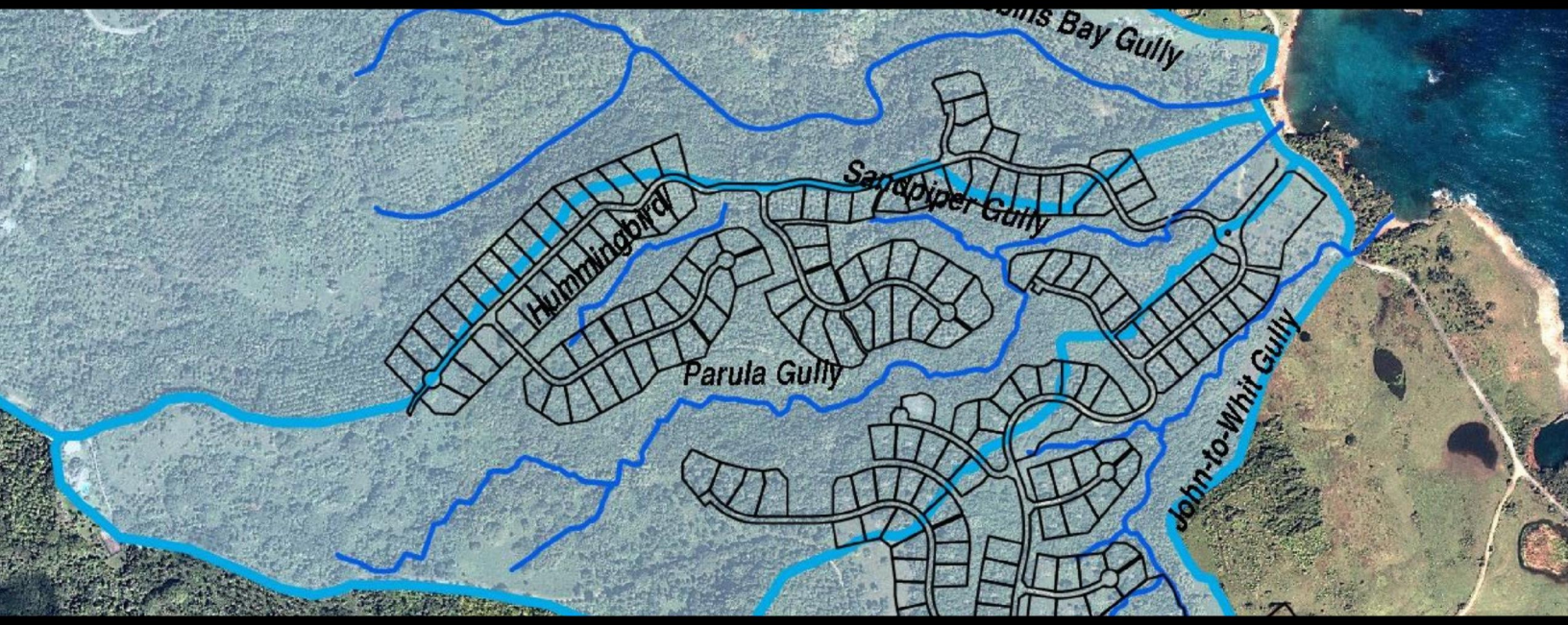
ENVIRONMENTAL IMPACT ASSESSMENT

for the Proposed Residential Sub-division Site, at part of Greencastle Estate, Robin's Bay, St. Mary



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Prepared for Greencastle Estate Ltd

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NATIONAL ENVIRONMENT & PLANNING AGENCY

PERMIT APPLICATION: 2012-05017-EP00136

ENVIRONMENTAL IMPACT ASSESSMENT

FOR A PROPOSED RESIDENTIAL SUB-DIVISION AT PART OF GREENCASTLE ESTATE, ROBINS BAY, ST MARY, JAMAICA

March 2013

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March 2013

Acknowledgements/List of Contributors

Environmental Management Consultants (Caribbean) Ltd. was contracted by Greencastle Ltd to prepare this report.

- Dr. Ravidya Burrowes prepared the following sections: Executive Summary, Project Description, Analysis of Alternatives, Legal Framework Impacts Assessment and Environmental Management Plan.
- Mr. Marc Rammelaere was primarily responsible for the Physical Baseline. He also assisted with Stakeholder Consultations.
- Mr. Llewelyn Meggs prepared the Ecology Baseline section.
- Ms. Kamille Dwyer prepared the Socio-economic Baseline. She also contrubuted to the Land Use, Heritage Resources and Traffic Survey sections of the baseline.

