indirect and cumulative impacts, and indicate their relative importance to the design of the development's facilities.
6) Identify mitigation measures to be implemented to minimise adverse impacts and quantify associated costs.
7) Prepare an Outline Design for a Monitoring Plan which should ensure that the mitigation plan is adhered to.
8) Describe the alternatives that were considered for the project.

To ensure that a thorough Environmental Impact Assessment is carried out, the following tasks will be undertaken:

Task #1. Description of the Project

Provide a comprehensive description of the project, noting 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.

This should 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. All phases of the project will be clearly defined, the relevant time schedules provided and phased maps, diagrams and appropriate visual aids be included. The method, level and location of the sewage treatment facility and the impact of effluent disposal will be presented. Information will be provided regarding the proximity of the treatment system to the adjacent houses and basic infrastructure. The source of potable water will also be identified.

Task #2. Description of the Environment

Baseline data will be generated which will be used to describe the study area as follows:

i) physical environment
ii) biological environment
iii) socio-economic and cultural environment.

Methodologies employed to obtain baseline data and other data will be clearly detailed, and references provide as appropriate.

In their letter of May 25, 2006 NEPA also requested an overall evaluation of the existing environmental conditions, values and functions of the proposed development area.

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.

ii) Drainage, especially with respect to existing natural drainage channels or any proposed man made drainage/water features will be investigated. This will include disposal of storm water runoff

and any risk of impact on communities, and will be supported by engineer's reports. Issues with respect to increased surface runoff and sediment loading will also be addressed.

iii) Hazard vulnerability will be assessed.

iv) The risk of soil erosion will be assessed and an erosion plan presented to minimise soil loss resulting from removal of vegetation.

v) Water quality of the existing well on the property will be given. Quality Indicators should include but not necessarily be limited to manganese, lead, zinc, sodium, pH, chlorides, sulphates, TDS, conductivity, nitrates, phosphates, total coliform, faecal coliform, and suspended solids.

vi) A qualitative and quantitative assessment will be given of the supply of water from the well on the property in the context of the long term availability of the ground water resources.

vii) Climatic conditions and air quality in the area of influence including particulate emissions from stationary or mobile sources, NO_x, SO_x, wind speed and direction, precipitation, relative humidity and ambient temperatures,

viii) Soil toxicity characteristics through randomised soil sampling and testing within the development area for the determination of pesticide residues.

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

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

xi) Availability of solid waste management facilities.

(B) Biological

Present a detailed description of the flora and fauna of the project site, with special emphasis on rare, endemic, protected or endangered species. Migratory species will also be considered. A survey will be conducted on the existing

vegetation, vegetation loss and hence loss of habitat for the fauna on the project site.

(C) Socio-economic & cultural

A socio-economic evaluation will be conducted and will include present and projected population; past, present and proposed land use; planned development activities, issues relating to squatting and relocation, community structure, employment, distribution of income, goods and services; recreation; public health and safety; cultural peculiarities, aspirations and attitudes should be explored. Any issues related to health risks, which may arise from cane filed fires and/or agricultural pesticide use will be explored. The historical importance of the area should also be examined. While this analysis is being conducted, it is expected that an assessment of public perception of the proposed development be conducted. This assessment may vary with community structure and may take multiple forms such as interviews, meetings or questionnaires.

Task #3 - Legislative and Regulatory Considerations

The EIA will outline the pertinent legislation, 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. The examination of the legislation will include at minimum, legislation such as the NRCA Act, the Housing Act, the Town and Country Planning Act, Building Codes and Standards, Development Orders and Plans and the appropriate international convention/protocol/treaty where applicable.

Task #4 - Identification of Potential Impacts

The EIA will identify the major environmental and public health issues of concern and indicate their relative importance to the design of the subdivision. Potential impacts will be identified as they relate to, the following:

- change in drainage pattern
- stormwater run-off

- flooding potential
- landscape impacts of excavation and construction
- soil erosion
- loss of natural features, habitats and species by construction and operation
- pollution of potable, coastal, surface and ground water
- air pollution
- public health risks
- capacity and design parameters of proposed sewage treatment facility.
- socio-economic and cultural impacts
- risk assessment
- noise
- solid waste management
- sustainability of ground water resources

Potential impacts will be identified as significant positive or negative, direct or indirect, long term or short term impacts, avoidable as well as irreversible impacts. The extent and quality of the available data, explaining significant information deficiencies and any uncertainties associated with the predictions of impacts will be characterized. Project activities and impacts will be represented in matrix form. Cumulative impacts of this project will be discussed.

Task #5 Mitigation

The EIA will present guidelines for avoiding, as far as possible, potential adverse impacts due to proposed use of the site and use of the existing environmental attributes for optimum development. Mitigation measures will include the required setbacks from the well, the sewage treatment plant and the drainage channels. Mitigation measures as related to public health and safety will also be presented, where appropriate, for issues related to current and previous agricultural practices near to, or on the project site, (for example, cane field fires, pesticide use and termite infestation). Where possible mitigation measures will be quantified and assigned financial and economic values.

Task #6 - Monitoring

Consult with the Regional Health Authority/medical Officer (Health) St. Catherine Health Department to investigate the present and potential public health risks associated with the development and the long-term impact on community health status.

Task #7 - Monitoring

An Outline Monitoring Programme will be given for monitoring the implementation of mitigatory or compensatory measures and project impacts during construction and occupation of the units. An Outline Environmental Management Plan for the long term operations of the site will also be presented, and a detailed version submitted to NEPA for approval after the granting of the permit and prior to the commencement of the development.

An Outline Construction Phase Monitoring Programme will be included in the EIA, and a detailed version submitted to NEPA for approval after the granting of the permit and prior to the commencement of the development. The outline monitoring programme and report should include:

- Introduction outlining the need for a monitoring programme.
- 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.
- Frequency of reporting to NEPA

The Monitoring report should also include:

- Raw data collected.
- Tables and graphs 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 #8 - Project Alternatives

The EIA will examine alternatives to the project including the no-action alternative. This examination of project alternatives should incorporate the history of the overall area in which the site is located and previous uses of the site itself.

All findings will be presented in the **EIA report** and must reflect the headings in the body of the TORs, as well as references. Eight hard copies and an electronic copy of the report will be submitted to NEPA. The report will include appendices with items such as maps, site plans, the study team, photographs, and any other relevant and appropriate information.

3.0 Legislation and Regulatory Considerations

This section presents the legislation and regulations pertinent to the proposed New Harbour Village.

3.1 National Legislation – Natural Environment

3.1.1 Natural Resources Conservation Authority Act (1991)

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

The body is also responsible for investigating the effect on the environment of any activity that may cause pollution or which involves waste management. Sections of the Act that relate specifically to pollution control state that:

(i) No person shall 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.

(ii) No person is allowed to construct or reconstruct or alter any works designed for the discharge of any effluent.

The Act also empowers the authority to require of any owner or operator of a pollution control facility information on the performance of the facility, the quantity and condition of effluent discharged and the area affected by the discharge of such effluent.

The Authority has the right to consult with any agency or department of Government having functions in relation to water or water resources to carry out operations to:

(a) Prevent pollutants from reaching water bodies.

(b) Remove and dispose of any polluting matter or remedy or mitigate any polluted water body in order to restore it.

3.1.2 Environmental Review and Permitting Process (1997)

The Environmental Permit and License System (P&L), introduced in 1997, is a mechanism to ensure that all developments in Jamaica meet required standards in order to minimize negative environmental impacts. The P&L System is administered by NEPA, through the Applications Section (formerly the Permit and License Secretariat). Permits are required by persons undertaking new development which fall within a prescribed category. Under the NRCA Act of 1991, the NRCA is authorized to issue, suspend and revoke permits and licences if facilities are not in compliance with the environmental standards and conditions of approval stipulated. An applicant for a Permit or License must complete an application form as well as a Project Information Form (PIF) for submission to the NRCA.

3.1.3 Wildlife Protection Act (1945)

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

3.1.4 The Endangered Species (Protection, Conservation and Regulation of Trade) Act (2000)

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

3.1.5 The Natural Resources (Prescribed Areas)(Prohibition of Categories of Enterprise, Construction and Development) Order (1996)

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

3.1.6 Water Resources Act (1995)

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

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

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

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

The soils test report produced by Hill-Betty Ltd. states that in all eleven (11) boreholes tested water was present at a depth of 0.8 m (2.5 ft.) indicating a high water table. Implications for the potential contamination of ground water are clear. An immediate buffer zone of 30m around the well should be established as requested by NEPA in their letter of August 21, 2006 (Appendix II).

3.1.7 Quarries Control Act (1983)

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

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

Any quarries used to provide material for the project should be licensed.

3.1.8 The Pesticides (Amendment) Act (1996)

The Pesticides (Amendment) Act of 1996 amended sections of the principal act, which came into effect in 1975 and established the Pesticides Control Authority. This Act gives the Authority the responsibility of controlling the importation, manufacture, packaging, sale, use and disposal of pesticides. Section 11 states that the Authority is required to keep a register or record of all relevant information such as registered pesticides, restricted pesticides, pest control operators and persons licensed to import or manufacture pesticides. Under Section 16 of the Act, the Authority may also, with the approval of the Minister, make regulations which relate to areas such as:

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

The use of pesticides should be approved by the relevant regulatory agencies and any application of subsurface chemicals/pesticides should be prohibited within a 200m radius of the well, as specified by NEPA in their letter of August 21, 2006 (Appendix II).

3.1.9 Clean Air Act (1964)

This act refers to premises on which there are industrial works, the operation of which is in the opinion of an inspector likely to result in the discharge of smoke or fumes or gases or dust in the air. An inspector may enter any affected premise to examine, make enquiries, make tests and take samples of any substance, smoke, fumes, gas or dust as he considers necessary or proper for the performance of his duties.

3.1.10 Noise Standards

Jamaica has no national legislation for noise, but World Bank guidelines have been adopted by the National Environment and Planning Agency (NEPA) and are used for benchmarking purposes along with the draft National Noise Standard that is being prepared. The guidelines for daytime perimeter noise is 75 decibels and 70 decibels for nighttime noise.

3.1.11 Trade Effluent and Sewage Regulations (1996)(Draft)

Jamaica has draft regulations governing the quality of the effluent discharged from facilities to public sewers and surface water systems. These draft regulations should be gazetted sometime in 2006. The draft guidelines require the facility to meet certain basic water quality standards for trade effluent including sewage. The requisite permits and licenses are required to install and operate sewage treatment facilities.

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The site contains several streams and is adjacent to a gully. During the construction and operation phases the integrity of the water quality in these systems should not be compromised.

Gore Developments Ltd. has applied for a permit to construct a sewage treatment plant and a licence to discharge sewage effluent. The proposed sewage treatment facility will be designed to meet NEPA standards for effluent discharge.

Table 3.1.11: NRCA Sewage Effluent Standards

Immediate Technology Based Effluent Standards - Existing Plants	
Parameter	**Effluent Standard**
BOD_5	20 mg/l
TSS	30 mg/l
Nitrates (as Nitrogen)	30 mg/
Phosphates	10 mg/l
COD	100 mg/l
pH	6-9
Faecal Coliform	1000 MPN/100ml
Residual Chlorine	1.5 mg/l
Proposed Sewage Effluent Standards – New Plants	
BOD_5	20 mg/l
TSS	20 mg/l
Total Nitrogen	10 mg/l
Phosphates	4 mg/l
COD	100 mg/l
pH	6-9
Faecal Coliform	1000 MPN/100ml
Residual Chlorine	1.5 mg/l
Natural Resources Conservation Authority (NRCA) Interim Sewage Effluent Irrigation Standards	
Parameter	**Standard Limit**
Oil & Grease	10 mg/L
Total Suspended Solids (TSS)	15 mg/L
Residual Chlorine	0.5 mg/L
Biochemical Oxygen Demand (BOD)	15 mg/L
Chemical Oxygen Demand (COD)	<100 mg/L
Faecal Coliform	12 MPN/100mL

3.1.12 The Natural Resources Conservation (Portland Bight Protected Area) Regulations (1999)

These regulations apply within the area declared to be the Portland Bight Protected Area as described in the Schedule of the Natural Resources Conservation (Portland Bight Protected Area) Declaration Order 1999, and in addition to any other regulation relating to said Protected Area. The regulations give the activities that can be undertaken within the protected area, activities that can be undertaken with a license/permit, activities that can be undertaken with the written permission of the Protected Area Manager, enforcement and exemptions.

The project site lies within the boundary of the Portland Bight Protected Area.

3.2 National Legislation – Socio-economic Environment

3.2.1 Town and Country Planning Act (1958)

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

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

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

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

development order.

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

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

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

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

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

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

3.2.2 Land Development and Utilization Act (1966)

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

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

The New Harbour property is on lands previously used for agriculture but is now recommended for residential/urban use.

3.2.3 Public Health Act (1976)

The Public Health (Air, Soil and Water Pollution) Regulations 1976, aim at controlling, reducing, removing or preventing air, soil and water pollution in all possible forms. Under the regulations given:

i. No individual or corporation is allowed to emit, deposit, issue or discharge into the environment from any source.
ii. Whoever is responsible for the accidental presence in the environment of a contaminant must advise the Environmental Control Division of the Ministry of Health and Environmental Control, without delay.
iii. Any person or organization that conducts ac tivities which release air contaminants such as dust and other particulates is required to institute measures to reduce or eliminate the presence of such contaminants.
iv. No industrial waste should be discharged into any water body which will result in the deterioration of the quality of the water.

3.2.4 Country Fires Act (1942)

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

empowers the Minister to prohibit, as may be necessary, the setting of fire to trash without a permit.

Offences against this Act include:

- Setting fire to trash between the hours of 6.00 p.m. and 6.00 a.m. (Section 5a);
- Leaving open-air fires unattended before they have been completely extinguished (Section 5b);
- Setting fires without a permit and contrary to the provisions outlined in Section 6 (Section 8);
- Negligent use or management of a fire which could result in damage to property (Section 13a);
- Smoking a pipe, cigar or cigarette on the grounds of a plantation which could result in damage to property (Section 13b).

Vegetation clearance will be required and burning may be used to facilitate this. The Developer should note the legal requirements for burning of vegetation.

3.2.5 The National Solid Waste Management Authority Act (2001)

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

Solid waste management will be essential in both the construction and operation phases of New Harbour and will require the removal and proper disposal of vegetative matter, untreated sewage effluent, soil, construction rubble, unused subdivision infrastructure and sludge from the existing sewage pond.

3.2.6 Jamaica National Heritage Trust Act (1985)

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

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

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

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

The JNHT has been contacted officially to advise them of the project and to determine if there are any relevant listings on their Sites and Monuments Records.

3.2.7 Land Acquisition Act (1947)

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

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

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

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

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

3.2.8 Registration of Titles Act (1989)

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

3.2.9 The Housing Act (1968)

The Jamaica Housing Act of 1968 is the legal basis for housing in Jamaica. The Act outlines the primary roles of the Minister of Housing; the procedures for acquisition of

land required for schemes, the preparation and approval of schemes; and the preparation, approval, and completion of schemes prepared by housing associations.

The Housing Act established the Minister responsible for Housing as a Corporation Sole, which allows him to have perpetual succession and to acquire, hold and dispose of land and other property of whatever kind.

The Minister is advised under section 9 of the Act; that before approving a scheme, information be furnished to the Local Authority within whose area the scheme is to be operative. The particulars to be furnished shall include specifications and estimates, and particulars relating to roads, water supply, sewerage and lighting, if appropriate to the scheme.

The Minister before approving a scheme should also consider any objections or representations made to him in pursuance of this section and shall afford the Local Authority making such objections or representations an opportunity to be heard.

3.2.10 The Office of Utilities Regulation Act (2005)

Clause 4 (1) of the Act defines the OUR's functions as follows:

> "It shall be the duty of the Office to receive and process all applications for a licence to provide any utility service required by virtue of the provisions of any Act, and to make such recommendations to the responsible Minister in relation to the application as the Office considers necessary or desirable".

The Act states that:

1. All Organizations or body of persons should provide a prescribed utility service without first being issued with a licence granted by the Minister to provide such service.
2. An application for a licence to provide a prescribed utility service should be made in the prescribed form to the Office and shall be accompanied by such non-refundable fee as may be prescribed.

3. Where necessary, it may be required that the applicant provide such additional information as the Office considers necessary for the purpose of considering the application
4. In deciding whether to recommend to the Minister that an application be granted or to refuse a licence, the Office shall satisfy itself that the prescribed utility service which is the subject of a application for a licence will:

    a. Meet the needs of the community to which the utility service is to be established.
    b. Operate efficiently.

The company responsible for treating and providing potable water and for treating and disposing of wastewater including sewage effluent, will have to have a licence from the OUR in order to perform these functions.

3.3 International Legislative and Regulatory Considerations

3.3.1 Cartagena Convention (Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region) (1983)

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

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

- *The Protocol Concerning Co-operation in Combating Oil Spills in the Wider Caribbean Region* (The Oil Spills Protocol), which was adopted and entered into force at the same time as the Cartagena Convention;
- *The Protocol Concerning Specially Protected Areas and Wildlife in the Wider Caribbean Region* (The SPAW Protocol), which was adopted in two stages, the text in January, 1990 and its Annexes in June, 1991. The Protocol entered into force in 2000;
- *The Protocol Concerning Pollution from Land-based Sources and Activities in the Wider Caribbean Region* (LBS Protocol), which was adopted in October, 1999.

3.3.2 Convention on Biological Diversity

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

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

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

4.0 Methodology and Approach

4.1 General Approach

A multi-disciplinary team of experienced scientists and environmental professionals was assembled to carry out the required resource assessment, generation and analysis of baseline data, determination of potential impacts and recommendation of mitigation measures. The EIA professional team is given in Appendix VI. An iterative approach among the environmental team members and other project professionals was adopted, and was facilitated by fortnightly or weekly team meetings as required. The EIA team worked very closely with the other project team members including the project manager, engineers and architect.

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

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

- Field studies
- Aerial observation
- Analysis of maps, plans, aerial photos
- Review of reports and background documents
- Structured Interviews
- Laboratory analyses

4.2 Physical Environment

4.2.1 Site and Situation

A definition of the study area was prepared, based on the drainage area of which the project site forms a part. These boundaries were demarcated based on a desktop review of available topographical maps and field reconnaissance along open and traversable access ways. Baseline data collection on the study area was conducted and included climate, hydrology, geology, hydrogeology and topography. Information on soils provided by Hill Betty Engineers Ltd. (Titus, 2006) was reviewed.

Information on rainfall, groundwater pollution incidents, flooding incidents, mains supply facilities and other critical facilities were reviewed within a 1km radius of the site. Information was obtained from the Office of Disaster Preparedness and Emergency Management (ODPEM), the Water Resources Authority (WRA), the National Water Commission (NWC) and internet searches.

Information was garnered from field reconnaissance, aerial photographs, previous site and intrusive site reports done and current public domain reports held within various governmental and non-governmental organisations. A summary of internet searches for baseline data is given in Appendix VII.

4.2.1.1 The Highway 2000 Development Corridor

The Highway 2000 (H2K) Corridor Development Plan is a comprehensive document outlining proposed infrastructural development between Portmore and Clarendon Park. The Development Plan is phased with the implementation of the Highway 2000 project, to ensure that the areas contiguous to the highway are "recognized spatially, physically, socially, institutionally and economically, in a manner that is efficient, stimulating and sustainable" (*Portmore to Clarendon Park – Highway 2000 Corridor Development Plan 2004-2025, Preliminary Draft – Volume I, 2004) (PIOJ, 2004)*

The plan proposes land use zoning, which has established new urban fences for the Portmore Municipality, Spanish Town, May Pen, Old Harbour, Esquivel, and

Rhymesbury and has proposed re-zoning of several areas. Figure 4.2.1.1a shows the proposed land use zoning for the Esquivel Area which includes the proposed site for New Harbour Village. Figure 4.2.1.1b shows a section of the proposed land use zoning map of Esquivel highlighting the project Area which itself sits in an area zoned as a Sub-Regional Centre.

The Highway 2000 Development Plan covers an area of approximately 99,442 hectares. Approximately 42,000 hectares or forty-two percent (42%) of the land is located in the parish of St. Catherine and approximately 57,000 hectares or 58 percent lies in the parish of Clarendon, accounting for forty-eight percent (48%) of the Parish of Clarendon.

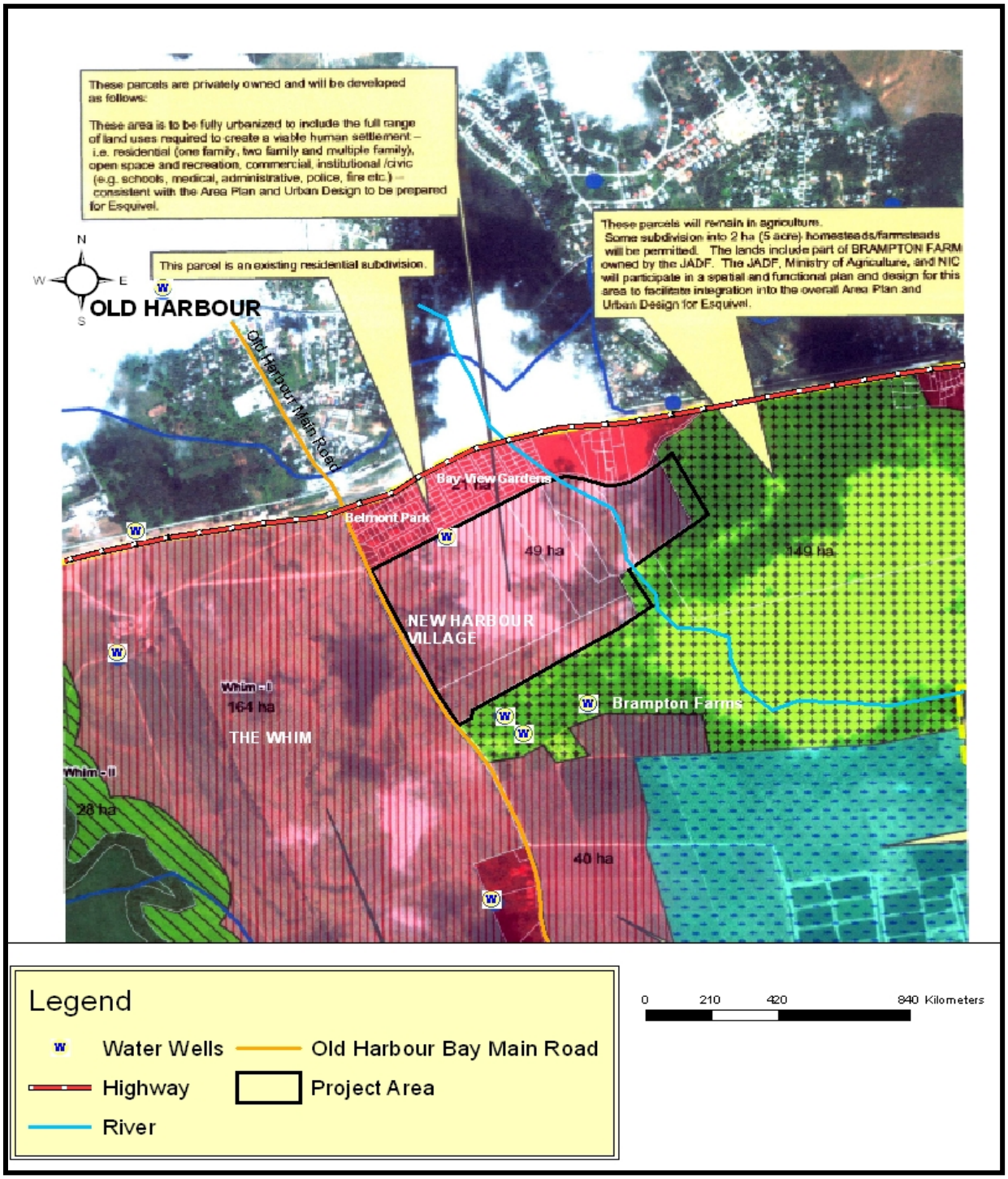
The proposed housing development lies within this Highway 2000 Corridor Development area, and is within an area zoned for residential development. The area to the west (the Whim) is slated for urban development and the area to the east (Brampton Farms) is to remain in agricultural use. Just south of Brampton Farm is 40 ha of land owned by the GOJ which is slated for social housing.