The preparers of the EIA are grateful to the following persons for their input to the EIA process:

- Mr John Marcocchio, Sub-Division Project Manager.
- Mr Karl McIntosh OF Noel Whyte and Associates Ltd.
- Ms Elaine Russell, Green Castle Estate.

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Executive Summary

This Environmental Impact Assessment (EIA) is submitted in support of the applications made by Green Castle LLC (GCL) for sub-division approval and an environmental permit for a proposed residential sub-division. Green Castle Estate is located along the north coast of Jamaica, in the vicinity of the village of Robins Bay in the parish of St Mary. The largest nearby town is Port Maria, which is located ~12 km to the north west of the site (along the coast). Annotto Bay is located ~ 5 km to the south-east of the site along the coast.

The parcel proposed for sub-division (Volume/Folio: 646/49) has an area of 77.46 ha and represents ~12% of the total 1600-acre area of Green Castle Estate. The applicant is seeking permission to sub-divide this parcel into 171 residential lots with provisions for infrastructure and services. The proposed sub-division lots are priced to sell at 75,000 USD per lot (~7 million JMD). The sub-division has been designed with this demographic in mind, with relatively large low density lots all backing onto open green space. Sub-division infrastructure shall be provided inclusive of water, power, stormwater drainage, and roads. All lots shall be properly surveyed and titles provided. The infrastructure shall be developed in such a way to have low impact in terms of visual intrusion and environmental footprint. Sub-division amenities shall be provided including: access to green space, walking trails along green preserves, vistas, and landscaped public areas. The proposed residential sub-division has a design density 2.2 lots/ha. The design population is ~1026 persons (at full build-out). It must be emphasized that the actual population is not expected to (a) be fully resident upon completion of lot sales, or (b) be permanently resident even after villas are constructed.

This assessment examined a number of environmental impacts that were identified during the course of site investigations and stakeholder consultations (see Table below).

Construction Phase	Operational Phase
Visual Intrusion	Change in land use
Increases in Ambient Noise Levels	Visual aesthetic
Reduction in Air Quality (Construction sites)	Change in air quality
Contamination of Surface Water by site effluents	Increased ambient noise
Contamination of Surface Water by sewage & grey water	Night time Lighting
Loss of Vegetation Cover	Degradation of Nature Preserves
Demand for Landfill Space (Construction Solid Waste)	Introduction of Invasive Pest Species
Adverse Effects of Construction Traffic	**Increased Demand for Solid Waste Disposal**
Vending and Food Hygiene	Demand for Municipal Services
Slope Instability	Traffic Impact
Accidental Damage to Buried Artifacts	Decline in Water Quality in receiving water bodies
Carbon Footprint	Flood Risk

Most of the impacts (21 of 24) were classified as having a minor residual impact. Three of the impacts were classified as having the potential to have a residual effect that was medium-scale: (1) adverse effects of construction traffic (2) carbon footprint (3) demand for solid waste disposal during the operational phase. Of the 24 potential adverse impacts that were evaluated, there were no impacts that qualified to be classified as major, as defined in paragraph 6.8.

This study therefore concludes a finding of no significant impacts and recommends that the project be granted an environmental permit subject to the conditions listed in the following section. Cost effective mitigation measures are summarized below.

Planning & Design Mitigation Measures

- Explore the feasibility of setting up a Forest Reserve within the wider Green Castle Estate to off-set vegetation losses in the development site (~15 ha).
- Off-set carbon footprint of the project.
- Have dialogue with NWA to ensure that the best practices are being implemented.
- Have dialogue with NWC to ensure that water can be provided in the quantities needed.
- A geotechnical investigation should be conducted to inform the final road design. Particular attention should be paid to areas where the fill is expected to be more than 1 m. Upon field survey of the road alignments, it should be ascertained that lands adjacent to filled areas will drain freely, and the all required culverts are installed as planned.

Construction Phase Mitigation Measures

- Implement the construction of the detention basins and stabilized construction exits prior to the commencement of construction works for sub-division infrastructure.
- During infrastructure development phase contractors should be required to implement the following mitigation measures to minimize environmental impacts during the construction of sub-division infrastructure.
    - Manage fugitive dust and air pollution.
    - Manage nuisance noise.
    - Manage stockpiles & material stores.
    - Implement controls on vehicle operation and maintenance to prevent pollution.
    - Manage traffic issues.
    - Manage solid waste.
    - Make provisions for construction workers.
- Contractors should also implement:
    - A standard procedure for dealing with artefacts unearthed during any excavations.
    - Procedures for shutting down the laydown/site office and construction sites within the property in the event of emergency (e.g. hurricane or earthquake).
    - Procedures for closure or decommissioning of the infrastructure development phase.

Guidelines for the Lot Purchasers' Agreements (Development Standards)

- This should include restrictions on:
    - The extent of the built footprint on any given lot to maintain built density ratios. Buildings should not exceed two storeys.
    - The kind of land use that is allowed, i.e. residential use
    - The use of colours and construction materials with a preference for natural or earth tones and materials.
    - Off-site stormwater outflows.
    - Building on the steeper sections of any particular lot that is close to a valley.
- It can also include "green design guidelines" such as:
    - Site buildings should be designed to maximize the use of natural light.

- Design buildings to be naturally cool.
- Selection of design and materials that minimize the use of concrete or cement products with a preference for natural materials like stone and wood.
- Discourage fences and boundary walls between properties.
- Grating of roof openings to discourage occupation by birds or bats.
- Encourage rainwater harvesting systems to be installed.
- Utilize photo-voltaic cells if possible.
- Select material suppliers that are located closer to source.
- The use of plumbing fixtures that allow conservation of water as necessary, e.g. low flow faucets.

– Clear guidelines should be given in respect of:
  - The types of foundations that would be acceptable given geotechnical conditions that are likely to occur across the site.
  - The type of sewage disposal system to be used given various percolation rates that are likely to occur on the property.
  - Methods to retain storm water on each individual lot, through grassy verges and other strategies to promote on-lot infiltration. Encourage interior design plans that utilize energy efficient appliances such as inverter air conditioners, solar water heaters.
  - Compliance with building codes for hurricane and earthquakes in Jamaica.
  - The need to verify the stability of sections of lots on steep slopes before construction is undertaken on the lots.
– In respect of construction, the LPA should make recommendations in respect of
  - Construction screening.
  - Prevention of site run-offs during construction.
  - Control of soil erosion on each lot site during construction.
  - Provision of workers with a temporary pit latrine (soak-away) and shower on site.
  - Minimization site clearance and preserve large trees.
– In respect of possible controls during the post-construction phase (occupancy), the LPA can encourage:
  - Planting of vegetation (gardens) around dwelling units.
  - The use of lawn mowers to week-days, during the hours of 9 am and 4 pm.
  - Properly housed and noise muffling to be installed on all back-up generators.
  - The use of fluorescent or LED lights to the extent practicable.
  - The use of motion activated bulbs for security.
  - The use of light sensitive or programmable lights that will shut off automatically when there is enough ambient light.
  - The angling of external lights downwards or use lamp shades.
  - Populating of garden ponds with fish as means of controlling mosquito larvae.

Ownership of the green space within the boundaries of the sub-division will be deeded and granted (at no cost) to the Homeowners Association, which is a collective of all lot owners. Maintenance of all public areas, including roads, verges, community lots and drainage infrastructure will be the responsibility of the Homeowners Association once it becomes an operational entity. All lot owners will automatically become members of this association upon signing the LPA.

- It is recommended that the Homeowners Association also:
  - Ensure that there is routine collection of garbage from residential lots.
  - Designate and mark nature trails.
  - Place signs asking users not to deviate from the nature trail or collect vegetation.
  - Place signs restricting walking dogs or smoking on nature trails.
  - Designate a controlled picnic area where the risk of fire is low.
  - Ensure that bank and gully vegetation is not disturbed.
  - Retain a list of private medical practitioners in the area.
  - Prohibit commercial parties ("sessions") from being held on property.
  - Prohibit racing (running or biking) or playing of music along nature trails.
  - Prohibit bird shooting.
  - Encourage the use of shuttle service to large private functions, with a large parking area designated on the outskirts of the development.
  - Encourage and facilitate large private functions to be held at the Estate Country Club.
  - Be responsible for implementation of the Evacuation Plan (which was required in the TORs by NEPA).
- It is recommended that the Homeowners Association make available posters or information (through the Sales Office) to increase environmental awareness concerning:
  - The presence of a near-threatened species of bird (White Crowned Pigeon, Bald Pate), which is endemic to this region.
  - Protected wildlife species, whether or not they are found at Green Castle Estate.
  - Strict rules for putting out trash.
  - The stipulations of the Noise Abatement Act (paragraph 3.17).
  - Pet neutering.
  - Domestic waste reduction.
  - The need for water conservation during periods of drought.
  - Closed season for lobster.
  - Permit requirements for recreational fishing.

SECTION 1 PROJECT DESCRIPTION

The aim of this task is to 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.