The land use zoning map of Esquivel acknowledges that the land is privately owned to include the full range of land uses required to create a viable human settlement, i.e. residential (one family, two family and multiple family), open space and recreation, commercial, institutional/civic (e.g. schools, medical administrative police, fire etc.) consistent with the Area Plan and the Urban Design to be prepared for Esquivel.

This plan has no legislative or regulatory authority.

Figure 4.2.1.1a

Figure 4.2.1.1b: Zoning of Project Area within Highway 2000 Corridor Development Plan
(Source: PIOJ, 2005)



4.2.2 Climate

Climate data including rainfall was collected from the National Metrological Services.

4.2.3 Topography, Hydrogeology and Drainage

The site assessment was conducted on June 15 and 26, 2006 to visually verify the geology, ascertain the hydrogeology and investigate any scale-related events that may not have been captured in the previous studies.

The hydrological assessment was made using WinTR-55 storm run-off model which is a robust, single-event rainfall-runoff small watershed hydrologic model. The model generates hydrographs from both urban and agricultural areas and at selected points along the stream system. The model was developed and is currently used extensively in the USA for catchments between 1 and 6,500 ha. The New Harbour site covers 54.4 ha, but the upper drainage basin is approximately 105 ha.

Existing reports and data were reviewed with a view to determining the following:

1) Water demand based on population and consumption rate for the proposed site.
2) Pre and post project runoff rates for 25 yr return period
3) Possibility for contamination of the water courses as a result of the proposed project.

An assessment of the quantity of water available from the well recently advanced on the project site, was done through an estimation of the potential per capita demand for the housing development and comparing this with the maximum yield of the well as approved by the Water Resources Authority (WRA).

4.2.4 Drainage/Stormwater Runoff

A comparative evaluation of the site using Rational Equation indicated storm runoff of similar orders of magnitude, though less than that calculated by WinTR-55. The difference is mainly due to the sophistication of the WinTR-55 model compared to the Rational Equation as well as the areal limitations of the Rational Method.

The Rational Method is normally the recommended hydrologic model for drainage areas up to 100 hectares (247 acres) in size due to its underlying assumptions. However, use of the equation in large watershed introduces errors due to the assumptions inherent in the method. The WinTR-55 model on the other hand is more suited to computing peak discharges of larger drainage basins up to 6,500 hectares (16,000 acres) hence its preference in this document.

It is likely that the underlying assumptions and the Rational being applied right upon its limit are the reason for the divergence between the runoff figures.

4.2.5 Natural Hazard Risk

Assessment of natural hazard risk was accomplished through a review of relevant literature pertaining to history of flood events, seismicity and hurricane impacts. Anecdotal reports on historical events were recorded from residents in the surrounding communities. The stormwater runoff analysis provided a basis for evaluating flood risk, and canals and gullies in the project area were examined in terms of level of maintenance and historical performance. The Office of Disaster Preparedness and Emergency Management (ODPEM) provided a report at the request of the EIA consultants which is given in Appendix IX. The WRA Report is given in Appendix X.

4.2.6 Air Quality

The objective of the respirable particulates (PM 10) air quality monitoring exercise was to provide baseline data on the typical concentration of respirable particulates in the project area prior to the start of construction works.

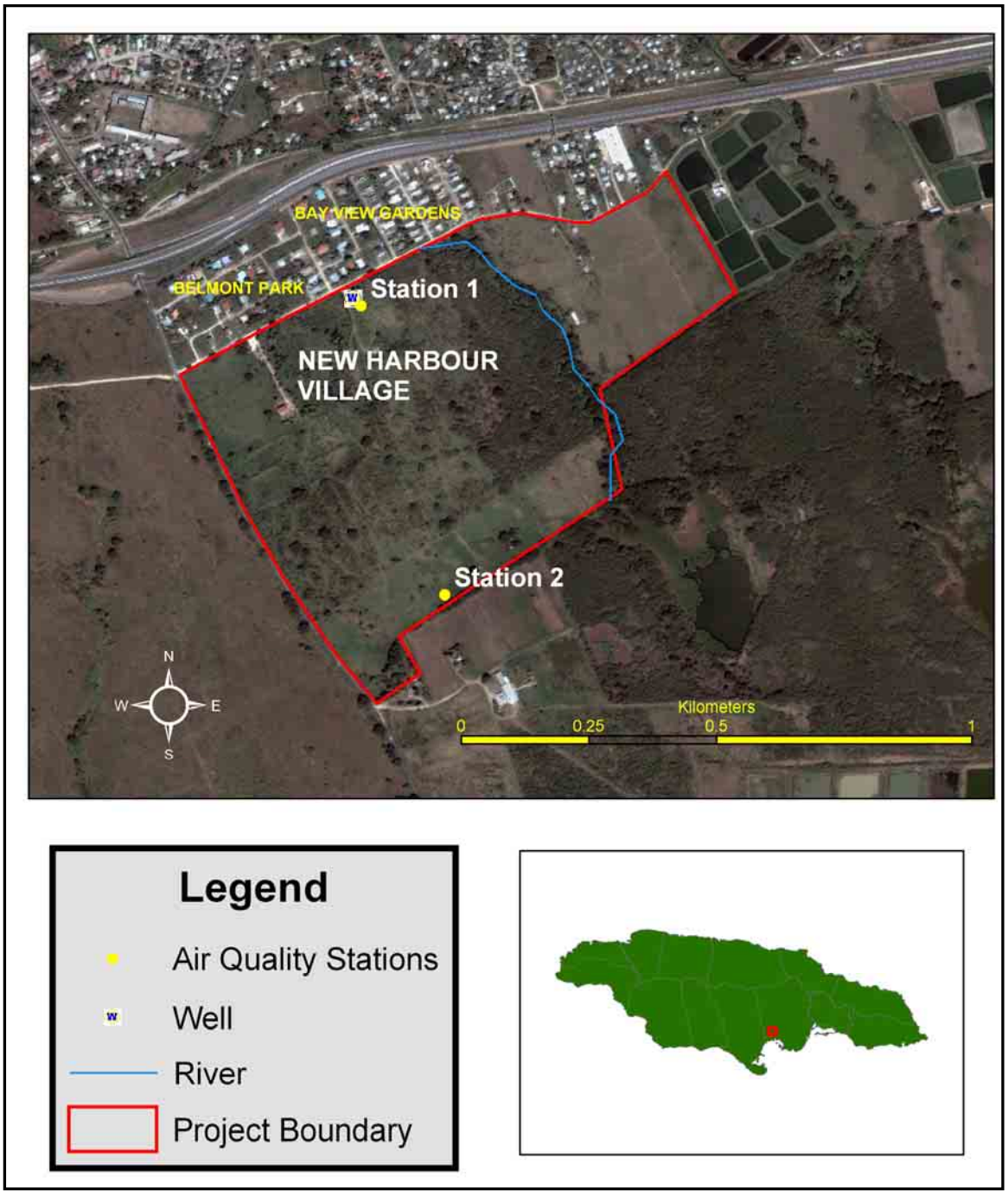
Air contains particulates in the form of dust. A portion of that dust with particle size less than 10 microns can be retained in the lungs. During construction and excavation activities the concentration of fugitive dust increases significantly.

Air quality measurements were taken at two sites upwind and downwind of the project area as shown in Figure 4.2.6.

The air quality assessment involved the measurement of ambient levels of respirable particulates, PM10 (<10µm). Particulates were measured using SKC low flow vacuum pumps (suction 2-5 1/min), attached to pre-weighed Millipore filters. The pumps were placed at the approximate respiratory height of pedestrians over a twenty-four hour period at the two sites. The pumps were then returned to the ESL laboratory where the filters were stabilised and weighed to determine a Time Weighted Average (TWA) value for the particulates.

Calibration certificates are given in Appendix XI.

Figure 4.2.6: Air Quality Sampling Stations



4.2.7 Noise

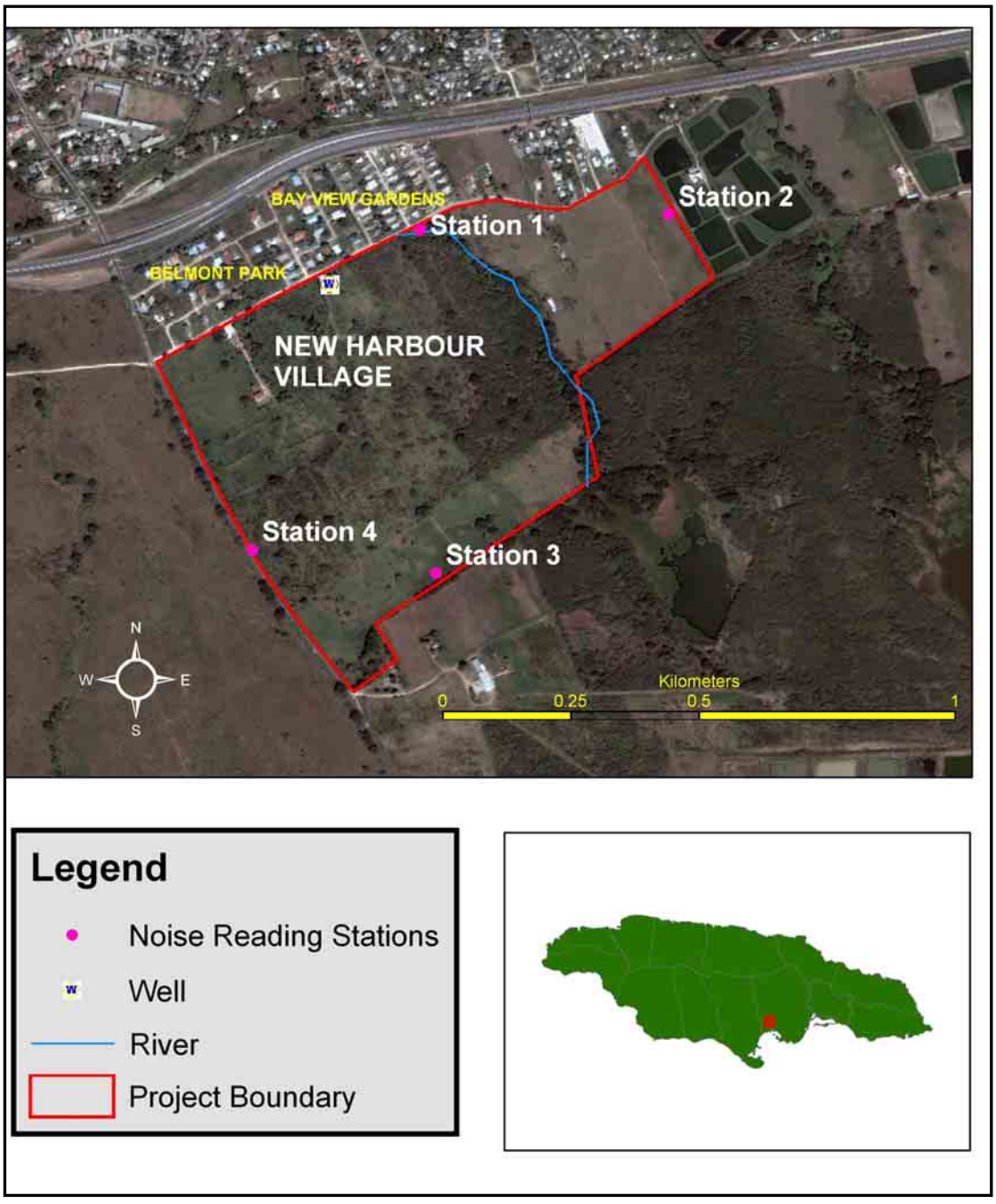
Noise readings, wind direction and any unusual local noise sources were recorded. Measurements were taken using Quest Electronics sound level meters, which conform to ANSI S1.4 - 1983, TYPE 2 and IEC 651 - 1979, TYPE 2 standards. The meter was calibrated before and after each set of readings. Noise was tested at four sites (Table 4.2.7 and Figure 4.2.7). The stations selected included consideration of Noise Sensitive Receivers (NSR's) such as the existing subdivision at Belmont.

Calibration certificates for analytical equipment used are given in Appendix XI.

Table 4.2.7: Location of Noise Reading Sampling Stations

Site #	Site Location and Description
N1	Middle of perimeter fence approximately 10 M from the entrance of Christine Way (North of property)
N2	Middle of East perimeter fence
N3	Middle of perimeter fence shared with Brompton Farms (South of Property)
N4	Middle of perimeter fence parallel to Old Harbour Bay main road

Figure 4.2.7: Noise Reading Sampling Stations



4.2.8 Water Quality Methodology

The goal of the water quality sampling programme was to assess the status of the surface waters in the project area and to understand the primary factors that influence their quality. The data generated from this exercise will establish predevelopment (baseline) water quality conditions for post construction monitoring activities.

An unnamed earthen drainage channel taking stormwater and municipal wastewaters from the town of Old Harbour traverses the property and merges with other surface drainage systems that discharge to the coast. Two water quality sampling points were selected: Station 1, just upstream of the entry point of the drain into the project area, and Station 2, downstream of its exit point. The station locations are given in Table 4.2.8 and shown at Figure 4.2.8.

Samples were collected in the middle of the channel approximately 0.2 meters below the water surface. All samples were collected in pre-cleaned 2 litre polyethylene sample bottles. Bacterial samples were collected in sterilized 100 ml glass bottles and BOD samples were taken in opaque polyethylene containers.

The following parameters were analyzed on all of the water samples:

- ◊ pH
- ◊ Salinity/conductivity/temperature
- ◊ Dissolved Oxygen
- ◊ Turbidity
- ◊ Nitrate
- ◊ Phosphate
- ◊ Biochemical Oxygen Demand (BOD_5
- ◊ Total and Faecal Coliform
- ◊ Total suspended solids
- ◊ Manganese
- ◊ Lead
- ◊ Zinc

Salinity, temperature, and dissolved oxygen were measured *in situ* at the sampling stations using a YSI Model 57 Salinity/Conductivity/Temperature (SCT) meter and YSI Model 33 oxygen meter respectively. Measurements were taken at the surface (0.5m depth) of the water column. Sampling was conducted twice, on June 22 and July 4, 2006.

Environmental Solutions Limited Laboratory performed or supervised the analysis of all parameters. Laboratory analyses used certified methodology, primarily from the text 'Standard Methods for Examining Water and Wastewater'.

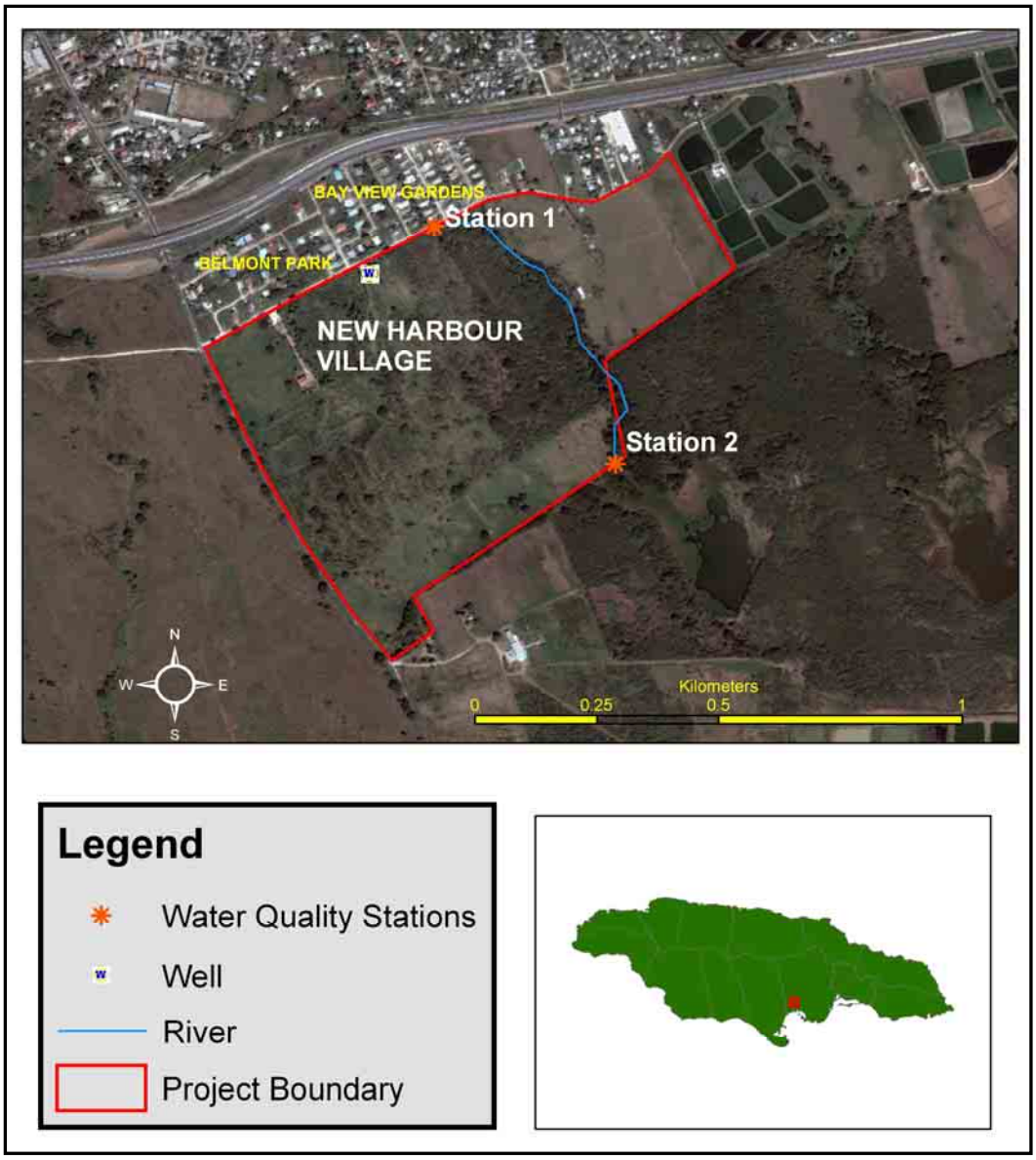
Calibration certificates are given in Appendix XI.

Ground water quality was analyzed by the Scientific Research Council in the well advanced by Hood Daniel Well Co. Ltd.

Table 4.2.8: Water Quality Stations for New Harbour Village

Station #	Station Location & Description
1	Northern boundary o the property where the unnamed gully enters the site
2	South-eastern boundary on the property where the unnamed gully exits the site
Well	Recently advanced well, on the north of the property, to the west of Station # 1.

Figure 4.2.8: Water Quality Stations



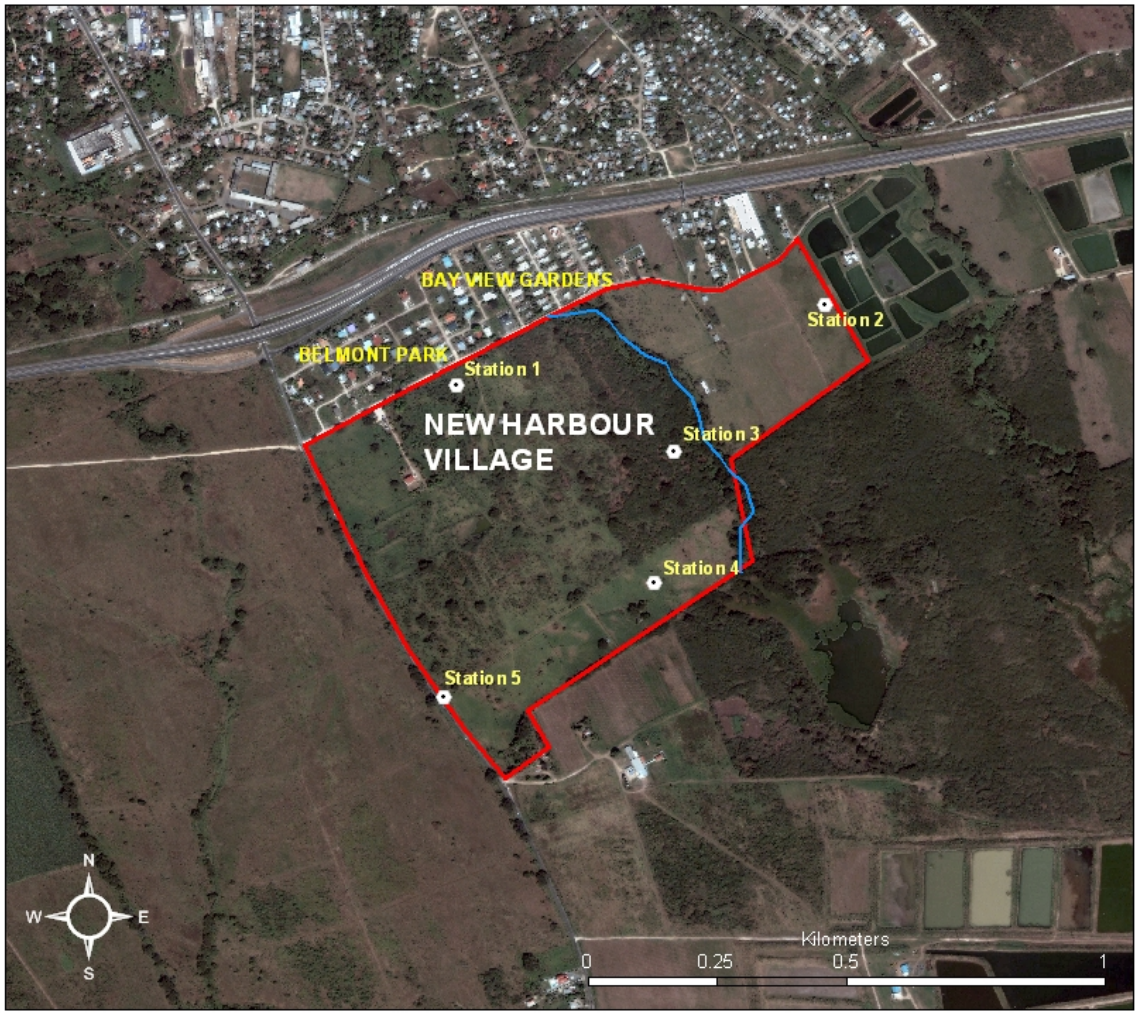
4.2.9 Pesticide Residues in Soil (Soil Toxicity Testing)

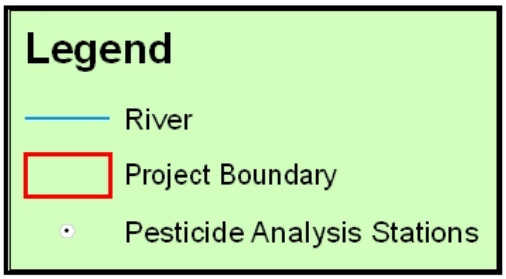
Randomised soil sampling and testing was conducted within the development area in order to determine levels of pesticide residues. Five sites were selected as shown in Table 4.2.9 and Figure 4.2.9. Five soil samples were collected using a hand augur to a depth of 0.5m. The samples were placed in opaque glass containers and taken to the Mona Institute of Applied Science Chemistry Laboratory at the University of the West Indies. Analysis was performed by Gas Chromatography - Mass Spectrometry.

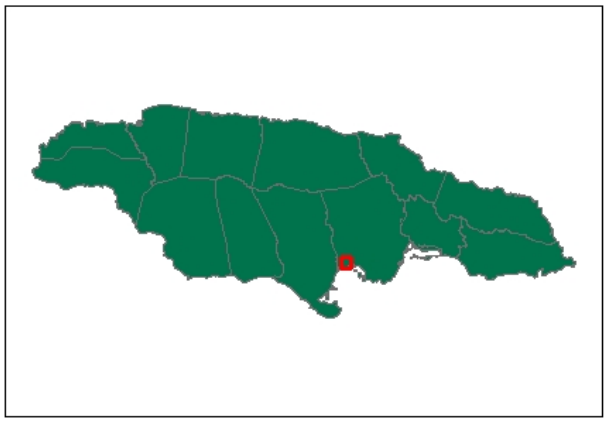
Table 4.2.9: Location of Soil Sampling Sites

Station Number	Station Location
Station 1	Adjacent to well
Station 2	Northeast of property at perimeter fence by fish farms
Station 3	Approximately 50 m from the un-named gully
Station 4	Near the southeastern perimeter approximately 30 m from perimeter fence with Brampton Farm
Station 5	On the southern section of the property

Figure 4.2.9: Sample Sites for Pesticide Residue in Soil







4.3 Biological Environment

4.3.1 Flora

Plants were identified along walking transects through trails on the property. Surveys of the flora were conducted from June 29 to July 4, 2006. Unidentified plant specimens were collected and taken to the University of the West Indies herbarium for identification.

4.3.2 Fauna

The surveys of the faunal groups on the proposed site for the New Harbour Village housing development were conducted from June 29 to July 4, 2006 and included both daytime and night-time surveys. Bird surveys included walking transects along trails on the property and six minute point counts at ten locations dispersed randomly across the property. Point counts were conducted between 5:45 a.m. and 9:00 a.m. in order to sample during the period of highest activity for the majority of bird species so as to maximize detectability. Additional fifteen minute counts were conducted at five sites located across the property between 7:00 p.m. and 8:30 p.m. in order to survey those birds which might be most active only at night. Observation of butterflies and other wildlife was also recorded.

4.3.3 Parks and Protected Areas

The situation of the project site within the Portland Bight Protected Area (PBPA) was identified. The assessment of the flora and fauna of the project site included an identification of any species of significance to the PBPA. The Caribbean Coastal Area Management Foundation (CCAM), the entity responsible for co-management of the park (along with NEPA) was contacted to advise them of the project and to determine if there were any issues they wanted to raise.

4.4 Socio-economic Environment

Rapid urban appraisal techniques were used in communities neighbouring the project and likely to be impacted by the project. The process involved windshield observations of the general project area, as well as structured and semi-structured interviews with approximately 90 respondents. The interview instrument is given in Appendix XII. Non structured interviews were also held with a number of key informants and members in community leadership.

Government agencies within the area were interviewed including the police, fire brigade, health centre and high school. Private sector enterprises were also interviewed including a variety of shops and a number of vendors. The list of persons interviewed is given in Appendix XIII.

The residential communities surveyed comprise a mix of middle, lower middle and low income housing stock, but the communities can be characterized as mainly middle and low income, with pockets of squatter elements.

Analysis of the socio-economic environment has focused mainly on land use, population and employment, community attitudes to the project, flooding and transport. These reflect the issues of interest in the human environment relating to the project.

4.4.1 Communities of Interest

The communities of interest were:

Old Harbour

Belmont Park	One of the three adjoining residential neighbourhoods
Bay View Gardens	Second of the three adjoining neighbourhoods
Sharpers Lane (East)	The third of the three adjoining residential neighbourhoods
Brampton Farms	The adjoining commercial farm to the south.
South Street	The community of business places and residences along the main thoroughfare linking the project to Old Harbour town center
Walkers Road	A road through a primarily residential are, linking South Street to Goldbourne Lane and Laffe Street, both used to circumvent traffic congestion on South Street.
Goldbourne Lane	A road through a primarily commercial area used to bypass South Street
Laffe Street	The more heavily used of both streets, which passes through a mainly residential community
Hart Street	Mainly residential and the main link between South Street and the large squatter community of "Schools Lane". Arguably the street that is most subject to congestion along South Street.
Vaz Street	One way west bound linking Old Harbour main street back to South Street and which runs immediately behind the police station.

Plate 4.4.1a: Houses in Belmont Park

Old Harbour Bay Main Road:

Comprising a cluster of 8 private homes just beyond the southern boundary of the project along the main road to Old Harbour Bay.

Old Harbour Bay:

New Road	At entrance to Old Harbour Bay and its closest community to the project
Terminal Road	One of two main arteries serving Old Harbour Bay, serving several residential communities and commercial activities and also the JPS Old Harbour Power Station.
Main Street	The main street into Old Harbour Bay and the fishing beach.
Settlement	A residential settlement lying east of Main Street
The Fishing Beach	A major zone of economic activity
Marine Lane & East Bay	Eastern most communities in Old Harbour Bay and contained by the Salt Gut to the north and Old Harbour Bay to the south

.

Plate 4.4.1b: The Main Fishing Beach in Old Harbour Bay

Collectively these communities and neighbourhoods define a zone within which immediate and cumulative project impacts will likely first be experienced. However, over time, impacts of the project will permeate well beyond this limited zone, particularly the employment and incomes generation effect. It is beyond the scope of this document to quantify fully the impacts, however some conclusions are drawn where these can be supported by data and judgment.

Only those communities and neighbourhood's with discernable and direct project impacts, are described and these communities and neighbourhoods are dealt with either concurrently or separately where this serves the purpose of limiting repetition.

4.4.2 Demographics and Livelihoods

Demographic data was sourced from STATIN.

4.4.3 Land Use and Zoning

The Highway 2000 Corridor Development Plan was reviewed to determine the suggested land use and zoning requirements. (PIOJ, 2004) Current land use and zoning was obtained by interviews, review of maps and aerial photographs, as well as from Ministerial and Agency communication to the developer.

4.4.4 Physical Infrastructure

Existing physical infrastructure on the site was determined and include the drain, the irrigation canal, the well, JPSCo lines and other utilities. Requirements for infrastructure for the project were also identified.

4.4.5 Traffic Pattern, Transportation and Access Roads

Information on traffic was obtained through interviews as well as assessment of the Traffic Impact Assessment (TIA) Report (Nicholson, July 2006) commissioned for this project.

4.4.6 Archaeological and Cultural Heritage

Data bases in the National Library were consulted to understand the historical context of the site. Preliminary discussions were held with Jamaica National Heritage Trust and a letter was also sent to the JNHT with a location map, formally advising them of the project and requesting information on any listing on the Sites and Monuments Record that may be relevant to the site (Appendix XIV). No written response was received from the JNHT but verbal communication with them indicated no listed heritage elements on the project property.

4.4.7 Public Consultation

The communities and more specifically the neighborhoods in which interviews were conducted are listed below. They were selected mainly because of general proximity to the project and the early identification of likely impacts that they would be exposed to.

Old Harbour Bay

Settlement	Main Street
New Road	The Fish Market
Terminal Road	Old Harbour Bay Main Road.

Old Harbour

South Street	Laffe Street
Walkers Road	Main Street
Goldbourne Lane	The Market

Bay View Gardens Belmont Park

Sharpers Lane

Additionally, the public consultation process included the serving of Public Notice #1, which appeared in the Daily Gleaner on Friday, August 4 (Appendix XIII). The Public Notice provided the public with notification of the proposed development and also invited the public to review and comment on the Terms of Reference for the EIA. Additionally, NEPA circulated the TOR's to stakeholders and sister agencies.

4.4.8 Consultations with Regional Health Authority/Medical Officer in St. Catherine Health Department

Discussions were held with the Chief Public Health Inspector at the Regional Health Authority/Medical Officer (Health) St. Catherine Health Department, in order to investigate the present and potential public health risks that may be associated with the development and the long term impact on community health status. The Chief Public Health Inspector reported that the only issue of concern for them at this time was effluent discharge from other entities. The Deputy Chief Public Health Inspector for St. Catherine visited the site on Wednesday September 20, 2006, with a team.

4.5 Prediction of Potential Impacts

The various aspects of the project and their potential impacts on the physical, biological or socio-economic environment, were identified and are presented in an Impact Matrix.

The selected aspects highlighted for consideration in depth were:

1) Loss of vegetation and loss or alteration of habitat for fauna
2) Drainage, especially with respect to existing natural drainage channels or man-made drainage/water features
3) Soil erosion potential due to vegetation clearance and impacts from rainfall events
4) Increased surface runoff, potential impacts on downstream communities and sediment loading

5) Natural hazard risk

6) Well water quality for potable supply.

7) Well water quantity as it relates to sustainable yield of groundwater resources

8) Public health and safety as it relates to cane field fires and/or agricultural pesticide use

9) The method level and location of the sewage treatment facility and the impact of its disposal on the environment, and required set back distances

10) Increase in traffic flow

11) Highway 2000 Corridor Plan and land use requirements

12) Cumulative impacts of this project along with other existing or planned developments

13) Other proposed developments

Impacts were identified as follows:

Duration:	short, medium or long term
Direction:	positive or negative
Magnitude:	major of minor
Type:	reversible or irreversible

Where applicable the impact of the existing environment on the proposed project has been discussed.

4.6 Limitations to the Study

Some limitations to the study were identified and are recorded here to ensure that there is complete understanding of the methodology used, the data generated and the application of impact prediction. These limitations are:

a. The comments made on storm water runoff and groundwater conditions are based on observations made at the time that site inspection was carried out or available documents reviewed. It should be noted that storm water runoff and ground water levels will vary owing to seasonal, tidal and weather related effects.

b. Water quality data was collected over a 3 day period during July. The period was relatively dry and so no rainy period data was collected.

c. Assessment of birds was conducted in the summer months and no information on species actually observed during the winter months was available. However reference is made to species likely to be found on the site in winter months based on historical data.

d. The estimates of stormwater run-off were prepared using the WIN TRSS Model (Hydrogeologist preference) and using the Rational Method (Engineer's preference). The difference in flow estimates were resolved using HEC RAS to assess the ability of the drain and available freeboard to convey the estimated flow, and so this limitation was compensated for.

5.0 The Existing Environment

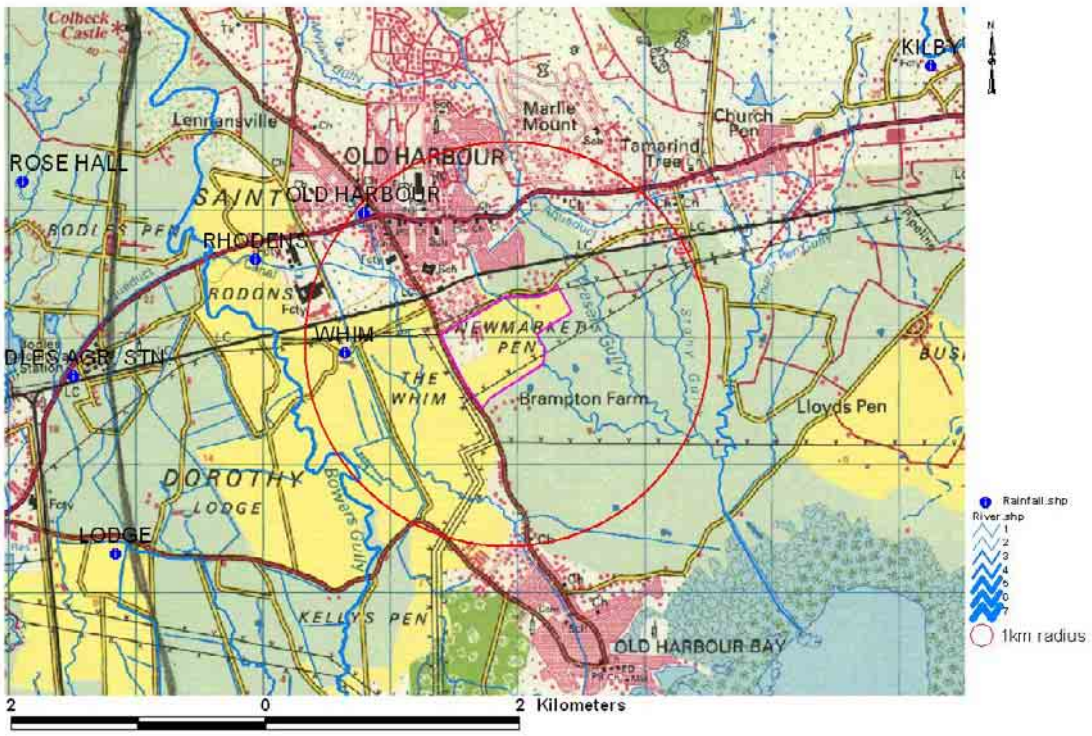
5.1 Physical Environment

Data sets for physical baseline assessments are given in Appendix XVI.

5.1.1 Site and Situation

The site (N17.9 ° W 77.1 °) is located off the southern exit ramp of Highway 2000 Toll Road and is accessed by a semi-paved road leading off the main Old Harbour Road to the Old Harbour Bay Road (Figure 5.1.1). The site is bound by the Belmont Park Subdivison to the north, aquaculture processing farms comprising fish and shrimp farming to the east and south, and by undeveloped feral lands to the west. The total site area is 52.44 ha. The site is for the most part undeveloped with only a few small concrete dwellings on the property.

Figure 5.1.1: Site location plan showing rainfall stations and watercourses within 1km buffer *(Source WRA)*



5.1.2 Climate

The meteorological station nearest to the study area is located at Old Harbour (E 237808) (N142991), approximately 2km north of the project site. Monthly mean maximum temperature at Bodles for the period 1987 - 2005, ranges from 18°C in the cooler months to 34°C in warmer months. Monthly mean minimum temperatures for the same period range from 16°C in February to 21°C in July.

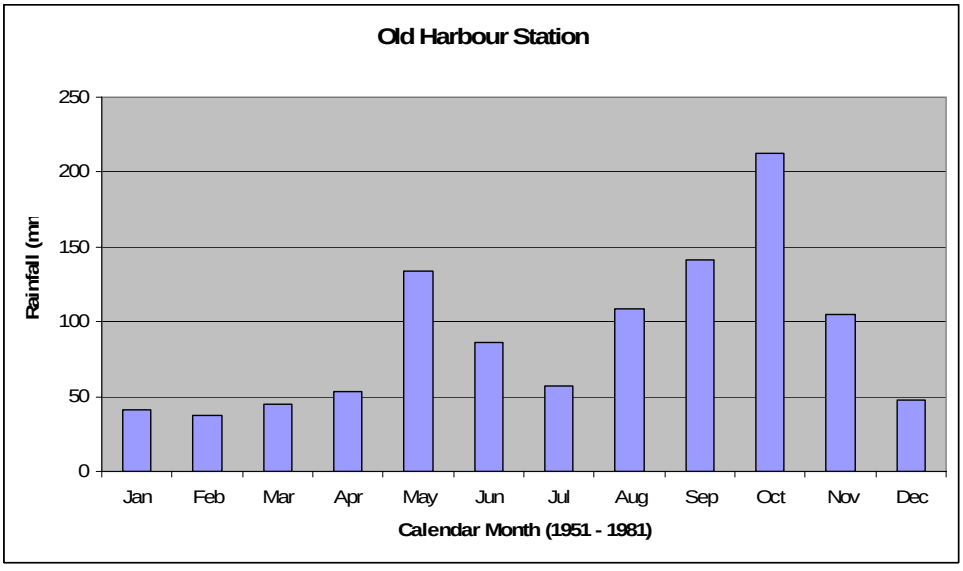
The Meteorological Service 30-year long-term mean monthly rainfall (1951-1981) for Old Harbour, St. Catherine ranges between 41 – 213 mm. 24-hour rainfall data was obtained from the Old Harbour station over the 48 year period 1937-1985 and is presented in Table 5.1.2 while the 30 year mean rainfall is shown in Figure 5.1.2.

Table 5.1.2: 24-hr rainfall intensity (obtained from the Met Office & WRA)

Exceedance Probability	100% (1yr return)	50% (2yr return)	20% (5yr return)	10% (10yr return)	4% (25yr return)	2% (50yr return)	1% (100yr return)
24-hr rainfall (mm) –	-	105	164	203	252	288	324

The rainfall stations and water course within a 1km radius is shown in Figrue 5.1.1.

Figure 5.1.2: 30 year mean rainfall in mm ***(Source: Jamaica Meteorological Services)***



The profile is bi-modal with a peak in May and again in October indicating two periods of heavier precipitation than generally occur across the parish. This is consistent with the regional precipitation events across Jamaica.

The mean daily evaporation for the Bodles Station ranges from 4.1 mm in January to 7.1 mm in July.

5.1.3 Topography

The site is located on the southern side of the Highway 2000 Toll Road on the St. Catherine Plains. The land is bisected by a natural drainage channel (gully) in the eastern section with the land on either side of the gully sloping generally towards it. The higher elevations are found along the northern boundary of the site at approximately 19m asl (62ft), falling some 8.5m asl (28 ft) along the southern boundary. Approximately two-thirds of the land has a general slope of 1(v) in 97(h) whilst the smaller third on the eastern side of the gully is comparable but slightly steeper at 1(v) in 91(h).

5.1.4 Geology and Hydrostratigraphy

Published geological information (Geological Map Sheet 20, 1:50,000 Imperial Series) indicates the oldest solid geology as Mid-Eocene Albert Town Member of the Yellow Limestone Group, followed by the Troy-Clarmenont Formation and the Newport Formation of the White Limestone Group. The overlying superficial Plio-Pleistocene deposits, in the vicinity of the site, comprise coarse gravels, sand and clay derived from the Rio Cobre River that historically discharged sediments onto the St. Catherine Plains. The Alluvium is reported as ranging in thickness from a few metres near the contact with the surrounding hills to several hundred metres in the central areas of the alluvial plain.

The soils map of St. Catherine (1:50,000 Series) obtained from the Ministry of Agriculture indicated that the site is underlain by Lodge Clay Loam (High Salinity Phase). It further indicates that the salinity within the soil increases with depth. A discussion on the origin of the salinity was not proffered but is likely the result of arid conditions in the paleo-climate that leads to the formation of saline evaporite deposits within the alluvial deposits.

Borehole records, encountered varying thickness of Alluvium overlying limestone. An intrusive investigation completed in March 2006 by Hill-Betty Engineering Ltd. (Titus, 2006) is summarized below and describes the upper lithological details of the Alluvium. None of these boreholes proved the solid limestone beneath the Alluvium. Groundwater was observed in seven of the seventeen boreholes at around 3.5- 6.3m bgl. The groundwater strikes were limited to the southern and eastern boundary. The water is more likely perched water within the upper alluvium and not part of the main aquifer, though it will eventually percolate downwards to the main aquifer.

Percolation tests done during the investigations report indicate an average flow rate of 8 cm/hr (0.0022 cm/s) which suggests a semi-pervious material (Bear 1972). This corresponds well with the St. Catherine soils map that classifies the drainage of the Lodge Clay loam as low to moderate.

Table 5.1.4: Typical Geological Profile
(Summarised from Hill-Betty Intrusive Soil Investigation, Titus , 2006)

DEPTH	GEOLOGY
0 – 3m	Very Stiff Clay with occasional sand pockets
3 – 6m	Sandy Silty Clay

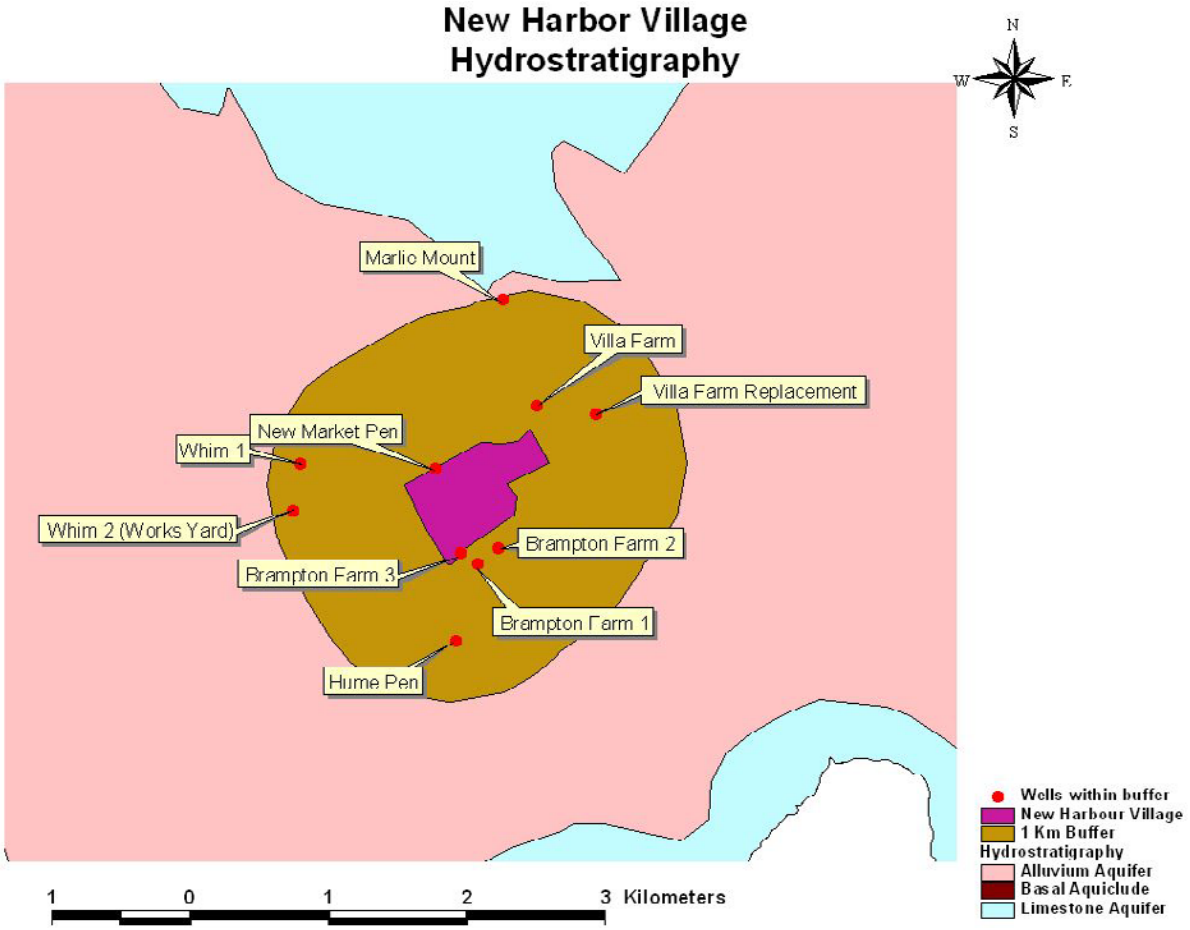
Deeper borehole records were obtained from historical well records and the recent well advanced by Hood-Daniel Well Co. Ltd in April – May 2006. The deep lithology encountered beneath the site is described as clay with occasional sandy deposits to 39m bgl and fragmented limestone to the final depth of 45.7m bgl. Groundwater was initially encountered at 8.5 m bgl but declined 11.9 m bgl to a standing level of 20.4 m bgl. This newer well was installed adjacent to an on site existing older well which was decommissioned due to poor structural integrity of the well casing. Limestone bedrock was not proved by this borehole. Appendix XVI presents all the well records held by the WRA within 1km of the site.