Introduction

Background

1.1. This Environmental Impact Assessment (EIA) is submitted in support of the applications made by Green Castle LLC (GCL) for sub-division approval and an environmental permit for a proposed residential sub-division. An Environmental Permit is required for the sub-division of 51 lots or more in accordance with the Natural Resources Conservation Authority Act Permit and Licenses Regulations (1996). The EIA has been prepared in accordance with the Terms of Reference, which were approved by the National Environment and Planning Agency on October 17, 2012 (Appendix 1).

1.2. The applicant contracted Environmental Management Consultants (Caribbean) Ltd (emc2) to prepare the EIA in accordance with approved Terms of Reference (TORs). Prior to this (2011) emc2 conducted a comprehensive Environmental Baseline of the area, which was used to inform and the guide the planning process.

1.3. Green Castle Estate has a total acreage of 647 ha (1600 acres), registered on four (4) individual titles: Volume/Folio 646/49, 335/1, 335/2 and 510/96. The parcel proposed for sub-division (Volume/Folio: 646/49) has an area of 77.46 ha (191.41 acres) and represents ~12% of the total 1600-acre area of Green Castle Estate.

1.4. The applicant is seeking permission to sub-divide a 77.46 ha parcel into 171 residential lots with provisions for infrastructure and services. This parcel was formerly part of the wider Green Castle Estate. The Rural Physical Planning Division of the Ministry of Agriculture was approached with the proposal to change the land use at the development site from agricultural to residential. Further to a site visit, the RPPD concluded in June 2012 that "*Taking into consideration soil type, topography and suitability for agriculture, the RPPD has no objection to change of use for the Green Castle Estate as proposed" (*Appendix 2)

The Proponents

1.5. Green Castle Estate is owned by a family trust, which is registered in the United States. Since acquiring the estate in 2007, the owners (the Padgett Family) has promoted and encouraged the development of agro-businesses on the property by issuing leases to JamOrganix, GC Orchids, and the Eastern Livestock Development Association Ltd.

Development Rationale

1.6. The owners of Green Castle Estate in St Mary have created a Master Plan for the long-term development of the property. The first component of the Master Plan to be planned in detail is the proposed residential development for which the environmental permit is being sought. The development proposal involves the sub-division of 171 lots which are designed to take advantage of the salubrious sea-side climate of the estate, as well as the spectacular views of the sea and the Blue Mountains.

1.7. The development of the residential sub-division as the first component of the Master Plan is intentional, as the sale of these lots is expected to generate income and leverage to facilitate the development of other non-agricultural and agricultural components of the Master Plan.

1.8. The proposed sub-division lots are priced to sell at 75,000 USD per lot (~7 million JMD). With an overall average lot size of 1,573 m2 (~16,175 sf or 0.4 acres), the average price per square foot is ~4.4 USD per square foot (developed lots). This would be considered a mid-range development, which would primarily attract second home buyers (e.g. retirees or investors), who are looking for a country villa retreat. The sub-division has been designed with this demographic in mind, with relatively large low density lots all backing onto open green space. There would also be strict controls in the purchase agreement limiting construction materials and villa size to maintain a rustic open feel to the development.

1.9. It is therefore not expected to be a high proportion of the property occupied by permanent residents with children that need to go to school, or adults that have to commute to work during week-days. It is envisioned that a few older local or foreign retirees may take up residence here, but the majority of lots will be purchased by town residents seeking a country home or vacation rental property, or foreigners looking for a home that is surrounded by natural tropical landscapes. Consequently, no increased pressure on schools or commuter traffic is expected.

1.10. Dwelling units are expected to be relatively small (with an average size of 2,500 to 3,000 square feet), with no more than 3 bedrooms. In general household size would be expected to average less than 2 persons per bedroom, and less than 3 occupants per unit.

1.11. Aside from helping to finance the later development phases of Green Castle Estate, it is expected that the sub-division would bring a range of wider social and economic benefits to the area, including:

- Increasing the availability of developed lots on the market for investment by a wide range of persons including Jamaicans.
- Contributing to the development of tourism in the area through the development of vacation homes and rental villas.
- Stimulation of the construction sector through the creation of jobs and demand for construction materials.
- Creation of jobs (house-keepers, gardeners, security, cooks etc.) once houses are occupied.
- Stimulation of the local economy at Robin's Bay, through the demand for restaurants, groceries, supplies (e.g. fresh produce and fish).

1.12. The developers presently have several social linkages and the Robin's Bay Community, particularly as they are the owners of the land on which the elementary school is built. It is expected that the developers will continue to support the community through contributions to community sporting activities, as well as other community organizations.