The WRA classifies both the solid geology and the superficial Alluvium deposits as aquifers.

Water abstractions are largely obtained from the alluvial deposits with the deeper limestone aquifer being tapped in areas where the alluvial deposits are absent or too thin to be viable sources.

WRA records indicate 11 abstraction wells located within 1 km of the site and the water use is recorded as irrigation, agriculture and cattle. Figure 5.1.4 shows the location of the well sites. Given the geometry of the site it is likely that principal groundwater flow direction will be south towards Old Harbour Bay. However, local variations may exist.

Figure 5.1.4: New Harbour Village Hydrostratigraphy Plan showing well with 1km buffer *(Source WRA)*



NB. 10 well locations are shown as the old well, now closed, and the recently advanced well on the project site are shown at one location, due to the scale of the map.

Data searches were undertaken through the WRA, NWC and ODPEM. In addition a web site search of the National Environment and Planning Agency (NEPA), the National Water Commission (NWC) and the Water Resources Authority (WRA) was undertaken to obtain relevant information. The results of the written searches are included in Appendix VII.

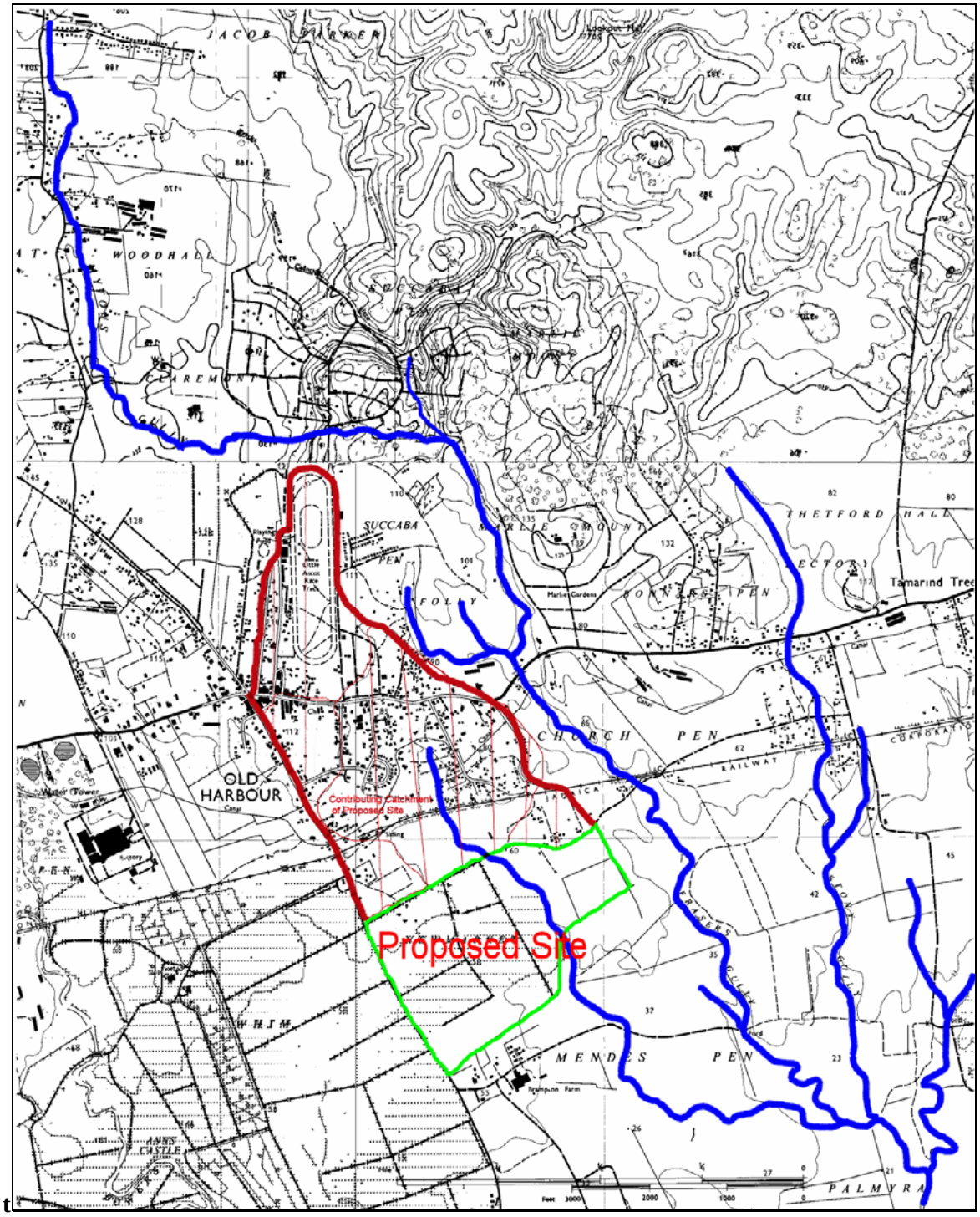
5.1.5 Hydrology and Hydrogeology

The nearest, named surface watercourse to the site is the Frasers Gully, which lies approximately 200m east of the site. On-site a tributary of the Frasers Gully traverses the northeastern third of the site. One other named watercourse – Stony Gully, associated with the drainage system that created the Fraser Gully and its tributary is located further east of the site. West of the site drainage is controlled by The Whim Estate natural drain. Though this drain does not discharge onto or near the subject site it provides significant control to runoff immediately west of the site including accepting water from the Old Harbour Bay main road. The Whim drain's impact on the site is not material and is therefore not further considered.

Historic water quality has not been established for these watercourses and hence no data is available. Water samples were collected for the un-named tributary during the EIA by ESL.

Neighbouring drainage channels, as well as the main drainage channel and the contributing upper catchment for the project site are shown in Figure 5.1.5.

Figure 5.1.5: New Harbour Village Contributing Upper Catchment



Class A pan evaporation data from the WRA indicate an average of 156 mm (6.1in)[i] for the Bernard Lodge site in the Rio Cobre hydrologic basin. Comparing the monthly average rainfall to the mean evaporation figures, only in two months of the year (September and October) does rainfall exceed evaporation. This results in dry to arid conditions at the site.

The natural unnamed gully that traverses the full width of the eastern third of the site is a tributary of the larger Frasers Gully and flows in a northwest to southeast direction towards Frasers Gully. The upper contributing catchment of this gully (approximately 56 ha) originates just north of the site (Figure 5.1.5) in the town of Old Harbour where it travels south-easterly through the Belmont Park Sub-Division. The gully beneath the parochial road that leads to Church Pen via several 1m diameter concrete box culvert before entering the northwestern boundary of the site.

During the site investigations debris comprising PET bottles and Styrofoam (Plate 5.1.5a) was seen blocking the drain's approach to the Church Pen road culvert. The considered upper contributing catchment clearly shows that the area being drained by the gully is separate and independent of that drained by the adjacent Frasers Gully and the Whim drain. Additionally, the culverts beneath the railway bridge and Highway 2000 both act as significant physical flow control structures within the catchment. A scoping analysis of the Highway 2000 box culvert suggest that flows limited to around 20 m^3/s are the maximum allowable through-flows without overtopping the culvert. Anecdotal information indicates that occasional flow restrictions occur behind both the railway and Highway 2000 bridge during significant precipitation events.

Plate 5.1.5a: General detritus, PET bottles and Styrofoam food containers blocking the inlet to the pipe culvert beneath the Church Pen parochial road *(photograph taken June 26, 2006)*

The main drainage system in the vicinity of the site comprises the Fraser and Church Pen Gullies, draining a catchment of approximately 20km^2 which extends northwards (deep) into Thetford Hall hills. It does not contribute materially to the site as is clearly evident by the natural drainage plan (Figure 5.1.5). Flows from this large catchment with a 4% chance of occurring in any one year have been reported at just under 100m^3/s[ii]. Given that this larger catchment does not impact materially on the site it is not considered further or incorporated within the drainage area contributing off-site runoff to the proposed development.

Standing water with very little thorough-flow (approximately flow velocity < 30 cm\s) was noted both on the northern and southern approaches to the circular culvert during the site visit (Plate 5.6b and c). Scoping calculations indicate a flow volume of <0.06 m³/s (<15 gal/s) based on flow velocities and drain dimensions on the northern approach to the circular culvert.

The natural gully continues, unpaved, through an overgrown, tree-lined, U-shaped channel approximately 1 m wide by < 0.5 m deep. The invert level of the gully is +15m at site entry and +10.5m on site egress following typical slope of 1(v) in 133(h) as measured on the site topographic plan. It continues offsite until its confluence with the other natural gullies approximately 1,370m southeast of the site and then ultimately discharges into the northwest corner of Galleon Harbour, (part of Portland Bight) via a maintained canal through the mangroves.

Plate 5.1.5b: - Southern discharge of pipe culvert in the road reservation adjacent to the property boundary *(Photograph taken June 26, 2006)*

The photo-reconnaissance identified three artificial wetlands southeast of the site which are the result of micro-damming of the Fraser's Gully and a tributary and the Stony Gully. The micro-dams are currently in poor condition and appear to be a mid-1970's construction as they are clearly absent from the 1973 survey map (Sheets 86c 1:12,500).

The closest constructed wetland is over 250 m south of the site and is established on an un-named tributary of Fraser's Gully that traverses the site. These micro-dams are unlikely to contribute to the overall site hydrology, but regionally they will act as temporary storage areas and polishing areas for surface runoff as evidenced by the artificial wetlands north of the dams.

Plate 5.1.5c: Distal end of artificial wetland (photograph taken just beneath the JPSCo power cables on June 26, 2006 looking generally to the south)

Discussions with local residents indicated that the gullies only carried water during precipitation events and that no flooding or ponding within the site has been experienced in the recent past. Given the close proximity of the distal end of the artificial wetland waters, which encroach onto the site at the southern end of the natural gully, it is more probable that some limited increase in the water level onto the lower reaches of the site is likely though not

significant. However, the design modifications that are being considered for the development include significant modification of the outflow path of the unnamed drain beyond the site boundary to ensure that flow continues unimpeded once it has gone off-site.

The closest proposed physical structure to the discharge point of the drain is the sewage treatment plant (STP). However, it is understood from the design engineers that the top of the STP will be 1.8m (6ft) above final grade. This will ensure that any inundation would have to be significant before it overtops any of the STP structures. Additionally, setback of the STP from the drain reserve also provides a buffer. The buffer is approximately 10m from the drain reserve at its closest approach but on average 20m from the drain reserve. However, it is necessary to point out that the closest structure is the final chlorination/discharge tank, which would have already received near tertiary treated water.

5.1.6 Sewerage Facilities

There is no record of a sewage treatment facility within 1000m of the site as held by the WRA. Currently on-site waste water treatment systems (soak-aways) located within the individual lots is the preferred method by which household sewage is dealt with in the immediate area.

Currently there is no central sewerage for existing developments in the area and each household is responsible for treating its own sewage. This is normally done via soak-away systems presumably with septic tanks. This is likely to be the current practice in the vicinity of the site for domestic sewage.

Several process industries ranging from hatchery to aquaculture exist immediately adjacent to the site. Given the high BOD and nutrient content of such industrial process wastes it would be reasonable to assume that more sophisticated effluent treatment systems have been implemented to treat the generated wastes. However, during site assessments an open and filled effluent drain line was noted (Plate 5.1.5b, Section 5.1.5). Visual and olfactory evidence suggest a significant nutrient content.

NEPA effluent discharge licences indicate that discharge consents are noted within the

immediate vicinity of the site. These are listed below:

Table 5.1.6: NEPA discharge consent within the immediate vicinity of the site

Identification and Location	Owner	Approval Date
Sewage Effluent at Hampton Meadows, Old Harbour	WIHCON	May 2003
Sewage Effluent at (Rhone Park) Charlemont Shaw Pastures	Marley and Plant	Dec. 2005
Trade Effluent at Spring Village	Jamaica Broilers	2002
Trade and Effluent Discharge at Old Harbour Bay	Jamaica Energy Partners	Renewal 2002/2003
Trade Effluent at Old Harbour Bay	Jamaica Energy Partners	Approved 2005/2006 (New)
Trade Effluent at Old Harbour Bay	JPSCo.	No stated date

The proposed housing development will be serviced by a dedicated sewage treatment plant (STP). The proposed STP will provide treated effluent discharge, which will meet NEPA requirements and will also require a separate environmental permit for construction and a license to discharge sewage effluent which will be directed to the unnamed watercourse at its egress from the site. Most package plants require electric power to operate and all will require regular maintenance and de-sludging in accordance with the manufacturer's instructions in order to ensure that the system operates effectively and the effluent complies with the consent conditions.

5.1.7 Stormwater Runoff Calculations

Although daily rainfall data actually recorded were available, these records are not immediately useful for determining peak flows from watersheds with times of concentration considerably less than 24 hours. The estimated times of concentration (T_c) of the contributing watershed is approximately 41 minutes (0.68 hrs). The Engineer's Drainage Report (Foreman Chung and Sykes (2006a) calculated times of concentration comparable to this. The calculated T_c times fall within the limitation criteria for the use of TR-55 which ranges between 0.1 and 10 hours.

It is therefore necessary to know how the daily rainfall had been distributed over the 24 hours and perhaps divide this daily rainfall into smaller storms having durations that match the estimated times of concentration. Had information been obtained for several storms from an automatic continuous rainfall recorder, then their records could have been used for determining the temporal distribution pattern of daily rainfall. In the absence of such records, use was made of the standard curves produced by the Soils Conservation Service of the United States. These curves have been derived from a very long database of rainfall measured continuously over 6-minute intervals for gauges scattered throughout the United States and are quite robust. Even though these curves should strictly be applied within the regions for which they have been developed, these curves have been applied in areas far removed from the United States with much success. More often than not, the research has found that the local temporal distributions fitted closely one of the standard curves; however, which one of the curves is most suitable needs to be determined.

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

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

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

The time of concentrations were determined for the Fairy Hill watershed using the sheet flow formula (below), shallow concentrated flow and open channel flow:

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

where, T_t = travel time (hr), n = Manning roughness coefficient (for sheet flow), L = flow length (m), P_2 = 2-year, 24-hour rainfall (mm), and s = slope of hydraulic grade line (land slope, m/m). Both shallow concentrated flow and open channel flow use similar equations. For determining the storm runoff in Jamaica the 24-hour, 25-year return period storm is normally accepted as the design flow period. However, instead of return period, it is more accurate to think in terms of the exceedance probability (*p*), where *p*=1/T. Thus, a "25 year storm" actually designates a rainfall event which has a 4% chance of occurring in any given year.

5.1.8 Pre-Development Stormwater Runoff

The upper contributing catchment is delineated in Figure 5.1.5 (Section 5.1.5). The catchment outline is approximately 105ha, and the proposed site is an additional 54ha bringing the total catchment to just under 160ha. The Ministry of Agriculture's soil map indicate that the site soils comprise a moderate draining clay loam. The land use of the area to the north is mostly urban.

The total storm runoff due to the catchment for a storm with a 4% chance of occurring in any one year is approximately 51 m^3/s. Given that the outlet from the upper catchment is concentrated at a single discharge point – the Old Harbour drains and ultimately to the unnamed gully, it is unlikely that any other storm runoff that will impact materially on the project site. Given that no site flooding has been recorded in recent memory and that the natural gully will be upgraded to a concrete drain reserve it is unlikely that storm runoff will impact the proposed site negatively once the drains are adequately sized.

The existing pipe culvert at Christine Way that takes the storm runoff onto the site will be replaced by a 3.6m wide by 1.5m high culvert, as the current culvert is clearly inadequate. The inadequacy is due to both capacity and debris. Plate 5.1.8a shows debris overtopping its northern entrance the upgrade will beneficially impact the site and the adjacent residents. The

90° on the approach will also need to be softened to ensure that a smooth curve is achieved to reduce overtopping.

Plate 5.1.8a: General detritus, PET bottle and Styrofoam food carrier blocking the inlet to the pipe culvert beneath the Church Pen parochial road *(Photography taken June 26, 2006)*

Of some note is the irrigation canal that comes onto the site at around proposed Lot 633 via a cistern. There is clear evidence of localized flooding immediately off-site before the canal comes on-site. Plate 5.1.8b clearly shows the installation of an impromptu drain immediately east of the irrigation canal. This relief drain was presumably constructed by the community residents to alleviate historical localized flooding on the road.

Plate 5.1.8b: Manually excavated relief drain (foreground) adjacent to the National Irrigation Commission Canal *(Photograph taken June 26, 2006)*

However, it is unclear whether it floods after heavy precipitation events or whenever the canal is flooded to provide pond water for the adjacent fish ponds. Given the balance of the evidence the latter is more likely. Debris was noted within the approaches of the canal along with evidence of improper cleaning as the retrieved debris was deposited <10cm from the edge of the canal. It is likely that this flooding will persist as long as the fish farm requests water from

the National Irrigation Commission (NIC), through the canal.

The canal reach that supplies the fish farm is just inside the site property boundary. Given that irrigation water is supplied to the fish farms periodically it would be prudent to ensure that a buffer zone is demarcated around the canal. Investigations have led to two options - the relocation of the canal or splintering the land from the developer's property.

5.1.9 Post-development Stormwater Runoff

For post development stormwater runoff land use determinations were interpreted from the New Harbour Village Sub-division plan and updated in the model. All other landuse remained unchanged. The table below presents the modified, lumped land-use.

Table 5.1.9 a: Proposed (Lumped) Landuse

Proposed (Lumped) Landuse	% of total catchment
Impervious areas (roads, roofs, parking etc)	49
Grassed areas (lawns, open green space etc)	23
Commercial & Business Urban Districts	28

Post-development the predicted runoff with a 4% chance of occurring in any given year is estimated to be 54.5 m^3/s.

Table 5.1.9 b: Pre & Post Development Stormwater Runoff

Site Catchment Area	Stormwater Runoff with a 4% exceedance probability
Pre-development (i.e. existing landuse)	51 m^3/s
Post-development (i.e. proposed landuse)	~55 m^3/s
Increase above existing	4 m^3/s
Percentage increase above existing	7.8% increase

It is a widely accepted best practice to compare this predicted post-development run-off to the pre-development predicted runoff with a 2% chance of occurring in any given year (i.e. 50 yr return) which is predicted to be 58.8 m^3/s. Both runoff figures are generally equivalent

suggesting that the post-development runoff will not be significantly different.

It should also be borne in mind that the box culvert at Highway 2000, which acts as a physical flow control, limits this upper catchment in-flow to approximately 20 m^3/s. If this considered the realizeable pre-development flows then the practical increase will be 24 m^3/s.

Although the post-development runoff is larger then the pre-development figures it is unlikely that the proposed development will impact significantly on the overall catchment runoff given the orifice control of the Highway 2000 culvert.

Appendix VIII presents the complete WinTR-55 reports used.

5.1.10 Existing and Projected Water Demand

Water is currently obtained from both the Succabba Pen and Bowers Pen water supply systems. The major land use in the immediate vicinity of the project site is farming and individual abstraction wells are the preferred means of obtaining potable water. At the site the now decommissioned well provided all the domestic and agricultural water needs for the previous owner. Current supply for the proposed development will be met by the recently advanced alluvial groundwater well.

Using typical daily water usage per household (assuming 4 persons per 845 lots) the annual water demand is presented below:

Table 5.1.10: Projected Annual Water Demand For New Harbour Village

Area	Projected Water Demand (m^3/yr)	Number of Persons
New Harbour Village	202,680	3,380

The soon to be superseded 1990 Water Resources Development Master Plan lists the total domestic demand in the hydrological basin at 24.2 Mm^3/yr, and in 2015 the projected domestic demand is 27.9 Mm^3/yr. As this is a global parish-wide demand it is probable that the calculated projected demand may not have been incorporated within any of the above demand

figures as the site may not have been considered for development at the time of the projections.

Nevertheless, given that supply will be sought from on-site abstraction, water demand shortfall is not a material impact at the site. The annual projected water demand equates to approximately 0.4 m^3/min (or just over 100 GPM) and this can be substantively supplied by the new abstraction well as the wells in the vicinity abstract up to 1100 USGPM, and the WRA licenced abstraction quantity for the New Market Pen well is 2,400 m^3/day (440 US GPM). This permitted amount will be sufficient for the site for the foreseeable future with the ability to provide future resource expansion.

5.1.11 Sediment Loading

Sediment loading of the watercourse is a possibility at any construction site as large tracts of land will be cleared of vegetation. Proper house-keeping must be exercised. Post development very little if any sediment will be mobilized from the site into the watercourse. However, during construction, conditions may exist that could cause sediment pollution of the water course if precautionary engineering measures (such as cut-off trenches, etc) are not an integral part of the construction environmental plan. If good construction practice is exercised the risk will be minimized. Some site disturbance will be inevitable during the development of the drain reserve but this will be short-term and be subject to various precautionary engineering practices as outlined above. Overall the sediment impact will be temporary and a natural consequence of upgrading the site. Precautionary engineering measures will reduce this to negligible. Long term sediment loading from the site will be minimal and not impact the site negatively.

5.1.12 Pollution Incidents

No groundwater or surface water pollution incidents have been recorded within 1000m (1km radius) of the site by the WRA.

5.1.13 Water Quality

5.1.13.1 Surface Water Quality

An understanding of the factors that affect the quality of both surface and ground water will aid developers and regulators to effectively implement water-quality mitigation and management strategies. The proposed New Harbour Housing Development is sited in a mixed residential/commercial area on the outskirts of the town of Old Harbour. Wastewater generated by the commercial properties as well as domestic flows in the immediate project area, and from Old Harbour discharges to the storm water drainage channels. These discharges significantly influence the water quality in the area, both directly and indirectly.

The results of the water quality sampling exercise conducted on June 22 and July 4, 2006 are presented at Table 5.1.13.1 below.

Table 5.1.13.1: Water Quality Data for New Harbour Village, June 22 and July 4 2006.

PARAMETERS	SAMPLES				NEPA Standards	
	Station 1		Station 2		TRADE EFFLUENT	SEWAGE EFFLUENT
	22/6/06	04/07/06	22/6/06	04/07/06		
pH (Units)	7.0	7.8	6.9	7.7	6.5-8.5	6-9
Conductivity (mS/cm)	1.23	1.39	0.62	0.76	0.15-0.60*	-
Dissolved Oxygen (mg/L)	0.23	0.58	0.46	0.48	>4.0	-
BOD (mg/L)	11.0	54.0	46.0	18.0	30.0	20.0
Nitrate (mg/L)	20.2	4.8	18.5	5.3	5.0	10.0
TSS (mg/L)	30.0	7.3	79.0	3.7	150 MAX for a day & 50 for 30 day avg	20.0
Chloride (mg/L)	129.2	151.8	52.1	84.4	300.0	-
Sulphate (mg/L)	22.0	7.0	14.0	9.0	250.	-
Phosphate (mg/L)	1.75	0.65	1.25	0.63	5.0	4.0
Oil & Grease (mg/L)	1.6	1.2	1.7	1.6	10.0	-
Total Coliform (MPN/100ml)	>2400	>2400	>2400	>2400	<1000	-
Faecal Coliform (MPN/100ml)	>2400	>2400	>2400	1100.0	<100	1000.0
Copper (µg/L)	<10	<10	<10	<10	100.0	-
Manganese (µg/L)	140.0	163.0	<20	<20	1000.0	-
Lead (µg/L)	<20	<20	<20	<20	100.0	-
Zinc (µg/L)	<10	<20	<10	<10	1500.0	-

A discussion of the variation of the critical parameters follows, based on data generated from two sampling exercises

- **pH and conductivity**

The pH levels indicate that the waters are within the neutral range of the pH scale. The conductivity recorded for Station 1 is high, approximately doubling the national Trade Effluent guideline. A marked decrease is observed downstream at Station 2, falling to within compliance levels.

- **Dissolved Oxygen (DO) and Biochemical Oxygen Demand (BOD)**

The water in the drainage channel is anoxic, having low dissolved oxygen levels and a high oxygen demand. It has a foul odour with a grayish white colour. Both BOD and DO levels are significantly out of compliance levels.

- **Total and Faecal Coliform**

Total and faecal coliforms are used as indicators of pathogenic organisms and by extension pollution. Coliform bacterial levels are considerably elevated suggesting that in addition to trade effluent, sewage may well be discharged to the drain. The high coliform levels coupled with the high oxygen demand suggest a high organic loading to the drain.

- **Total Suspended Solids (TSS)**

Total suspended solids are elevated throughout the system, higher than both the national sewage and trade effluent (average monthly) TSS standard.

- **Total Dissolved Solids (TDS)**

A review of the well data analyzed by the Bureau of Standards is presented in Section 5.1.13.2. The results show that TDS exceeds the standard and this will result in a salty taste to the water

- **Nitrate and Phosphate**

Nitrate and phosphate levels are also quite high and typical of municipal effluent.

- **Metals**

The concentration of copper, lead and zinc were at or just above detection levels. Station 1 had significant manganese levels; the concentration is however still within compliance levels. This is also consistent with the nature of the wastewater (high organic loads).

- **Oil and Grease, Sulphate and Chloride**

Oil and grease, sulphate and chloride levels were all within compliance levels.

Summary

The quality of the water in the drainage channel is quite poor, suggesting that the trade effluent from the commercial properties are likely not compliant with the national guideline. The accumulated effect of the poor water quality in the drainage channels could have a negative impact on the coastal zone to which they discharge. The existing water quality conditions, associated odours and discoloured water may be a negative impact on the proposed housing sub-division.

5.1.13.2 Ground Water Quality

Abstraction from a well recently advanced on the site will provide over 760 liters/minute of groundwater to the site. Water quality data obtained from the Scientific Research Council by Hood-Daniel 2006 is summarized below:

Table 5.1.13.2: Water Quality Data *(Source Scientific Research Council)*

Parameter	Date of Analysis	Value	JNDWS[1]
Chloride	19/5/2006	261	250
Total Coliform (MPN/100mL)		<3	-
Faecal Coliform (MPN/100mL)		<3	-
Ammonical Nitrogen		Non-detect	-
Total Hardness	22/5/2006	441	-
Total Dissolved Solids	30/5/2006	921	500
Na		176.36	-
Ca		118.56	200
Mg		32.31	-
K		2.32	-
Fe		<0.01	0.30
Mn		<0.03	0.05

Parameter	Date of Analysis	Value	JNDWS[1]
SO_4	19/5/2006	69	250
NO_3		11.88	45
Conductivity		1400	-
BOD		0.15	-

[1]Jamaican National Drinking Water Standards
All units expressed as mg/l unless otherwise stated.

The results indicate that the untreated groundwater quality is acceptable with the slight exception of chloride and TDS which show an exceedance of their respective standards. Chlorides normally give water a salty taste. At what concentrations this becomes noticeable depends upon the individual. In large concentrations chlorides cause a brackish, briny taste that definitely is undesirable. Although chlorides are extremely soluble, they possess marked stability. This enables them to resist change and to remain fairly constant in water unless the supply is altered by dilution or by industrial or human wastes. TDS on the other hand is that portion of solids in water that can pass through a 2 micron filter. The more minerals dissolved into the water the higher the total dissolved solids. Waters with high dissolved solids are generally of inferior palatability. However, the water within the older well has been used as potable supply by the site's previous occupants without complaint. The JNDWS chloride value is exceeded by 4%.

5.1.13.3 Potable Water Quality

It is proposed that the potable water supply will be obtained from the well sited on the project site. A set of water quality studies were conducted by the Scientific Research Council, after the new well was advanced by Hood Daniel Well Company to characterize the quality of source waters. The results are presented in Appendix XI.

The data show that nitrate and faecal coliform bacterial levels are low and within the World Health Organisation (WHO) drinking water standards, 50 ppm and 0 mpn, respectively. Total coliform bacterial levels are higher than the drinking water standard.

Chloride levels are consistently higher than the standard (250 ppm) while sodium levels exceeded the standard (200 ppm) thrice in five sampling exercises. Chloride levels are not significantly higher than the standard but with additional abstraction from the well to satisfy

the project demands these levels could increase further. Sodium levels when elevated exceeded the standard by approximately thirty five percent. Similarly as for chloride with increased abstraction these levels may well increase.

Total dissolved solids levels (921 ppm) are just inside the WHO standard of 1000ppm. This was a one off sampling exercise for this parameter and on that sampling exercise sodium levels were within the sodium standard. The data suggests that on those occasions when sodium levels were significantly elevated that it is likely that TDS levels could be higher than the standard.

The water requires treatment before achieving potable quality.

5.1.14 Noise

The noise measurements recorded for the present study are presented below.

Table 5.1.14: Noise measurements conducted at the New Harbour Project Site, July 5, 2006

Sites	Location	Results Noise Db	Comments	NEPA Guide Line
N1	Middle of perimeter fence approximately 10M from the entrance of Christine Way (North of property)	51.6	Low traffic flow on Highway 2000, situated approximately 80m from the entrance of Christine Way. No traffic on the parochial road.	75.0
N2	Middle of East perimeter fence	51.6	Moderate traffic flow on Highway 2000, approximately 200m north of the sampling site	
N3	Middle of perimeter fence shared with Brompton Farms (South of property)	51.6	Approximately 150m from the sampling site a tractor was being loaded onto a truck at Brampton Farm	
N4	Middle of perimeter fence parallel to Old Harbour main road	51.6 & 80.5	51.6dB when there was no traffic flow and 80.5dB when there was moderate traffic on Old Harbour Bay main road	

The noise levels recorded at the stations selected are currently within the NEPA guidelines for perimeter noise. Only one station had noise levels above the standard, due largely to traffic related noise on the Old Harbour Bay road.

5.1.15 Air Quality

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

The particulates of concern are those small enough to be respired directly into the lungs, those with internal diameter less than 10 microns.

Particulates do not remain airborne but are generally deposited. The rate of deposition depends upon the size and density of the particle as well as atmospheric conditions.

The ambient air quality data generated for the present study are presented in Table 5.1.15.

Table 5.1.15: Ambient Respirable Air Quality Data for the New Harbour Village Development Site, June 22 and July 4, 2006

Location	Results extrapolated to 24 hrs/$\mu g/m^3$	NEPA 24 Hr Guide Line $\mu g/m^3$
AQ1	4.7	150
AQ2	13.4	

Conditions on the site on the day the samples were taken were fair with light winds. Respirable particulates levels as shown in the table above were well within the recommended ambient air quality PM10 guidelines established by NEPA.

5.1.16 Soil Testing

The results of the pesticide residue analyses conducted on the New Harbour Village soil samples revealed the absence of pesticide residues in all five samples. The results of the randomized soil testing are given in Table 5.1.16.

Table 5.1.16: Results of Pesticide Analysis conducted on New Harbour Village Soil Samples

SAMPLE CODES	TESTS		RESULTS
	Type	Date	Screening for Organophosphates & Organochlorates Pesticide Residues
MESS0008 NH 1	GC-MS Analysis	14/09/06	A.O.R.
MESS0009 NH 2	GC-MS Analysis	14/09/06	A.O.R.
MESS0010 NH 3	GC-MS Analysis	14/09/06	A.O.R.
MESS0011 NH 4	GC-MS Analysis	14/09/06	A.O.R.
MESS0012 NH 5	GC-MS Analysis	14/09/06	A.O.R.

A.O.R. - Chromatogram indicated an absence of residues

5.1.17 Natural Hazards

5.1.17.1 Flooding

This section describes the natural hazard exposure of the site. Drainage evaluation and design criteria have taken account of potential change in run-off characteristics and of watershed/catchment conditions. The probability of flooding is low.

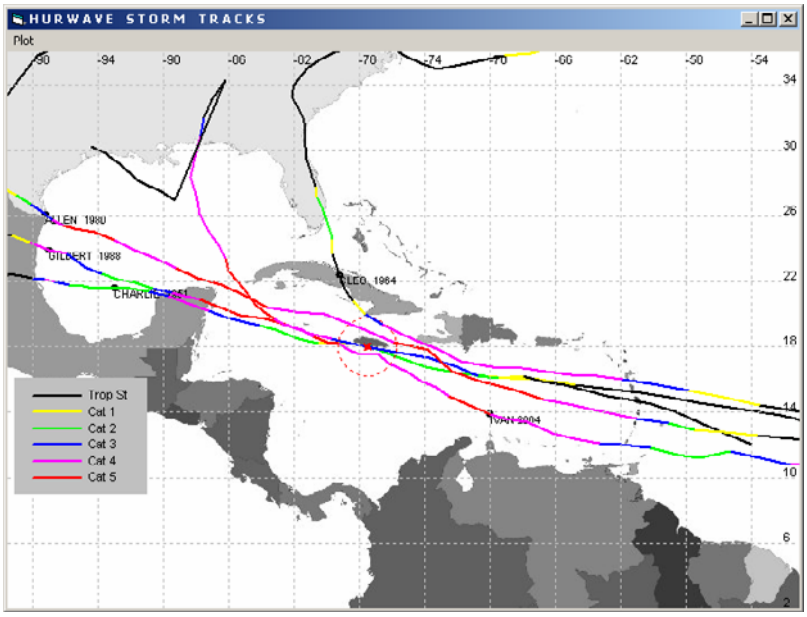
The WRA has no reports of any flooding incidents within a 1km radius of the site.

Data obtained from the ODPEM Disaster Catalogue (Appendix IX) revealed no reported cases of the Brampton Farm or New Market Pen area being affected by flooding. However, incidents in the catalogue are mostly flooding in communities. Given that the site prior to the development was pasture land reports of flooding would not have been recorded.

5.1.17.2 Hurricanes

Jamaica is susceptible to hurricanes and other storm events as indicated by the historic hurricane tracks (Figure 5.1.17.2). The rainy season is from May to October, with peaks in May and October, and tropical depressions, storms and hurricanes can occur any time during this period. These systems usually bring large volumes of rain with or without flash floods, slow inundation and high winds.

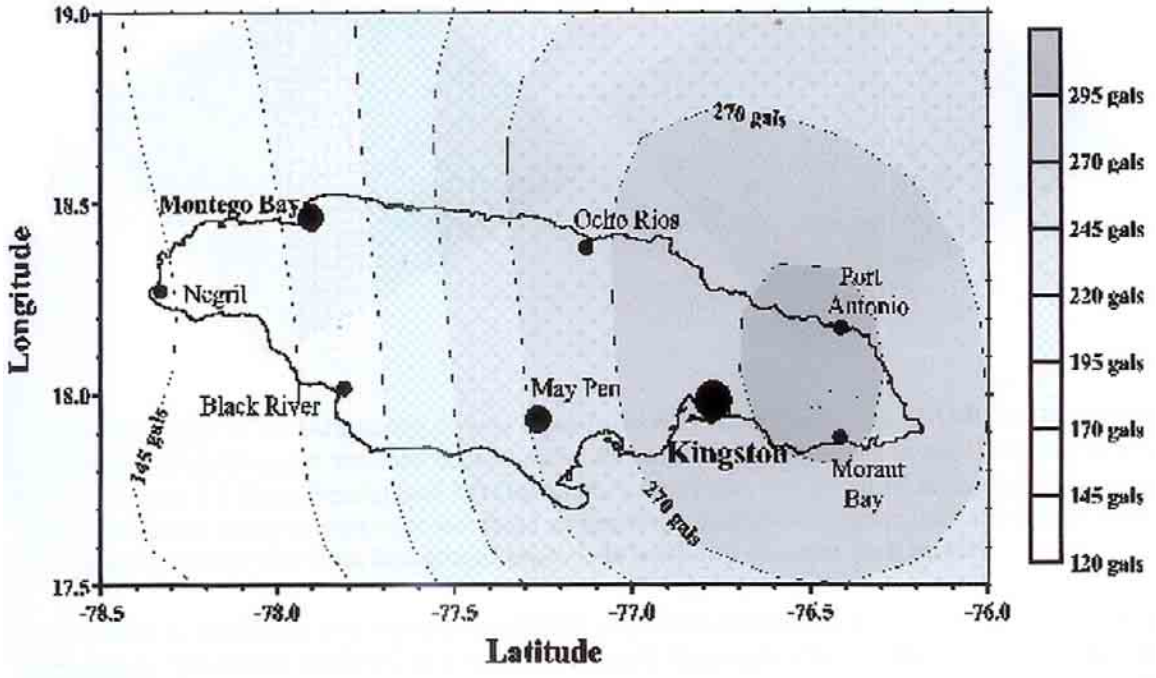
Figure 5.1.17.2: Historic Hurricane Tracks Across Jamaica – 1880-1988



5.1.17.3 Earthquakes

The main effect from earthquakes on land is the impact of ground shaking on structures. The impact on buildings in turn depends on the nature of the soils at the site and the design of the building. In general high rise buildings are more vulnerable to ground shaking than low rise buildings. The potential for earthquake related ground shaking throughout Jamaica was studied by Shephard, 1997. Figure 5.1.17.3 shows the range of peak horizontal ground acceleration that can be expected across Jamaica.

Figure 5.1.17.3: Expected Peak Horizontal Ground Acceleration (Source: Shephard, *et al*, 1997)



5.1.17.4 Landslides & Erosion

Not applicable to site.

5.1.17.5 Ground Water or Surface Water Pollution

No ground water or surface water pollution incidents are recorded within 100m of the site by the WRA.

5.2 Biological Environment

Data sets for biological baseline assessed are given in Appendix XVII.

5.2.1 Flora and Habitats

The project site is highly disturbed and does not have natural habitat zones or zonation. There are two main types of habitat, the less disturbed corridor around the stream which is dominated by mature trees typical of secondary growth in this climate and soil. These include Guango and Bastard Cedar (*Guazuma ulmifolia*). The surrounding properties are also highly disturbed and

do not therefore provide an easy source for recolonisation of the site with native flora. This in turn is a main limiting factor to the diversity of the fauna such that even though the site has been left relatively undisturbed for several of years the diversity is very limited.

5.2.1.1 Abandoned pasture

The abandoned pastures are dominated by African Star grass which was cultivated for cattle grazing with a few scattered mature trees and shrubs, mostly Guango and Cashaw (*Prosopis juliflora*). The open grassland nature of the habitat supports a limited number of birds such as seedeaters like Grassquits (Yellow-faced and Black-faced) and Grasshoppers Sparrows. The (*Ammodramus savannarum*) is an endemic sub-species that is particularly abundant on the site and in the surrounding habitats.

Plate 5.2.1.: Grasshopper Sparrow

5.2.1.2 Secondary Woodland

The woodland along the banks of the stream is dominated by only three species. The Guango tree, Bastard Cedar and Cashew tree provides the majority of the canopy with several large mango trees scattered among them. The grass was not well developed there and many of the other weeds and shrubs were to be found here as well as along the periphery of the property and along internal paths and roads.

There were no threatened or endangered plants on the site.

Plate 5.2.1.2a: Typical abandoned pasture and secondary woodland

Plate 5.2.1.2b: Typical ruinate pasture and woodland

5.2.1.3 Stream Flora

Due to pollution (as indicated by its very strong mal odour) the water was very dark and could not support aquatic plants (Plate 5.2.1.3)

Plate 5.2.1.3: Entry point of inflows to gully

5.2.2 Fauna

5.2.2.1 Birds

A total of thirty six (36) different species of birds were observed during the four field visits. This represents a fraction of the possible species known to occur in nearby habitats but is a consequence of the highly disturbed nature of the property and its environs. Although several other species that were expected to occur there were not detected in the survey (because of various factors such as variation in seasonal abundance, naturally low density, low detectability during survey times) the overall abundance and diversity of birds was low. No rare and threatened species would be expected to occur on the site.

Several waterbird species were detected during the counts and these were present because of the proximity of the aquaculture ponds and the Micro Dam located on neighbouring properties. These birds were therefore encountered as they were passing through the site or because they were identified by their call which could be heard from sampling points on the project site.

Endemic species

Only three of Jamaica's 28 extant endemic bird species was observed - including Jamaican Woodpecker (*Melanerpes radiolatus)*, Red billed Streamertail Hummingbird (*Trochilus polytmus*) and the Jamaican Mango Hummingbird (*Anthracothorax mango*). Some common endemics such as the Sad Flycatcher (*Myarchus barbirostris)* and Jamaican Tody (*Todus todus*) were not found on the site and none of the rare or forest dependent endemics were present. This is the result of the highly disturbed nature of the site and its environs.

Migrants

Neo-tropical migratory birds account for nearly half the total number of bird species occurring in Jamaica. This survey was conducted during the summer months when all such species are on the northern breeding grounds. This means that there are several potential species which regularly occur on the site that could not definitively be represented in this report. However, a list of the most likely migrants that can be expected to utilize the site based on knowledge of typical prevalence of these species in comparable habitat is presented. This list is presented along with the other species lists and most of these migrant species would be warblers that would be expected to be present mainly in the wooded areas. Common species on that list include the American Redstart (*Setophaga ruticilla),* Prairie Warbler (*Dendroica discolor)* and Palm Warbler (*Dendroica palmarum).* A migrant duck species such as the Blue-winged Teal (*Anas discors)* may occasionally be observed because of the proximity of the fish ponds and micro dam but are unlikely to occur in the stream on the site. The Northern Waterthrush *(Seiurus noveboracensis*) or Louisiana Waterthrush (*Seiurus motacilla)* may be expected to occur along the banks of the stream.

Nocturnal birds

Those surveys conducted at dusk and dawn identified several Barn Owls (*Tyto alba*) at various locations on the site. The birds were seen mostly in and around the large trees near old buildings. This could be because this species is better able to hunt for its preferred prey (small rats and mice) in more open territory and can retreat to the safety of some of the larger mango trees found around these buildings. Other nocturnal birds included the Antillean Nighthawk (*Chordeiles gundlachii*) which was heard near to the site. No Jamaican Owls were detected in the area although they might utilize the site in low numbers. The only other night bird was the Black-crowned Night Heron (*Nycticorax nycticorax)* which could be heard calling from the direction of the micro dam.

5.2.2.2 Butterflies

A total of eighteen species of butterflies were identified on the site. Some of those species observed were too small to be positively identified to species level but have been represented by the likely genus. Several of the smaller species were observed on the open grasslands (such

as the Skippers and the blues), but the overwhelming majority of the butterflies were encountered in the heavily wooded area along the stream. All the species were common and most were typical of disturbed open habitats. None are known to be range restricted or threatened in Jamaica.

Plate 5.2.2.2: Jamaica Long Tailed Skipper

5.2.2.3 Reptiles

The only reptiles observed were anolis lizards in the trees and a few geckoes which were heard during the evening surveys. These anolis lizards are endemic but are very common island-wide and a population of lizards is expected to remain in the gardens and landscaping on the site after the development. Pond Turtles (*Pseudemys terrapin)* are likely to occur in one or more of the ponds adjacent to the site and might be expected to wander through the area particularly during periods of heavy rainfall.

The ponds are reported to be inhabited by crocodiles (*Crocodylus acutus*) which is a locally and globally threatened species and protected by national and international laws. Although crocodiles have been reported from the lower reaches of the gully, the previous owners and the caretaker have no record of sighting any crocodiles in the gully on the project site. However the potential for them to wander further upstream should be noted.

5.2.2.4 Mammals

The only mammal observed on the site was a rat. The small indian mongoose (*Herpestes javanicus)* was not observed but is likely to be present. Only one bat which was unidentified was observed during the night surveys on the site.

5.2.2.5 Amphibians

The only frog observed on the site was the introduced species, the cane toad, *(Bufo marinius).*

5.2.2.6 Fish

Despite the absence of vegetation at least two species of mosquito fish *(Gambusia sp)* and probably the endemic Black-bellied Limnia *(Limnia melanogaster),* as well as Tilapia *(Tilapia sp)* were observed in the stream. No information is available about the seasonal occurrence of anadromous fish such as eels *(Anguilla sp)* in the rivers and streams of Portland Bight.