Location and Setting

1.13. Green Castle is located along the north coast of Jamaica (Figure 1), in the vicinity of the village of Robins Bay in the parish of St Mary. The largest nearby town is Port Maria, which is located ~12 km to the north west of the site (along the coast). Annotto Bay is located ~ 5 km to the south-east of the site along the coast. The site is about 45 minutes to an hour from either Ocho Rios or Kingston by car, with Ocho Rios proper being a slightly further away than Stony Hill in Kingston (~30 km away if driven via Junction).

1.14. The development site is bound on its northern side by the old (pre-north coast highway) main road to Robins Bay, which is maintained by the National Works Agency. The Green Castle Estate extends to the other side the old main road by shoreline which is not included in this development parcel.

1.15. On its southern and eastern sides the site is bound by the lands of the wider Green Castle Estate, which are owned by the applicant. On its western side it is bound by the community of Robin's Bay.

1.16. The site is located within Wagwater Basin (Water Management Unit #9), and lies at elevations between 15 m and 80 m above mean sea level (amsl).

1.17. Although the site was previously zoned for agricultural land use under the National Physical Development Plan (NPDP, 1970-1990), approval for a change of use was sought and obtained in 2012 from the RPPD (Appendix 2). Being within 1 mile of the coast on lands with low agricultural potential, the sub-division site lies within a belt considered to be prime real estate for tourism and residential development, and to yield the highest return on investment if development in this manner.

1.18. The proposed development is located within the Town and Country Planning (St Mary Coast) Confirmed Development Order 1963, which guides planning, management and development of land within the coastal areas of St Mary (within 1 mile of the shoreline). The nearest proposed residential lot lies 180 m from the sea. The furthest lots are located ~1,200 m (0.75 mile) from the shoreline.

1.19. NEPA's Local Area Planning Branch is responsible for administration of Development Order in conjunction with the local authority. Under this plan, the proposed sub-division site is not zoned for any particular land use; the beach at Robins Bay is zoned as a commercial/fishing beach, while the beach at Jack's Bay (the northern part of Annotto Bay) is zoned for public recreational use.

1.20. The site does not lie within any known national Protected Area.

Figure 1 Greencastle Residential Subdivision, Green Castle Estate, St Mary, Jamaica

Sub-division area shown in blue shading. Green Castle Estate in green outline.

Project Overview

1.21. The design philosophy of the owner, Mr Richard Padgett, has guided the development of plans for the sub-division. This design philosophy includes the following core values. Environmental information (ecology, heritage, terrain) informed the planning and design process so that environmental constraints can be identified and taken into account. In accordance with this, the environmental baseline was prepared to guide the design work prior to completion of the design. Preliminary environmental planning guidelines such as recommendations to avoid riparian zones, and use of existing farm roads to avoid re-grading new areas have been taken into account in the designs presented for permitting.

1.22. The rural character of the place shall be preserved with minimal disturbance to the existing vegetation (i.e. minimal landscaping and land clearance) and slopes (i.e. minimal site grading, new road cutting etc.). To this end, the existing farm roads and natural drainage systems have been integrated into the design to the extent reasonably practicable. The developer wishes to maintain a low-density character. Therefore, not more than 171 lots shall be developed, and these lots shall be not smaller than 1,193 m2 (12,265 sf), with an average size of 1,573 m2 (16,175 sf).

1.23. Sub-division infrastructure shall be provided inclusive of water, power, storm water drainage, and roadway access. All lots shall be properly surveyed and titles provided. The infrastructure shall be developed in such a way to have low impact in terms of visual intrusion and environmental footprint.

1.24. Sub-division amenities shall be provided including: access to green space, walking trails along green preserves, vistas, and landscaped public areas (such as sidewalks, roadways etc).

1.25. The main entrance to the sub-division shall be properly planned and developed in collaboration with the National Works Agency, with due consideration for road crossings, and culverts, etc.

1.26. Architectural elements of the entrance façade and other public areas shall be consistent with the overall development concept. Restrictions shall be placed on lot purchasers in respect of fencing type and elevation, boundary setbacks (for houses), elevations and over-all size of houses.

Design Parameters & Site Planning

Lotting& Phasing Plan

1.27. The proposed residential sub-division consists of two development phases during which a total of 171 residential titled lots will be sub-divided and provided with infrastructure (storm drainage, roads, electricity and water mains).

1.28. A simplified phasing plan showing the general site layout is given as Figure 2. Infrastructure for the first 109 lots will be developed (as Phase 1) at the higher elevations of the sub-division area. The line of demarcation between Phases 1 and 2 roughly divides the sub-division into northern and southern sections, with Phase 1 north of the line and Phase 2 to the south. Each of the two phases is further divided into two sub-phases (Phase 1A, Phase 1B, Phase 2A Phase 2B) as shown on Figure 2.