5.2.2.7 Endangered Species

The endangered American Crocodile (*Crocodylus acutus)* (Plate 5.2.2.5), which is protected by both national and international legislation, is reported from the lower reaches of the unnamed gully in the area of the microdam. Crocodiles nest along riverbanks and can be aggressive during mating season, nesting season, and in defence of their young. There are no reports of crocodiles coming into the project property via the gully and this was verified by discussions with the caretaker of the property who had worked with the previous property owners for approximately 20 years. However it should be noted that this general area forms a part of the crocodile's habitat and the gully is one of their waterways.

Table 5.2.2.7: Ecological characteristics of *Crocodylus acutus*

Scientific Name	Common Name	Range	Characteristics
Crocodylus acutus	American Crocodile	Caribbean waters, including Florida (indigenous to Jamaica)	Occurring naturally in wetland areas where there is brackish water and adequate food. Populations in Jamaica are located primarily along the south coast drainage channels.

Plate 5.2.2.7: The endangered American Crocodile (*Crocodylus acutus)* Source: NEPA

5.2.3 Parks and Protected Areas

The Caribbean Coastal Area Management Foundation (CCAM) is a non-profit environment and development NGO and is dedicated to the effective management and sustainable use of the natural resources of the Portland Bight/Hellshire Hills area and for residents of the area. The Portland Bight Protected Area includes the Vere Plains Region, St. Dorothy Plains Region, Hellshire Region and the Marine Region. The land area of the PBA is 1,975 ha (200.7 sq miles), and the marine area is 135,640 ha (523.7 sq miles) giving a total area of 187,615 ha (724.4 sq. miles).

The Portland Bight is the largest embayment on the island of Jamaica, and its complex ecosystems provide habitat for a wide range of Jamaican wildlife. There is extensive human activity within many areas of the PBPA and this includes large towns such as Old Harbour Bay, Hayes and Lionel Town, as well as squatter communities and the associated issues relating to unplanned urban sprawl. Industrial concerns also exist such as alumina production and mining. ESL contacted CCAM to advise them of the project both verbally and in writing (Appendix XV).

The project site has historical land use of sugar cultivation, dairy farming, chicken rearing and other penned farming. The vegetative communities are all completely modified secondary communities and there are no pristine areas of forest or woodland. No rare, threatened or endangered flora or fauna have been reported from within the project boundary.

This development is located within the boundaries of the Portland Bight Protected Area (PBPA). It is Jamaica's largest protected area and has been in existence since April 1999. The responsibility for managing Jamaica's proposed system of protected areas belongs to the governments National Environment and Planning Agency (NEPA) and their policy is to delegate some of this responsibility to local non-government organizations. The Caribbean Coastal Area Management (C-CAM) Foundation has been delegated some management responsibilities within the PBPA since 2003.

The PBPA is a multi-use area with several environmental management goals as stated in its management plan (C-CAM 1999). This plan is presently due for a comprehensive review. The PBPA managers intend to manage the area as a Biosphere Reserve where man and nature should coexist in harmony and pursue the principle of co-management in its approach to natural resources management. As such, it is intended that all stakeholders should have a means of participating in the management process and this includes not only the resource users and the government, but the residents of the PBPA as well.

The site of the New Harbour development is not located within or near to any area that is currently designated as highly ecologically sensitive or has been zoned for any sort of special protection under the PBPA management plan. A major management goal of the PBPA is to provide for improved standard of living for its over 50,000 residents (C-CAM 1999) and the availability of quality housing for its residents (who generally fall among the lowest economic group in Jamaica). The developers aim to provide quality, affordable housing solutions, should therefore not be in conflict with any of the goals of the PBPA.

The American Crocodile is the only species of special concern with respect to this development in the PBPA. The evidence suggests that crocodiles will be utilizing the property so it is important that this does not result in conflict. The safety of the residents and the crocodiles can best be assured by not allowing the crocodiles to enter areas occupied by the housing. The contractor may be required to work with the NEPA to improve the awareness of workers to reduce their fear and minimize the potential for conflicts (which generally result in the unnecessary persecution of this endangered species).

The source of pollution in the gully is not the responsibility of the developer of this housing development. However, the release of effluent of this nature is illegal, a health hazard and a threat to wildlife downstream. Authorities and regulatory agencies responsible should make efforts to identify the source of contamination and put measures in place to stop it.

5.3 Socio-economic Environment

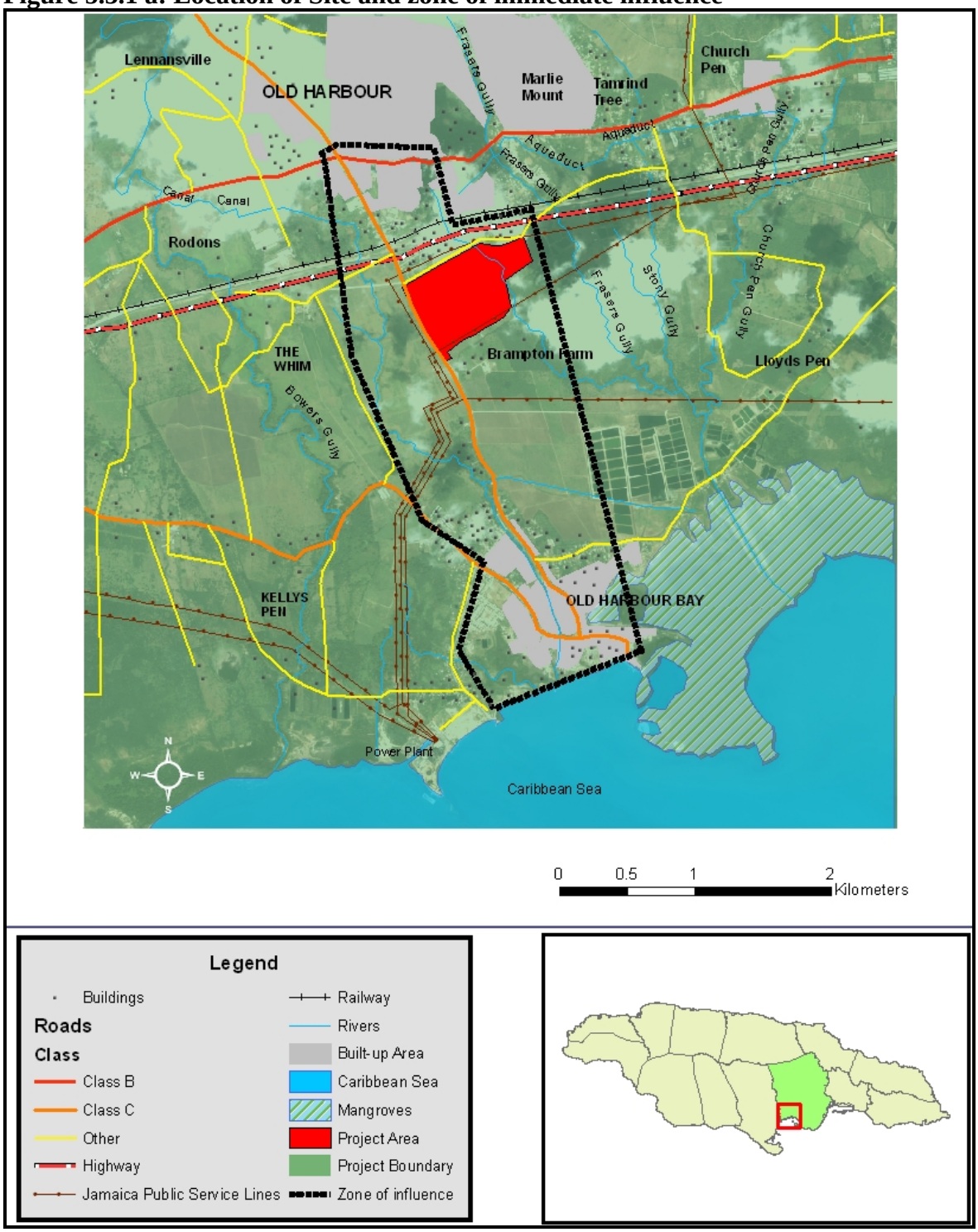
5.3.1 The Socio-economic Context

The Old Harbour community has grown rapidly in size over the last 20 years. Having lost much of its light manufacturing sector and important sections of its agricultural economy, the services sector is becoming its primary generator of jobs, if not income. Construction is an important employment generating activity and agriculture, mainly fisheries, offers some stability. Crop farming is not intensive, except for a relatively small sugar belt, and considerable hectares of unused agricultural lands lie idle. Large scale agriculture such as once existed in sugar and tobacco cultivation no longer exists. Bodles, once the center of the island's cattle breeding and livestock research program is a shadow of its former self and dairy farming, cattle rearing and pen-keeping are now on a much reduced scale.

Large manufacturing (once typified by a now closed textile mill and pulp and paper factory) has declined and a once vibrant industrial park just west of the town, is almost completely dormant. The photo below shows a once important Soya plant being renovated as a Church. However, heavy industry in the form of electricity generation and alumina still represent the areas major contributors to GDP and a proposed fuel ethanol plant will contribute as well.

Planners looking forward, have identified that the competition for scarce water resources to support either agricultural, manufacturing or housing development will ultimately play a determining role in the future economic profile of this area.

Figure 5.3.1 a: Location of Site and zone of immediate influence



Current economic activity within the town seems to be related to the urbanization process, whereby many persons who still work outside of the area have taken up residence in the area. Although the empirical evidence may be lacking, community based opinions point to an important informal sector. This is obviously trading based, but whether in drugs or other more 'legal' goods and services, opinions differ and are based on speculation. Similarly opinions were expressed on the impact of the new highway, some see it as having dampened the economy to date. It is the new highway however, that has paved the way for this and likely downstream housing projects.

Plate 5.3.1: *Then* Jamaica Soya Products Ltd.
Now New Testament Church of God

Social infrastructure is stretched to its limit. This will have to receive priority planning and implementation action even outside of additional new developments. Considerable building activity has taken place in recent years and there are some 16 mostly completed schemes in a rough semi circle around the town as listed in Table 5.3.1.

Table 5.3.1 Housing Schemes in or close to Old Harbour

	Housing Developments
1	Colbeck Heights
2	Big Pond
3	Bannister
4	Claremont Housing Scheme
5	Old Harbour Glades
7	Marley Acres
8	Claremont Drive
9	The Avery
10	Old Harbour Village
11	Church Pen Housing Scheme
12	Nightingale Grove
13	Bushy Park
14	Grove Scheme
15	Belmont Park
16	Bay View

In addition there is the Hurricane Ivan shelter replacement project nearing completion in Old Harbour Bay.

Many of these built communities are becoming physically dilapidated. Roads have deteriorated and well kept homes are interspersed with abandoned buildings or houses in disrepair. Very poor housing conditions coexist chains away from much better kept communities. In addition the police have been able to identify some 5 squatter settlements, two of which are said to be growing.

It is evident that adequate housing is a foundation need for reversing social decay. But it also requires that physical and social infrastructure keep pace with settlement development as it occurs. Sprawl results when this balance is lost. A demonstrated inability by the public sector to support physical infrastructural needs has already shifted a significant part of this burden to the developers. Now, in relation to social infrastructure, planning is trending towards the requirement that developers also address this gap. The size of future developments could possibly determine whether (in addition to recreational facilities) structures to house police posts, fire stations or basic schools need to be provided. If so, it remains unclear as to the

arrangements between public and private capital for supporting the movement in this direction. The policy dilemma is that as a consequence of rising costs, private developers may find themselves without a market for even high density schemes based on lack of effective demand.

In relation to the Proposed Project a general observation is that the town of Old Harbour seems ill prepared to absorb the social impacts of this size housing development unless an assumption is made that a significant proportion of its residents are simply relocating from within the area, a fact that cannot be accurately known until the scheme is sold.

Figure 5.3.1b shows an aerial view of the socio-economic zone of influence of the project.

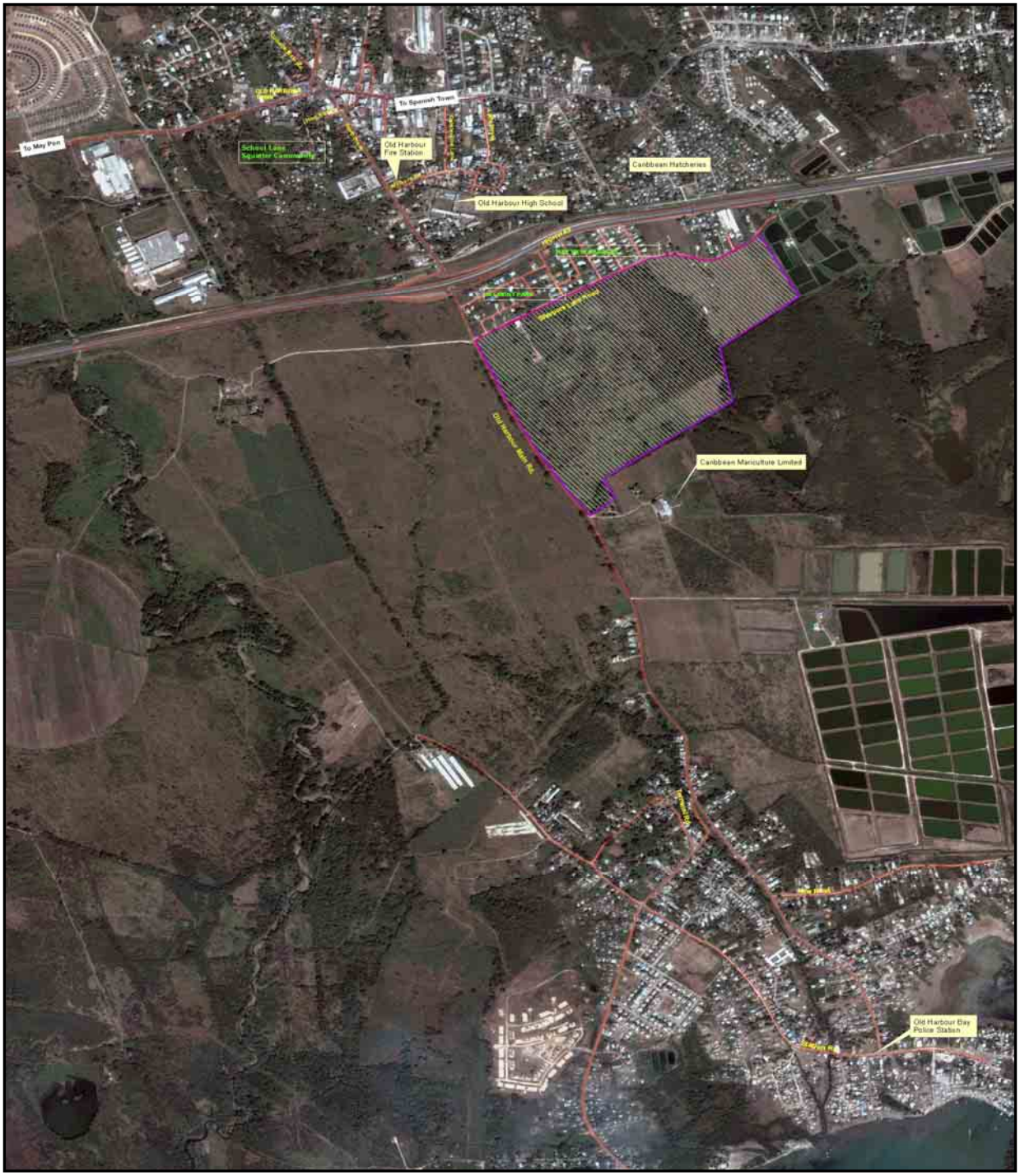


Figure 5.3.1 b: Location of site and socio-economic zone of influence

5.3.2 Land Use

The main land use in the more limited zone studied is settlement. However the project is bounded on three sides by land some of which is in agricultural use. To the north, and bordering on the Project are two housing schemes, Belmont Park and Bay View Gardens, which between them comprise about 80 homes and an unplanned community of about 34 mostly poorly constructed homes. Within the area described by the Highway and the clock tower and including all roads leading off of South Street, the number of houses counted in the rapid appraisal survey approximated 200. This did not include the large squatter community off of Heart Road known as School Lane. The zone is characterized by larger shops and commercial buildings towards the clock tower end and the intermingling of mainly food vending, motor repair, entertainment other commercial trading activities and residences in the rest of the area. Old Harbour High School is also located within this zone, as too are the police the fire brigade stations and at least two churches.

Plate 5.3.2: View of communities looking eastward from the highway pedestrian bridge.

South of the site, land use is predominantly agricultural until Old Harbour Bay which itself is residential.

In the wider land use context, the New Market Pen area (within which the Project falls) has been rezoned from agricultural land to residential use. This is further to a plan that has been developed for the lands adjoining the Highway 2000 corridor. The Ministry of Local Government and Environment is therefore supportive of the use of this property for residential development and has notified the Developers accordingly. (Appendix XVIII)

5.3.3 Demography, Employment & Social Infrastructure

5.3.3.1 Old Harbour

Demography and Employment

At the time of the 2001 census the population of Old Harbour was approximately 24,000, an increase of 30.3 % over the 1991 population, if electoral boundary changes are ignored. This means that population of Old Harbour has grown by over 3 times the national average. These population figures do not take into account the large daily movement of non residents into and out of the town on an almost continuous basis. It is both this growth and interchange that appear to fuel the importance of the services sector in the local economy.

The population of Old Harbour is evenly split with respect to gender, but 76% of the population is in the age range 39 yrs and under. The population can therefore be described as a predominately young one. The same holds generally true for Old Harbour Bay. Data for the parish's urban centers combined, suggests that female headed households could account for 45% of total households. A figure somewhat lower than the 60% average estimated by the communities themselves through interviews conducted. Both figures underscore the importance of females as heads of households. The role of females is further underlined by the STATIN calculated parish dependency ratio of 68% in 2001, indicating generally, that two thirds of the parish population was economically dependent on the other one third.

Parish employment figures provided by STATIN are of little interpretive value for the communities of Old Harbour and Old Harbour Bay. Community perceptions of unemployment and underemployment, provide a clearer qualitative picture of the impact of the lack of employment opportunities. In every neighbourhood sampled, respondents spoke to the lack of available employment as being both important and evident. A frequent question raised with community interviewers was directed at learning the employment opportunities within the Project.

The parish is also a net recipient of internal migration (receiving 21,000 persons in the decade ending 2001) most of whom migrated from the KMA. It has been estimated that this emigration is primarily originating out of Portmore.

The implication of this basic demographic profile is that the Project is located in an area of very rapid population increase in which a continued demand for housing can be expected. Typically, females constitute an important part of this demand, being significant players in the household economy as well as being chief caregivers. The pricing of the units and access by buyers to supportive financing will be an important determinant of whether the average citizen's housing needs will be impacted by this development. In either event, it is the continued economic empowerment of women that is likely to address reversing the social decline evident in Old Harbour.

Nevertheless the Project will bring to the Old Harbour area, the considerable income and employment benefits created by this scale and type of development. The construction phase will offer both direct and indirect employment and the follow on building activity by owners has traditionally been a very important extension to these benefits. Given the local pool of skilled construction workers, and a supporting network of sub contractors in the building trades, the impact of the Project on the local economy will be significant.

Plate 5.3.3.1: Then and now - Post construction improvements in a nearby scheme

5.3.4 Public Health & Safety

5.3.4.1 Health Clinics

Public health facilities available to Old Harbour and Old Harbour Bay comprise a single Type 3 clinic located in Old Harbour and a satellite clinic in Old Harbour Bay. A satellite clinic is

basically a very limited service (one to three times weekly) of a mobile nature. However three other satellite clinics also serve this part of the parish. The Type 3 clinic carries the full compliment of services offered at by this category of facility and provides a medical doctor and a dentist and dental nurse daily. The pharmacy however is temporarily closed. The satellite clinics mainly function to offer child health care.

The main clinic is facing severe stress in managing its current demands. They handle an average monthly case load of 3,267 patients with a staff comprising 2 medical officers, a dentist and 22 other health care professionals. This gives a health care professional to patient ratio of 130. The health authorities readily concede that neither the staffing levels, equipment nor space are adequate to function effectively. A larger location for the clinic is being sought, although it is not known whether this will result in an increase in health care professionals.

The nearest hospitals are in May Pen (Type C but in practical terms a Type B with a 150 bed capacity) and Spanish Town (Type A – 275 bed capacity), both facilities are about equi-distant in time, along the highway. Old Harbour is served by approximately 12 private medical practitioners but Old Harbour Bay is served only by the satellite clinic mentioned earlier.

Given that the Project will promote the resettlement of people from outside of the area the introduction of this scale and type housing scheme, will add to the already burdened health services in this area. This is unless these conditions are alleviated by the time the Project is implemented.

5.3.4.2 Fire Service

A fire brigade station located in Old Harbour (Area 3) provides services to both Old Harbour and Old Harbour Bay and back-up services throughout the parish as required. It has one unit which carries a limited supply of water, there being no water tender unit assigned to the station. The town is served by fire hydrants but the firemen themselves estimate that only 20% are in working condition. Compounding their challenge is the variability in water pressure often encountered. Fire personnel at the station estimate that in over 50% of the fires they respond to, the lack of water resources is their main challenge faced. There is a water tank at the station which carries sufficient water for about 4 trips.

Staffing is reported to be below the assigned level, there being 24 firefighters currently out of a complement of approximately 32. The practical, consequence of this is that doubling up of shifts becomes the norm. The introduction of new recruits for the station (final numbers were not available) is planned along with the introduction of a new fire unit. Currently backup assistance from both Spanish Town and May Pen is available in a response timeframe of about 15 minuets. This is one example of where Highway 2000 is facilitating the sharing of social infrastructure capacity within its corridor, and the continued process of social infrastructure resource assessments along its corridor is important.

Planned upgrading of the fire services to be available before project completion is an important requirement. However unless the issue of water supply is fully addressed as well, firefighting services remain a threat to the project. Similarly the project represents a potential drain on the firefighting resources available to the neighbouring communities, and is itself, therefore a threat.

5.3.4.3 Police Stations

The Project falls within Area 5 of the Constabulary Forces. The Divisional Headquarters for this Area is located in Portmore. Old Harbour police station is one of seven Out Stations within the Division. Old Harbour Bay Police Station is also an Out Station but is also a Sub Station administered by Old Harbour. Some idea of a notional 'resource capacity' of the station, and its challenge to render effective service can be inferred by its staff complement.

Table 5.3.4.3 : Manpower at the Old Harbour Police Station

	Positions	**Current Complement**	**Part Time**	**Total**
1	**Management**	Nil		
2	**Middle Management**			
	DSP	1		1
	Inspector	Nil (temp)		
3	**Rank & File**			
	Sergeants	4		4
	Constables	30 (approx)		30
	Special Constables		15 (approximately). Made available 3 days per week (Wd Fr Sa) from Portmore	15
	District Constables	10 (approx)		10
9	Total	45	15	60

5.3.4.4 Crime

Both police stations report that the crime rate, within the general project area is not considered high. This is the general view confirmed by the rapid appraisal interviews conducted in both communities. In fact several respondents commented on the project perhaps posing a threat to the peacefulness of their respective communities. In neighbourhoods bordering the project, for example Belmont Park, Bay View Gardens and Sharpers Lane this was a definite concern. At least one business establishment close to the project, thought their operations might become more vulnerable to praedial larceny. Data provided by the Constabulary Communications Network, for both stations reflect that major crimes over the one year period 2004-2005 increased by a very modest 1.48% for both stations combined.

Table 5.3.4.4: Major Crimes Reported by Old Harbour & Old Harbour Bay Police Stations 2004 & 2005

	Station	2004	2005	% Increase
1	Old Harbour	123	130	6
2	Old Harbour Bay	12	7	(41)
3	**Total**	**135**	**137**	**1.48**

In keeping with an island wide reality of the constabulary force, both stations are understaffed. For Old Harbour station the establishment force is about 40 persons, currently their average strength is below this (actual figure declined).

The introduction of the Project presents a concentration of settlement that will make demands on these limited resources. Although growth in major crime rates is small, the cumulative case load for the staffing compliment must be regarded as challenging, and even more so, when the higher ratio of major crimes to CIB personnel is taken into account. The implied ratio in this instance being 45 major new crimes per annum per current CIB personnel at the station.

5.3.4.5 Education

Old Harbour High School is the only high school located in Old Harbour and this part of St. Catherine. Its current student population is approximately 2,500. It has five main feeder

schools (Old Harbour Primary, Old Harbour Bay Primary, Marley Mount Primary, Davis Primary and Good Hope Primary). Collectively these compete for the totally inadequate intake capability of approximately 450 GSAT places annually. According to the school administration they routinely have to deny acceptance to large numbers of students seeking transfers from assigned schools elsewhere. This shortage problem has heightened over recent years, in that social dislocation arising from violence in Spanish Town, has brought tremendous pressure to bear on the Old Harbour school system. Anecdotal information from school sources tell of desperate parents offering to supply their child's desk and chair if space is made available. The recent statement in parliament by the Minister of Education on delays arising from the need to identify a couple thousand additional GSAT places island wide, underscores the existing pressure on educational resources in the general project area.

Notwithstanding that the highway will permit rapid transit between several parish capitals thereby allowing inter urban movement among school goers, the movement of migrants into Old Harbour will exasperate the already difficult school placement challenge in this area.

Because of the extent and growth of the construction industry in the Old Harbour area, building skills are available. This confers an advantage to the project and is an important means by which the income and employment benefits of the construction and post construction phase will flow into the Old Harbour and Old Harbour Bay areas. HEART Trust NTA has a training facility in Old Harbour, that graduates about 20 construction workers annually at each of two levels. The total construction employment needs of the Project is about 300. However building related employment generated by home improvement needs after project completion, represents a very important project benefit.

5.3.5 Utilities

5.3.5.1 Electricity

Jamaica Public Service Co Ltd has approved the electrical design of the project and a copy of this letter is given in Appendix XVIII.

5.3.5.2 Water

The Project will be extracting 100% of its water requirements from a well it plans to sink. Domestic water will not be required from The National Water Commission. A well owned by the Developers is already on the site, but the water quality from this source led to the decision to sink a second well. A water treatment facility will be installed to ensure the integrity of the project's domestic water supply needs. The Water Resources Authority (WRA) has approved abstraction from the well. The amount allowed to be extracted will be specified by the abstraction licence. It is estimated that the water consumption of the property will be in the order of 170,000 – 200,000 gallons per day based on 200 gallons per household for the 845 units. A 250,000 – 300,000 gallon water tank is to be provided to meet the storage capacity needs of the project.

The Rio Cobre Basin is the source of supply for the parish of St. Catherine and its resource and production profile is as follows:

Table 5.3.5.2 : Rio Cobre Basin Resource and Production Profile

	RESOURCES			PRODUCTION (Mm^3/yr)			Unused Reliable or Safe Yield
	Average Yield	Reliable or Safe Yield	Water Use Suitability	Installed Capacity	Average Production **	Max Monthly	
Surface	186.8	14.5	All uses	-	18.6	-	0.0
Ground	453.8	403.8	Restricted use *	450.8	307.1	-	96.7
Total	640.6	418.3		450.8	325.7	-	96.7

***** Water quality restrictions on use due to industrial or domestic effluents to localize overdevelopment of coastal aquifers.

****** Production in excess of reliable or safe yields reflects the use of seasonal surface flows or seasonal river recharge to all the limestone aquifers.

Table 5.3.5.2 indicates that the average annual production of surface water 18.6 Mm^3/Year is higher than the reliable or safe yield of 14.5 Mm^3/Year that the basin can produce. Therefore with respect to surface water, there is no unused reliable or safe yield to be obtained from the basin. With respect to ground water, there are resources still available in the basin, but water quality and in particular saline intrusion makes its use for domestic purposes dependent on treatment.

The main water supply to the communities is provided by NWC. For Old Harbour town itself, and Old Harbour Bay, this is sourced from well at Claremont. Other wells serving the outer environs of Old Harbour are located at Marley Mount, Bowers, Graham and Spring Village. Each well has an associated chlorination system. The majority of respondents interviewed were critical of NWC service based on their experience of frequent periods of low pressure. A few residents also complained about the hardness of the water, and a few about its poor taste.

5.3.5.3 National Irrigation Commission (NIC) Canal

An irrigation canal privately owned and supplied with water from NIC enters the property at the north east. A site visit on June 15, 2006 showed low levels of water in the canal. A site visit on July 5, 2006 revealed that the canal was overflowing. The developer proposes to splinter a portion of land around the canal to provide a reservation for the canal or to relocate /re-route the portion that traverses the property.

5.3.6 Community Identified Concerns

As indicated earlier, a rapid appraisal approach was used to canvass opinions about the project. Interviews were held in those areas identified. Structured, semi-structured and unstructured interviews were conducted with targeted and non targeted individuals. By untargeted is meant those respondents who were approached on a random basis, but in selected locations. Whereas targeted individuals were those key informants, pre selected for interviewing, whether by appointment or otherwise. The total number of interviews conducted were 70 non targeted and 21 targeted (comprising mainly those in the Key Informants list appended). A number of impact issues that surfaced sufficiently frequently to be representative of the respondents concerns were identified.

5.3.6.1 Traffic

The Project will require, perhaps 3,380 potential commuters to enter and leave the Project through one entrance along the relatively narrow Old Harbour to Old Harbour Bay main road. The potential for traffic congestion and even accidents involving pedestrians, was quickly identified by several respondents. Their concern was to know if proper traffic management arrangements would be put in place and whether construction vehicles would use an alternative

entrance to the site. This issue was of particular concern to those in the housing schemes and businesses immediately bordering the site. The ranking officer in the Traffic Department at the Old Harbour Police Station, as also police personnel spoken to in Old Harbour Bay, confirmed that these concerns were valid.

Because the Project targets the low middle and lower income market, it can be assumed that owners of vehicles in the Project and even residents relying on public transport, may avoid complete reliance on the Highway when traveling in-bound to Spanish Town, Portmore Kingston or locations accessible from these exit points. The only other route option involves travel along South Street in the direction of the clock tower in Old Harbour. Similarly until west bound access is enabled by the Highway authorities, all such traffic intending to go in the direction of May Pen must also route along South Street. Traffic moving in both directions along South Street is already an important contributor to the very heavy traffic congestion that characterizes the 4-way intersection at the clock tower. At almost any time of day traffic is bumper to bumper at this intersection. Consistently heavy, is traffic on Main Street comprising as it does, both commuters having business in Old Harbour, those transiting the town not wishing to use the Highway and those wishing to access the Highway via South Street.

Plate 5.3.6.1: Congestion: Looking south on South Street during the day.

As a result of this congestion, many motorists circumvent the square by using either Laffe Street or Goldbourn Lane, which both connect South Street to Main Street via Walkers Road. The roads in these communities are narrow, the surfaces only partially paved and are poorly

maintained, and the resulting constant flow of traffic through essentially residential communities, was a source of annoyance to some residents spoken to. The entrance to Heart Street, the sole roadway that accesses the large squatter community known as "School Lane" was inaccessible to the Consultants for unacceptably long periods (this over several visits) because of congestion at its intersection with South Street.

The main cause of this congestion is that the precincts of the clock tower serves as a grand transportation park. There are six taxi stands and a bus parking area within walking distance of each other and all located in this relatively small spatial area. When pedestrian traffic, the presence of the main market, street side vendors and large stores is factored, then the resulting congestion moves southward, along South Street, and will meet with and be compounded by incremental vehicle flows attributable to the Project.

The Old Harbour traffic department considers that the Project will be an important contributor to the continuing congestion the town is experiencing.

The solution put forward by almost every stakeholder spoken to is that the town needs a modern transportation park, improved roads, and proper traffic flow controls in place.

A Traffic Impact Assessment for the project itself (Appendix XIX) was commissioned by the Developers to ensure the safest possible design of the main entrance onto the main road and the construction site entrance (the current site entrance along Sharper's Lane). The Traffic Impact Assessment does examine the likely contribution of the project to the congestion described above but correctly places the responsibility for alleviating this on the relevant public authorities. With respect to its main findings, the report envisages additional operational loss of service along Old Harbour Bay Road through the year 2016. It also confirms the existing failure of the intersection at the clock tower and its continued failure through year 2016 if no adjustments to its operation are made. With respect to the main entrance to the project, its recommendations call for:

- The installation of " Traffic Ahead" signs along the Old Harbour Bay road.

- The installation of additional lanes in the vicinity of the development to facilitate entry into and exit from the scheme, and to ensure that corridor performance remains acceptable.

5.3.6.2 Land Use Issues

While all respondents with the exception of one, were supportive of the Project and recognized its likely social and economic benefits, a small percentage (roughly 7%) felt strongly that the site represented a poor choice of land use. They felt that land on which the project was sited, had traditionally been used for agriculture and that it represented fertile lands that should be under food production. Generally this minority felt that for this reason, no housing developments should take place south of the highway, in this area of Old Harbour.

Plate 5.3.6.2: Brampton Estate just south of the Project site.

Quoting from the Portmore To Clarendon Park Highway 2000 Corridor Development Plan 2004 to 2025 Preliminary Draft Volume 1 Main Report (2004) perhaps best addresses this issue. *"Squatting is the greatest contribution to the breakdown in law and order in the country and in general and in the project area (corridor) in particular"* The plan goes on to put adequate housing at the centre of the control of sprawl and the social consequences it spawns.

5.3.6.3 Flooding

Flooding in the vicinity of the project site is confined to a stretch along Sharpers Lane and the Old Harbour to Old Harbour Bay main road. Flooding along Sharpers Lane mainly affects the

movement of residents in Belmont Park and Bay View Gardens and residents and business places located towards the eastern end of Sharper's Lane.

It is caused mainly by the incorrect sizing and sharp angle of the main drainage channel and culvert which drains this part of the road towards the site. An important contributing factor is also the consistent lack of proper maintenance of this waterway. The President of one of the Citizens Associations in the area, claims that he personally undertakes its cleaning on an infrequent basis. The developers have plans for enlarging this culvert mainly to eliminate the threat of flooding onto the Project, but in so doing will considerably improve, if not totally eliminate flooding along this stretch of Sharper's Lane.

Flooding along sections of the main road is mainly attributable to overtopping of the drains that run on either side of the roadway. This overtopping is partly a result of these drains not being consistently maintained, but also partly because, water from the highway bridge that crosses this main road, is also channeled into these drains. The plane of the highway along the bridge is clearly seen to be inclined towards the south.

Some citizens are incorrectly of the opinion that the flooding is aggravated by drainage issues to do with traditional watercourses flowing through the large Whim property to the immediate west of the project site. This is the generally accepted view among the Old Harbour Bay respondents. According to engineers spoken to, this is an unlikely scenario but in any case it would not be a significant reason. However, the Bower's Gully is a major drainage asset in this region of the parish. It runs through the Whim and discharges west of Old Harbour Bay Township.

Plate 5.3.6.3a: The Bower's Gully aka Mighty Gully looking south from Colbeck Bridge

Project surface runoff was also an issue for the more knowledgeable respondents. The fear being that either surface water or effluent discharge would add to flooding along the main or alternatively, flooding in the Old Harbour Bay communities bordering the Salt Gully.

The issue in relation to effluent discharge and surface run-off into the Brampton drainage system has mainly to do with its possible contribution to the flooding of residents along the southern side of the Salt Gully. These are mainly squatter communities with no defenses against flooding. Again an engineering opinion is that the level of discharge from the project will contribute an extremely small incremental volume to this extensive body of water. In flood events of any magnitude, the combined discharge from the project area will represent an even smaller percentage of the water reaching the Salt Gully.

Plate 5.3.6.3b : Looking north west across a part of Salt Gully to Settlement in Old Harbour Bay

The conclusion is that the project will considerably improve flooding currently experienced by its northern neighbours, contribute a small reduction to flooding along the main road, and contribute, to an almost inconsequential degree, to the volume of water being discharged into Salt Gully.

5.3.6.4 Security

The issue of security was of concern mainly to those respondents, in the neighbouring areas of the site, both in Old Harbour and Old Harbour Bay. Overall they represented a minority concern but an important one. The threat to security was seen by some members of this minority as mainly impacting the new residents. Their thinking being that such a housing development would attract criminal youth elements in Old Harbour and Old Harbour Bay onto the site and its environs. Others were more concerned about the proximity of a lower /low income development and its implications for the sort of residents that would become neighbours. Here, concerns for noise pollution, sanitation and security tended to blend.

The concerns for security reflect several realities. Some of which have been mentioned earlier. Urban sprawl is threatening and there is a real concern that the traditional sense of security and community cohesion is slipping away. Although not necessarily supported by the crime statistics, there is a sense that what has happened in Spanish Town could migrate. As mentioned earlier some 16 housing schemes or settlements are adding to the pressures building

on the Old Harbour area and the police have already categorized some 6 communities as squatter settlements. These being:

Table 5.3.6.4: Squatter Communities

Squatter Communities	
OLD HARBOUR	
1	Succaba Pen (Marley area)
2	School Lane aka Succaba Gardens
3	Heart Street
4	Africa
5	Old Harbour Villa Phase 4
OLD HARBOUR BAY	
6	Terminal Road

.

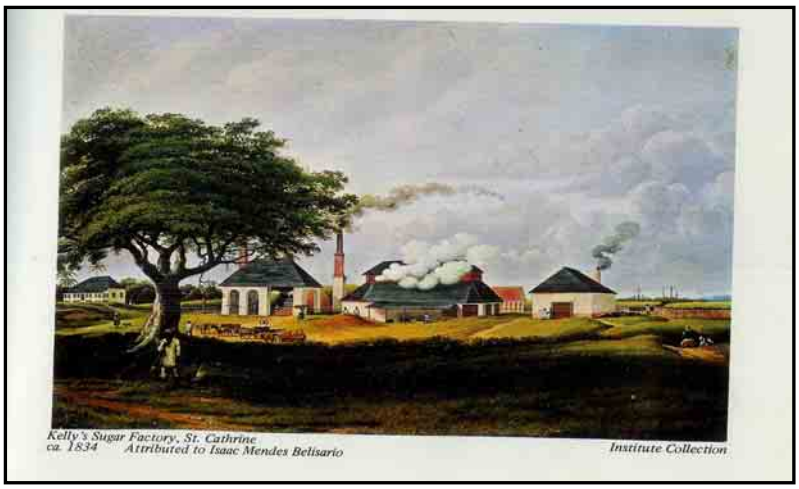
A small unplanned and somewhat degraded housing settlement actually exists at the eastern end of Sharper's Lane. It does not appear that they have been integrated into the Bay View Gardens small and almost inactive, citizens association.

5.3.7 Archaeological and Cultural Heritage

The project lies in an area whose settlement dates back to the Spanish and early British colonial periods. It lies on an historically important trade, commerce, communication and security axis between Old Harbour Bay, Old Harbour and the interior. For example, Bowers Gully and Bowers River took their names from a Captain Bowers who arrived with, or shortly after Penn and Venables army. Captain Bowers was stationed with militia in the area. The general area comprising Old Harbour to Old Harbour Bay was named by the Spanish as the District of Anaya. Over time a number of estates came to dominate cultivation in this area. The Whim (but more recently the Whim and Kelly Pen) is found on early maps of the area. Several smaller holdings, of which present day New Market Pen would be one, were very probably a part of the Whim. Records dating back to the late 19th Century confirm that sugar, cattle, bananas, tobacco and other livestock rearing were all well established activities at one time or the other in the area.

A limited inspection of a few exposed surface areas on the project site, yielded some old bricks but nothing that offered a basis for immediate dating. However, very recently (2006) JNHT has taken a keen interest in reasonably extensive foundations, brought to their attention, of what is believed to be the original Whim Great House. This lies some distance south west of the Project Site, and on the Whim estate.

Plate 5.3.7: Kelly's Sugar Factory *(The Whim & Kelly circa 1843)*



Important Taino communities existed in the Old Harbour Bay area including on Great Goat Island. Enquiries to date by the consultants have not revealed whether Taino settlements have been identified within proximity to the project site.

5.3.8 Consultation with the Regional Health Authority/Medical Officer (Health) St. Catherine Health Department

Following on from the site visit conducted by inspectors of the St. Catherine Health Department, ESL had discussions with one of the Inspectors. The Inspector advised that he found no public health issues associated with the site as it is vegetated (Pers. Com., Mr. Rattigan). Any issues related to the development, that could impact on public health, will be discussed directly with the Environmental Health Unit (EHU) during the EHU's review of this EIA report for NEPA.

6.0 Issues Identified, Potential Impacts and Mitigation Measures

6.1 Issues Identified

Several issues have been identified for the proposed New Harbour Village housing development, that must be taken into consideration at the design, construction and operation phases. These issues have been explored in light of the potential impacts of the project on the existing environment, as well as the environmental attributes and how they may affect the project. The main issues that have been identified are:

1	Drainage/Flooding	Pre and Post stormwater runoff
2	Liquid Waste Management	Approval and licencing of Sewage Treatment Plant Proposed
3	Air Quality	Construction phase dust
4	Water Quality	Surface and ground water
5	Water Quantity	Sustainable yield and long term availability of ground water resources
6	Geology	Erodibility, Soil stability
7	Hazardous Materials	Handling and storage
8	Hazard Vulnerability	Hurricanes, seismic activity, flooding
9	Ecology:	Vegetation and Habitat loss
10	Demographics	Character of communities
11	Traffic:	Egress and Ingress, Old Harbour Bay Main Road
12	Public Health and Safety	Cane field fires, agricultural pesticide use and water quality
13	Solid Waste Management	Removal of vegetative matter, removal of domestic waste and construction waste to an approved disposal site;

Many of the mitigation measures are incorporated in the project design. However indicative costs for other substantive mitigation measures are:

- Monthly monitoring during the construction phase (Approximately US$3,000 per month)
- Construction of Sewage Treatment Plant (Approximately US$ 1,200,000)
- Construction of Reverse Osmosis Water Treatment Plant (Approximately US$ 400,000)

Table 6.1: Impact Summary Matrix

6.2 Potential Impacts and Mitigation Measures

6.2.1 Drainage and Flooding

Potential Impacts - Construction Phase

During the construction phase, grading, earthworks and removal of vegetation will expose the top soil to erosion during heavy rainfall events. During construction improperly stockpiled earth materials can also be transmitted to the surface water drainage system, thus impacting on turbidity, and drainage capacity. This is a short term, reversible impact.

Mitigation Measures - Construction Phase

- Vegetation clearance should be phased with the phasing of the construction activities and bare soils should be re-vegetated as quickly as possible.
- Replanting the area with fast-growing trees that are already part of the ecology should be undertaken.
- Stockpiled earth material needs to be secured and covered against inadvertent removal by stormwater.
- Internal roads should be consolidated and haulage trucks should carry loads not exceeding axel limits.
- All existing drainage lines should be kept open

Potential Impacts - Operation Phase

During the operation phase the potential for on site flooding has been considered due to the current flooding experienced at the north of the property from the unnamed gully running through the property. However a major mitigation measure has been implemented to remove the risk of flooding, through the engineering design. The engineer's have designed a significant increase in the drainage channel to allow for maximum flow. A detention pond will retard the flow of water from the property. Homes in close proximity to the gully are elevated to prevent flooding in extreme events.

The proposed subdivision is just north of a retention area on the central drain alignment. The upper stratum of the soil is clay that would not allow significant infiltration to occur. The more permeable soils occur greater than 4m deep. Locating a retention pond on the site would not significantly recharge the aquifer.

There are no communities located south of the proposed subdivision to the confluence with Fraser's Gully. The flow in Fraser's Gully is significantly greater than that from the Central Main Drain. There is a large retention area created by a micro dam downstream of the central main drain discharge point that will provide detention of flow and will reduce the peak flows from this stream. This will limit the downstream flows into Fraser's Gully.

The potential for flooding could be long term and irreversible. However, the engineering design for drainage should mitigate these potential impacts and so flooding is not predicted.

Mitigation Measurse - Operation Phase

- The proposed drain reserve is designed to accommodate a rainfall event that has a 4% chance of occurring in any one year. However, given the significant limiting control of the Highway 2000 and the railway culverts it is highly unlikely that the total predicted flows will be received on site. The drainage design engineers have therefore taken a fiscally prudent approach to the drainage design based on existing and demonstrated upstream structural flow controls.

- The open space to the east of the drain reserve should be designed to accommodate spill-overs from the drain reserve so as to ensure that the properties in the western boundary are not affected by any extra-ordinary events.

- Source control techniques such as harvesting roof runoff, permeable pavements and infiltration devises are proven techniques in a complete and comprehensive and sustainable drainage plan. Dealing with the water locally not only reduces the

quantity that has to be managed at any one point, but also reduces the need for conveying the water off the site.

- A typical part of the drain was modeled in HEC RAS (Appendix IV) and the depth of flow was approximately 1.4m which would be contained in the 1.5m Ht paved drain. There is further freeboard available as the lot boundaries are a minimum of 0.5m above the top of the drain wall.

- Two large parks are available as detention areas in the case of extreme rainfall events.

Responsible Parties: Engineers, Developers

6.2.2 Sewage Treatment Plant

Potential Impacts

The Sewage Treatment Plant (STP) has the potential to release unpleasant and/or noxious odours in the event of malfunctioning, and also to release effluent below the required NEPA standard in the event of malfunction. The design engineers have included the main mitigation measures in the treatment process, to ensure that effluent standards meet NEPA's requirements.

Most package plants require electric power to operate and all will require regular maintenance and de-sludging in accordance with the manufacturer's instructions in order to ensure that the system operates effectively and the effluent complies with the consent conditions.