1.29. The first subdivision developed, Phase 1A will be developed upon acquisition of the necessary permits, inclusive of the sub-division approval and environmental permit for the sub-division. The schedule for the development of subsequent phases will depend on market forces and sales for Phase 1A. It is not possible to say at this time how long it would take before each phase is sold out.

1.30. As seen in Table 1, the minimum lot size in the 171 lots is 1,193 m^2, which is greater than the recommended minimum lot size of 1,012m2. The average lot size in the sub-division range from ~1,710 m^2 (18,300 sf or 0.42 acres) in Phase 1B (which has the largest average size) to ~1460 m^2 (15,715 sf or 0.36 acre) in Phase 2A (which has the smallest average size). On average, the lots being created in Phase 1 are slightly larger than the lots being created in Phase 2.

Phase	No. of Lots	Lots	Total Area (ha)	Lot Size (m2)		
				Mean	Max	Min
1A	58	1 to 58	9.5	1635	2488	1297
1B	51	59 to 109	8.7	1710	2061	1290
2A	35	110 to 144	5.1	1462	1948	1193
2B	27	145 to 171	4.0	1494	2223	1289
	171		**27.3**			

Table 1 Summary of Lot Development

1.31. Using the total sub-division parcel of 77.46 ha, the density is 2.2 lots/ha. It is therefore expected that the final build-out habitable room density will be well less than the maximum permissible density is 75 habitable rooms/ha (30 habitable rooms/acre). This stipulation shall be included in the lot purchasers' agreement.

1.32. The allowable footprint and floor area ratio are 33 1/3% (of net area) and 1.0 : 0.5, respectively for the site. This stipulation shall be included in the lot purchasers' agreement. That would be more than 5000 sf per house.

1.33. Assuming a maximum population size of 6 persons per home (3 bedrooms with 2 persons per bed room) at full build-out the sub-division is expected to accommodate less than 1,026 persons. It must be emphasized that the actual population is expected to be a lot less than this as owners are not expected to: (a) be fully resident upon completion of lot sales, or (b) be permanently resident even after villas are constructed.

Phase 1

1.34. Phase 1 of the development consists of 2 Phases (1A and 1B). Upon entering the main entrance of the sub-division (off the old coast road to Robin's Bay at Robin's Bay), the main road (to be named Jetty Road) continues for ~105 m to the southwest before encountering the first subdivision roundabout. No residential lots are planned on either side of Jetty Road. On the northern side of the front entrance road there is a large space allocation for a detention pond (with a surface area of ~9,361 m^2). Lot 1B, located on the south eastern side of the Jetty Road will be used for Estate Management purposes. A smaller detention basin (~1,382 m2) is located further east of Lot 1B.

1.35. The first 13 residential lots are located going south on the roundabout on Jetty Road along a roadway named Grassquit Terrace. This intersects with John-To-Whit Avenue, on which a further six lots are located (14 to 19). With the exception of lots 10 and 12, all of these lots are backed by undeveloped green space. These are relatively low lying lots with elevations ranging between 9 m above mean sea level (amsl) and 26 m amsl.