Mitigation Measures

- Storm water from the STP should not be allowed to discharge to the wastewater treatment system as this effectively reduces the design capacity and can cause solids to be flushed out of the treatment system.

- The final siting of the site STP should be at least 30m from any watercourse and the well.

- Distribution lines that take the primary treated effluent to the central, cluster system should have suitably placed cleanouts so they can be flushed at least twice per year. Pumps, floats and alarms must be checked as part of the regular maintenance.

- No sewage line should be within 50m of the abstraction well head. Additionally, a 50m buffer should be kept around the well head to avoid the possibility of contamination via unforeseen sub-surface breakage.

- Avenues should be considered for effluent discharge re-use for non-potable activities such as greening of adjacent green spaces.

- It is recommended that manhole covers are sealed so that when water is on the road, the manholes do not flood.

- The cost of construction of the STP is approximately $1,200,000.

A maintenance agreement with a suitable contractor is essential, and the installation of an alarm to warn of power or plant failure is recommended.

Responsible Parties: Engineer, Developer

6.2.3 Noise

Potential Impacts - Construction Phase

Noise nuisance related to construction may affect communities within a radius of 160 m. In particular the existing housing schemes at Belmont Park and Bay View Gardens may be affected. The 160 m zone is based on the physical property of sound whose energy is inversely proportional to the square of the distance. At a distance of approximately 160 m

and starting from a noise level of 95 dB the sound level would have been reduced to 68 dB. The recommended WHO standard is 70 dB for daylight hours. The increase in levels of sand and dust is expected to be a short term, reversible, minor impact.

No negative impacts are expected in the Operation Phase.

Mitigation Measures

- Vehicles should be properly maintained and the exhaust systems should be muffled as required.
- The movement of heavy equipment should be restricted to standard working daytime hours.
- The regular maintenance of vehicles is essential to reduce gaseous emissions.
- Adequate communication with residents at Belmont Park and other neighbouring communities is recommended.

Potential Impacts - Operation Phase

No impacts are expected from dust or noise during the Operation Phase. Additionally, impacts of reduced air quality to residents, from increased levels of particulates during the reaping season for sugar cane, are not expected. Sugar cane plantations are not in close proximity to the proposed site.

Responsible Parties: Developer, Contractor

6.2.4 Air Quality

Potential Impacts – Construction Phase

During the construction phase air quality is expected to decline as a result of an increase in levels of fugitive dust from cleared land, stockpiled earth materials, dusty roads and gaseous emissions from vehicular exhaust. Respirable particulates are a public health hazard and may otherwise create considerable nuisances to the public.

Fugitive dust levels will likely increase during construction activities, particularly excavation, transportation and storage of fines as well as aggregates, resulting in an increase in PM10 levels in the short term. These impacts are reversible and minor.

Mitigation Measures

- Phasing of vegetation clearance to coincide with phasing of construction activities.
- A monitoring programme for dust is recommended.
- Watering of un-vegetated areas and stripped road surfaces along which construction vehicles and trucks travel should control dust emissions by up to 70%.
- A watering truck should be maintained on site for watering road surfaces as needed to minimize fugitive dust emissions. Over-saturated conditions, which would cause outgoing trucks to track mud onto public streets, should be avoided. Watering would not be necessary on days when rainfall exceeds 2.5 mm.
- Stock piling of earth materials for construction should be carried out within temporarily constructed enclosures to limit fugitive dust. Vehicles transporting earth materials should be covered en route. Stockpiles of fines should be covered on windy days.
- Mixing equipment should be sealed properly and vibrating equipment should be equipped with dust removing devices.
- A monitoring program for dust is recommended to assess the effectiveness of control measures in meeting ambient air quality standards. The cost for monitoring particulates on a monthly basis would be included in the overall cost of the monitoring program.
- Where appropriate dust masks should be provided for wokers in order to protect them from dust impacts.
- Dust masks should be provided for workers.

No negative impacts are predicted during the operation phase.

6.2.5 Water Quality

6.2.5.1 Surface Water Quality

Potential Impacts - Construction Phase

Loose stockpiles of earth materials and unvegetated top soil can be washed into the unnamed gully during heavy rainfall events. During the construction phase stormwater run-off can carry large sediment loads which increase turbidity in the coastal waters. This would be a shot-term, irreversible impact if not mitigated. During construction, oil and grease and hazardous material should be managed in properly designated areas, and disposed of appropriately off-site. These are minor short term, reversible impacts.

Mitigation Measures - Construction Phase

- Cover or berm stockpiles of earth material
- Stockpiles should be situated at least 30m away from drainage channels
- Adequate siltation control devices should be deployed where earth movement occurs close to waterways.
- Precautionary engineering measures (such as cut-off trenches, etc) should be implemented to reduce sediment laden run-off and prevent it from reaching, existing drains and natural gullies. Nothing which could cause pollution, including silty water, should enter such any watercourse.

Potential Impacts - Operation Phase

In the operation phase the water quality of the unnamed gully is not expected to decrease due to the use of a Sewage Treatment Plant. The STP will be constructed with a biological nitrogen and phosphorus removal step within closed-loop reactors. The plant is designed by Lakeside Electro/Mechanical Equipment and has eight basic components:

- Grit/trash chamber
- Two anoxic chambers
- Two Spiraflo clarifiers
- Digester
- Anaerobic chamber
- Two closed loop reactors (oxidation ditches)
- Chlorine contact chamber
- Two drying beds

Mitigation Measures- Operation Phase

- Establishment of a new STP must be after receipt of a permit from NEPA for construction of same, and a license for the discharge of effluent.
- The current discharges of effluent into the unnamed gully should be stopped. This is not the responsibility of the developer, but of the regulatory agencies responsible for enforcement.

Responsible Parties: Engineer, Developer, Contractor, Regulatory and Enforcement Agencies

6.2.5.2 Groundwater Quality

Potential Impacts - Operation and Construction Phases

The integrity of the groundwater quality must be maintained in order to ensure the long term yield of water suitable for potable supply. The WRA has indicated that lands once used for agriculture may suffer from termite infestation and the application of pesticides is sometimes considered by developers.

Mitigation Measures - Operation and Construction Phases

- A 30m buffer zone should be established around the well
- There should be no surface drainage toward the well and no water should be allowed to settle near the well.
- No sub surface application of chemicals/pesticides should occur within a 200m radius of the well. Homeowners should be advised of this stipulation.

Responsible Parties: Developer, Contractor, Homeowners

6.2.6 Potable Water Supply

Potential Impacts - Operation Phase

The National Environment and Planning Agency requires the owners and operators of the commercial entities discharging to this drain to conform to the National Trade Effluent Regulations.

The potable water source, as proposed is the existing well on site. The water quality of the well shows high chlorides and some bacterial content. Treatment of the water would be required to meet potable water standards. The high chloride content would make the taste unpalatable. Environmental Health Unit must approve the quality of the water after treatment before it is made available for public consumption.

The data shows that nitrate and faecal coliform bacterial levels are low and within the World Health Organisation (WHO) drinking water standards, 50 ppm and 0 mpn respectively. Total coliform bacterial levels are however higher than the drinking water standard.

Chloride levels are consistently higher than the standard (250 ppm) while sodium levels exceeded the standard (200 ppm) thrice in five sampling exercises. Chloride levels are not significantly higher than the standard but with additional abstraction from the well to satisfy the project demands these levels could increase further. Sodium levels when elevated exceeded the standard by approximately thirty five percent. Similarly as for chloride with increased abstraction these levels may well increase.

Total dissolved solids levels (921 ppm) is just inside the WHO standard of 1000ppm, this was a one off sampling exercise for this parameter and on that sampling exercise sodium levels were within the sodium standard. The data suggests that on those occasions when sodium levels were significantly elevated that it is likely that TDS levels could be higher than the standard.

Mitigation Measures - Operation Phase

- Proper design and management of the proposed New Harbour Village Sewage Treatment Plant consistent with the national sewage regulations to ensure no groundwater contamination.
- An effective sterilization programme (chlorination/uv/ozonolysis) should be sufficient to bring levels well within the drinking water standard.

- The establishment of a Reverse Osmosis Treatment Plant as designed will treat the water by removing chlorides and ensuring potable quality that meets the taste standard locally.
- There should be no surface drainage towards the well and no water should be allowed to settle near the well.

Responsible Parties: Private Utility Company, Developer, Engineers.

6.2.7 Soil Erosion and Sediment Loading

Potential Impacts - Construction Phase

During the construction phase, the clearing of vegetation on large tracts of land can result in exposure of top soil. During heavy rainfall events the soil can be washed into drainage channels. Slope stability is not expected to be a risk at this site - as the land is flat.

If good construction practice is exercised the risk of sediment loading will be minimized to acceptable levels. Some disturbance will be inevitable during the development of the drain reserve but this will be short-term and can be mitigated as described in Section 6.2.5.

Mitigation Measures - Construction Phase

- Mitigation measures as presented in Section 6.2.5 for surface water quality should be applied.
- Additionally the natural drainage will be upgraded to a concrete lined drain reserve.
- A Soil Erosion Management Plan is presented in Appendix XXI.

No negative impacts are predicted during the Operation Phase.

6.2.8 Handling & Storage of Hazardous Material

Potential Impacts - Construction Phase

Worker health and safety, as well as the environment can be impacted by the improper storage and handling of hazardous material.

Mitigation Measures - Construction Phase

- All temporary fuel, oil and chemical storage must be sited on an impervious base within a bund and secured. The base and bund walls must be impermeable to the material stored and of an adequate capacity. Storage at or above roof level should be avoided.
- Leaking or empty oil drums must be removed from the site immediately and disposed of via a licensed waste disposal contractor.
- Washings from concrete mixers, paint or paint utensils should not be allowed to flow into any drain or watercourse.

6.2.9 Natural Hazards

Houses will be designed to the national building code standards, which take into account the resistance to high winds and seismic activity through the use of reinforced concrete structures. Architectural drawings and structural drawings will have to be submitted to the relevant authorities for approval.

Minimal risk of flooding in homes is expected through the engineering design with lot boundaries at a minimum of 0.5m above the top of the drain wall, and the presence of two large parks that can serve as water detention areas in extreme rainfall events.

Landslides and erosion are not a potential risk as the land is flat with gradient less than two degrees.

6.3 Biological Impacts

Potential Impacts - Construction Phase

The clearing of vegetation will result in the modification or removal of existing habitats for fauna. However, there are no rare, threatened or endangered fauna reported from the site. Loss of vegetation is a minor, long term and irreversible impact.

Crocodiles have not been reported in the unnamed gully as far up as the project site. However, the possibility exists that they could travel up should not be excluded. The risk is minor based on anecdotal evidence, but should be considered long term.

Mitigation Measures

- Landscaping in the development should occur to replace vegetation lost, and this could encourage the re-establishment of dislocated bird species. This is especially important for migratory species that are likely to use the habitat.
- Sensitization of construction workers to the likelihood of encountering crocodiles.
- If a crocodile is sighted, NEPA should be informed immediately.

Responsible Party: Developer, Contractor

6.4 Socio-economic Impacts

To the extent that the Project comprising 845 units, is responding to a projected need for 10,400 new houses annually [2] (St. Catherine and Clarendon) it must be seen as a necessary and even urgently needed development. In relation to its likely impact on the human environment it presents a difficult, if frequently posed, challenge, for decision making. The social capital in Old Harbour and most certainly Old Harbour Bay, is inadequate to support this project. Nevertheless the Project itself will contribute to the mitigation of sprawl, which is major indicator and cause of social disintegration.

In relation to the benefits of income and employment generation and the upgrading of shelter, the Project is likely to contribute an overall net benefit to the communities, but

[2] The Portmore to Clarendon Park Highway 2000 Corridor Development Plan 2004-2005.Preliminary Draft Vol 1 Main Report Sept. 2004.

the extent of the benefit will clearly depend on a focused effort at upgrading the supporting social infrastructure currently available.

6.4.1 Demographics

Potential Impacts- Construction Phase

The construction phase will see an increase in the number of persons entering the area for casual labour. This will, in the short term, alter the character of the area. Concerns have been raised by members of adjacent communities that this could affect the security of the area. Traffic is expected to increase with the movement of construction workers and haulage vehicles. These impacts may be major for the short term but are reversible as they will end when the construction phase ends.

Mitigation Measures - Operation Phase

- Communities should be made aware of the project and the construction schedule so that they may be aware of potential increase in human interactions.

- Proper use of construction signs, detours, and flaggers should be implemented as appropriate.

- JNHT be enabled to inspect the site before it is cleared for construction, and that to facilitate inspection select areas be cleared by the developer. JNHT should also hold a watching brief over the duration of the construction phase.

- Impetus needs to be given to the dialogue between government and developers in relation to realistic ways of integrating the provision of some basic social services into project design. Precedent has already been set.

- In relation to the Project, consideration could be given to accommodating a satellite clinic within that group of units earmarked for communal services. Medical waste collection and disposal to be the responsibility of the Ministry of Health.

6.4.2 Traffic

Potential Impacts - Operation Phase

Traffic is expected to increase during the operation phase. This impact is major, long term and irreversible.

Mitigation Measures

All measures as recommended in the Traffic Impact Assessment must be implemented.

Responsible Parties: GOJ Agencies, Developer.

6.4.3 Public Health and Safety

Potential Impacts

The area within which the project is sited is prone to flooding as a result of an inadequately designed drainage channel. The overflow of this highly polluted water into residences and public areas is a cause for concern.

Should the waters of the drainage channel overflow onto the New Harbour project site, then consequent to the polluted nature of the water there would likely be health and safety issues that may affect the residents. Smells from the water are also likely.

The project site is situated in an area which was predominantly agricultural land use. St. Catherine's agricultural lands have a high percentage of lands under sugar cane cultivation, where burning is a common practice during harvesting. The nearest sugar cane fields are at least 10 miles away and no negative impacts are anticipated for workers or residents from burning cane fields. Similarly, agricultural practices adjacent to the project site are primarily shrimp and fish farms and there are no anticipated negative impacts to workers or residents from the use of pesticides.

Mitigation Measures

- Proper design and management of the proposed New Harbour Village sewage treatment plant consistent with the national sewage regulations.

- The improved drainage system will allow waters to flow and the existing stagnant condition should no longer exist. Additionally, treated effluent from the STP and the RO plant will present increased volume and a dilution factor so that smells should be minimal.
- National Environment and Planning Agency and the Environmental Health Unit should require the owners and operators of the commercial entities discharging into this drain to conform to the National Trade Effluent Regulations.
- The proposed drainage designs for the project will be adequate to ensure that waters from the drainage channel do not overflow into the residences.
- In the event that any sugar cane plantations are brought into production in close proximity to the site, the owners of the sugar cane plantations should be required by the regulatory and enforcement agencies (NEPA and EHU primarily) to inform all residents of the proposed housing development of the intention to burn cane fields and indicating the period of burning proposed. This will inform the residents and allow them to make any necessary preparations in a timely manner.

Responsible Parties: Regulatory and Enforcement Agencies,(as and if required) Sugar Cane Plantation Operators, Engineers.

7.0 Positive Impacts

Several positive impacts are expected from the development of New Harbour Village, as proposed. These positive impacts are given below:

7.1 Generation of Employment in the Construction Phase

During the construction phase employment will be generated for skilled and unskilled labourers as well as some professionals. Employment opportunities should continue for the duration of the project. Opportunities will be created for the supply of various types of construction materials which is expected to be 3 years.

7.2 Provision of Housing in the Operation Phase

In the operation phase 845 housing solutions will be provided in the New Harbour Village. Public perception has indicated a need for the housing and anticipation for this new development. The planned development, meeting the requirements of current land use allocation for the region will be a positive impact, as it discourages the informal and unplanned settlements that have occurred elsewhere.

7.3 Reduction of Flooding Potential

In extreme rainfall events flooding occurs at the north east of the property and the adjacent Belmont Park Housing subdivision. The existing drain is under capacity to carry the flow. The engineering design for the drainage for this project will include improvement of that drain by increasing the capacity through increase of depth to 3.6 m and elimination of a 90 degree turn to crease two 45 degree turns. This will be a significant improvement of the drain and will reduce the flooding events currently experienced. This will be a positive impact that will be experienced off the property.

An existing pool of water to the east of the property flows into a micro dam which is off the property. This will be drained and water routed directly to the new dam.

Flooding on the Old Harbour Bay main road is reported during heavy rainfall events. The water flow from the property will be retarded by the creation of a detention pond which will assist in providing a net reduction of flow to the main road.

7.4 Education

Gore Developments will provide approximately half an acre of land to be given to the establishment of a Basic School, which is typically built, owned and operated by a separate entity.

7.5 Land Use Planning

In accordance with the recommendations of the Highway 2000 Corridor Development Plan (PIOJ, 2005), this proposed housing development will fulfill requirements for an area zoned for residential use. This will ensure that the land does not remain idle, become occupied illegally or be used for any illegal activity. Planned developments also easier to police as road networks are structured and named and entrances and exits are designated.

8.0 Cumulative Impacts

In addition to the potential impacts identified some cumulative impacts have also been identified.

8.1 Change of Land Use

Most of the area was originally under agriculture but based on the Highway 2000 Corridor Development Plan a large section is slated for residential and urban use. This development will be a part of this change in land use. This is not expected to be a negative impact as many of these lands have not been actively under agriculture and the need for affordable housing in the area is large.

8.2 Traffic

Traffic congestion on the Old Harbour Bay road is expected to increase significantly with the construction of 845 houses, as the vehicles from these houses will utilize this road. The Traffic Impact Assessment has identified measures to minimize this effect. The transportation network will require some improvement (the responsibility of the National Works Agency). During heavy rainfall events the flooding on the Old Harbour Bay road often experienced is likely to exacerbate the impeded traffic flow. Properly engineered access and egress for the development should prevent congestion at the entrance/exit.

8.3 Solid Waste Disposal

Garbage collection is the responsibility of the National Solid Waste Management Authority (NSWMA). The New Harbour Village will have to be included on the route and schedule for collection. The addition of 845 residential units to this area will create a cumulative impact of solid waste generation which will require appropriate collection and disposal by the NSWMA. It is the responsibility of the developer to write to the NSWMA to advise them of the proposed development.

9.0 Recommendations from Regulatory and Other Agencies

Recommendations from regulatory agencies have been incorporated into the mitigation measures but are also presented here for clarity with an explanation of the current status.

9.1 ODPEM Recommendations

ODPEM Recommendations	Current Status
Correct the 90 degree turn which the drainage channel takes at Christian Way to reduce overtopping.	This will be addressed with the culvert re-design with a 35 to 45 degree angle reduction.
Hydrological assessments to determine peak flows etc. will need to be done in order to determine adequate drainage channel size.	This has been done by the design engineers.
The drainage channel that bisects the site will have to be improved through engineering works.	This will be done by upgrading the natural drain to a concrete lined drain reserve.
Cut-and-filling to be supervised by a qualified engineer to ensure that lot levels are raised adjacent to the drain and ensure stability throughout the site.	This is addressed within the construction design documents.
The ODPEM recommends that the eastern boundary be considered for an upgrade to alleviate any possibility of flooding should the topographically higher areas such as Marlie Mount and Claremont be developed in the future.	This recommendation is overly conservative given that no significant flooding event has been noted by the fish farms that lie between the eastern boundary and the Fraser Gully. It is likely that this facility would have to be inundated first before the eastern boundary is affected.

9.2 Jamaica Environment Trust (JET) Recommendations

The Jamaica Environment Trust (JET) reviewed the Terms of Reference for the EIA and sent comments directly to Environmental Solutions Ltd. and copying NEPA. These comments are given in Appendix XVIII, and have been incorporated into this EIA report as appropriate. JET recommends the preparation of a Soil Erosion Management Plan for the construction phase. Mitigation Measures to minimize soil erosion and the secondary

impacts of contamination of drainage channels, have been presented in this EIA report. A Soil Erosion Management Plan is also included as Appendix XXI.

10.0 Consideration of Alternatives

10.1 Alternative Sites

Two other sites were considered for this development. These sites were both in Clarendon. One of the sites was no longer considered as legal ownership was in dispute. The other site was not considered to be favourably located, and the land use zoning was not confirmed.

10.2 Sewage Treatment Plant

The design of the STP meets the NEPA requirements for effluent discharge and is an overseas plant provided by a local agent. A maintenance contract will be included.

10.3 Potable Water Supply

Water supply for this area of St. Catherine is a major challenge as confirmed by the WRA. There is no other source of water. The existing well recently advanced on the site has adequate quantity to meet the needs of the development. The quality of the water is affected by high levels of total dissolved solids which is treated by Reverse Osmosis, a globally accepted technology which will provide water of potable quality. Discussions have been held with the NWC who are not interested in running the plant and a private utility company will provide this service.

Another source of potable water was considered as the NWC indicated it would provide water for the development. However, the WRA indicated that the NWC was not in a position to provide water for the development as the WRA is responsible for the determination of yield from surface and ground water flows.

The developers opted to utilize the source from the well, as the sustainable yield was confirmed by the WRA.

10.4 Housing Solutions & Green Space

Housing solutions have been determined based on the green space requirements of NEPA and including set back requirements from the drainage channel and the STP.

10.5 The No Action Alternative

The No Action Alternative would see the property at New Market Pen remaining in the existing condition, which is a mixture of secondary vegetative growth and unused agricultural lands. The No Action Alternative would see 845 housing solutions not being constructed for the Old Harbour area and no fulfillment of the potential opportunities for employment in the short term for skilled and unskilled workers. If Gore Developments does not construct this development at this site, it is likely that another developer will do a housing development there as the area is zoned for residential use under the Highway 2000 Corridor Development Plan 2004-2005.

11.0 Outline Monitoring Programme

If a permit is granted for the proposed development, and before site preparation and construction activities begin, a Monitoring Programme should be prepared for submission to NEPA, for their approval. The aim of the Monitoring Plan is to ensure the following:

- ✓ compliance with relevant legislation
- ✓ implementation of the mitigation measures provided
- ✓ conformance with any General or Specific Conditions as outlined in the permit
- ✓ long-term minimization of negative environmental impacts.

The Monitoring Plan should include the following components:

- Inspection protocol
- Parameters to be monitored, which should include
  - Ambient air quality
  - Water quality
  - Perimeter noise
- Construction monitoring
  - Worker health and safety
  - Disposal of solid waste
  - Disposal of hazardous material
  - Disposal of liquid waste
  - Draining and rehabilitation of sewage pond
  -
- Materials handling and storage
- Covering of haulage vehicles
- Transportation of construction materials
- Deployment of flaggers and signposting
- Storage of fines and earth materials

The duration of the monitoring programme should be for the entire construction period, with monthly reporting.

The Monitoring Programme cannot be prepared in detail before the permit is received from NEPA as Terms and Conditions of the permit must be taken into consideration, and included in the monitoring programme as appropriate.

The cost of monthly monitoring is approximately US$3,000 per month.

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[ii] http://www.nrca.org/eias/StCatherine/Brampton/EIA_MarineShrimpFarm_Brampton.pdf , accessed June 20, 2006