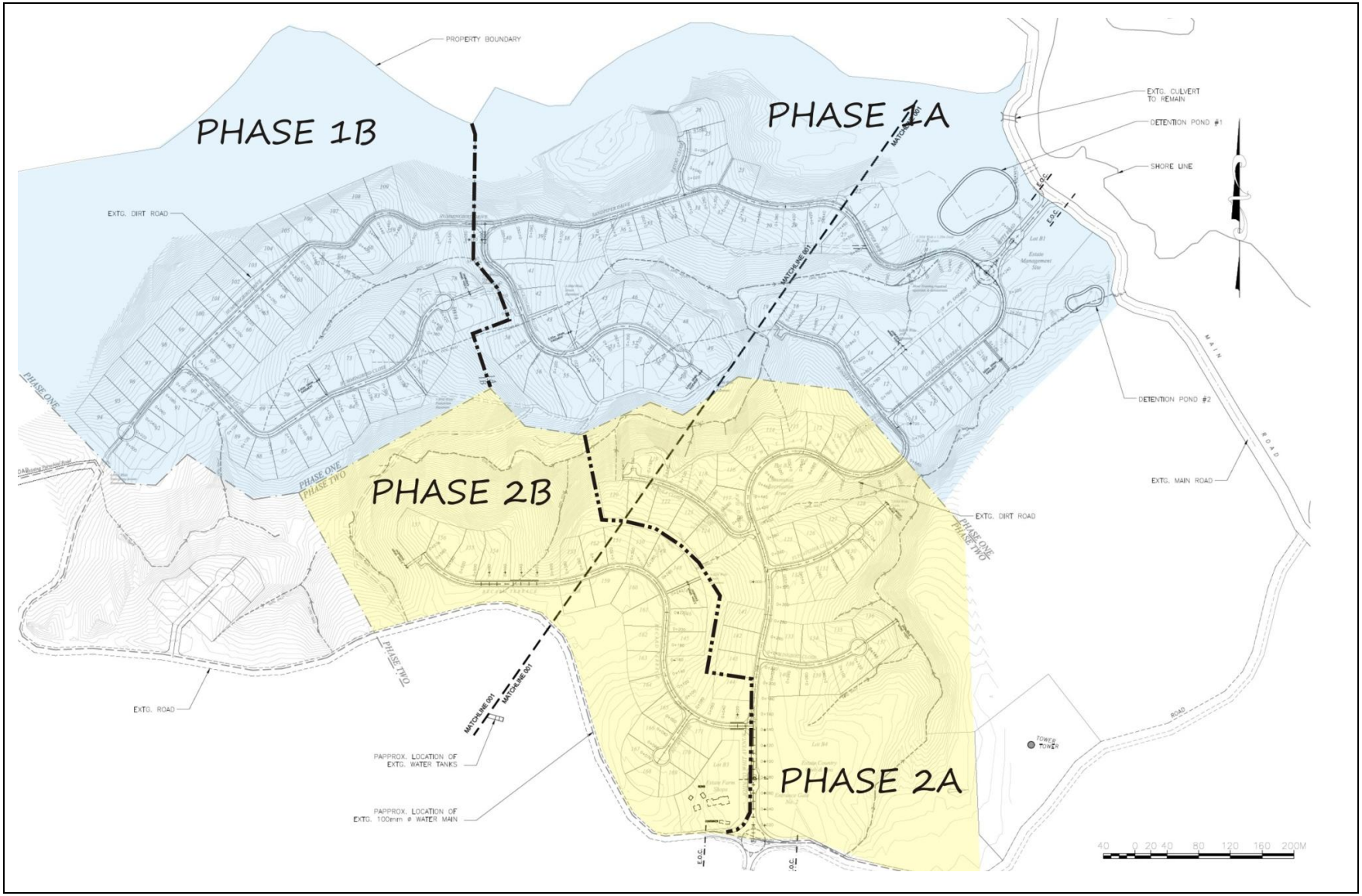

Figure 2 Phasing & General Layout

1.1. Going west on the Jetty Road Roundabout leads to the main arterial road through Phase 1, which is called Sandpiper Drive in Phase 1A continuing on as Hummingbird Drive into Phase 1B . This arterial road roughly follows an existing farm road which follows a natural ridge line. Near to the boundary with Phase 1B is a major turn-off named Mockingbird Close.

1.2. With the exception of Lot 25, Lots 20 to 40 are located directly on the Sandpiper Drive. Lots 24, 25 and 26 are located on Patoo Close, which is a short cul-de-sac on the north side of the road. Lots 20 through to 26 are the only lots located on the north side of the arterial road in Phase 1A. Lots 27 through 40 are located on the south side of Sandpiper Drive. Lots 41 through to 58 are all located along Mockingbird Close. Most of these lots are larger than the others in Phase 1A and all of lots (20 through to 58) are located at elevations ranging between 15 m amsl and 40 m amsl.

1.3. Phase 1B includes Lots 59 through to 109 (51 lots) and is 8.7 ha in size. Lots 59 through 68 and 90 through 94 are located on the south side of the arterial roadway (Hummingbird Drive), and Lots 94 through 109 are located on the north side of that road. All of these lots back onto open space. Lots range in elevation from ~85 m amsl at the far end of the road to 45 m amsl near to the boundary with 1A.

1.4. There is a south-bound turn-off immediately after Lot 68, which is called Hummingbird Close. This actually a cul-de-sac, along which Lots 69 through 89 are located. Some of the highest elevation lots in Phase 1 are located in this area, with Lots 72, 73, 83 and 84 all being partially located at elevations at ~85 m amsl.

1.5. All surveys and infrastructure for Phase 1A are expected to be completed within 12 months of receiving sub-division approval and the environmental permits. Sales of lots will commence immediately upon completion of Phase 1A infrastructure. Extension of infrastructure and surveying of lots in Phase 1B is expected to commence immediately upon the start of sales in Phase 1A. Assuming a construction start date of July 2013, it is expected that Phase 1 would be completed (at least in terms of infrastructure development) within a year (June 2014).

1.6. Development of Phase 2 will depend on market forces and sales in Phase 1A. It is possible that the entire sub-division could completed and sold-out within the next 5 years.

Phase 2

1.7. Phase 2 is also divided into development blocks (Phase 2A and Phase 2B). These lots will be developed after Phase 1 is completed. Phase 2A includes Lots 110 through 144 (35 lots) and is approximately 5 ha is area.

1.8. The eastern end of John-to-Whit Avenue continues into Phase 2A. John-to-Whit Avenue is another arterial road, off which there is Parula Close, Flycatcher Close and Kingbird Close. In Phase 2A, only Lots 110 through 117 and Lots 141 through 144 are located off the arterial road. Lots 118 through 124 are located along Parula Close; Lots 125 through 132 are located along Flycatcher Close and Lots 133 through 140 are located along Kingbird Close. John-to-Whit Avenue terminates at Entrance Gate #2. On the West side of this existing roadway are Estate Farm Shops (Lot B3, which is 0.7 ha or 2.3 acres) and on the East side, Lot B4 (5.7 ha or 14 acres) comprises a provision for an Estate Country Club and Spa. The Green Castle tower ruins are located immediately east of this space. Another communal area (B2, which is 0.4 ha or ~1 acre) is located in Phase 2A, across the road from Lots 110 through 117 on John-to-Whit Avenue. Lot B2 backs onto a minor gully. The Phase 2A lots are generally located above elevations around 40 m amsl and 60 m amsl.

1.9. Phase 2A (Lots 145 to 171) include all of 27 lots located on Becard Terrace. Becard Terrace is a turn off from John-to-Whit Avenue. This is the smallest development block (~4 ha). Elevations along this elevated road range from ~50 m amsl to ~70 m amsl.

Land Use

1.10. Table 2 shows the space allocations within the proposed sub-division. Developed space includes ~38 acres which includes titled residential lots, roads, and space allocations for the estate management office (Lot B1); Communal Recreation (Lot B2); Estate Farm Shops (Lot B3) and the Country Club and Spa (Lot B4).

Land Use Category	Area (ha)	% Total Area
Developed space		
Residential titled lots	27.4	35.4%
Roads and road reserves	4.3	5.5%
Site office, commercial & recreational	7.7	9.9%
Open space (including drainage easements)	38.1	49.2%
Total	77.5	100%

Table 2 Sub-Division Land Use Summary

1.11. The percentage of open space in the overall sub-division is ~50%. This works out to ~23 ha of open space per 100 lots, which far exceeds the requirement of 1 ha per 100 lots.

Conceptual Landscaping Plan

1.12. In keeping with sound environmental practice for landscape management the more pristine wooded areas (including wetlands, steep slopes and riparian zones) on the site shall be preserved in as natural condition. Gullies will be maintained in their natural state for a number of reasons: stormwater drainage, ecology and aesthetic quality (recreational value).

1.13. Minimal grading of lots is planned. Grading will generally be restricted to the roadways.

1.14. The verges of roadways, centers of roundabouts and cul-de-sacs, and other public areas within the sub-division will be planted with ornamental shrubs that require little water, and are acclimatized or indigenous to this area so that routine application of pesticides and fertilizer will not be necessary. This includes species such as Bougainvillea sp plumbago (*Plumbago auriculata*) and periwinkles (*Vinca* sp). Other common tropical species that may be planted include Lantana sp. *Ixora* sp, *Hibiscus* sp, *Alamanda* sp. and *Mussaenda* sp.

1.15. Trees already present at the site will be preserved as much as possible. This includes species such as Red Birch (*Betula occidentalis*), Trumpet Tree (*Cecropia peltata L.*). Thatch Palm (*Thrinax*/*Coccothrinax* sp.), pimento and other commercial crops that were grown on property. Aside from any vegetation clearance or grading necessary for the installation of roadways, curbs and engineered drains, individual lots will not be cleared or graded before sale. Individual lots will be cleared as necessary by lot purchasers.

1.16. It shall be recommended to lot owners that no fences be used on their property. If a lot owner insists on fencing, chain-link fencing fronted with hedge-rows forming the boundary-line landscaping will be allowed. A diversity of tropical hedge forming species shall be recommended for use throughout the property.

Infrastructure& Utilities

Roadways

1.17. There are two main gate entrances to the sub-division. The first is located in Phase 1A, off the Robins Bay old coast road as shown on Figure 3, which is Jetty Road. The second is located in the southern part of Phase 2A (off the Tower Road inside Green Castle Estate), and opens to John-to-Whit Avenue. The old coast road to Robin's Bay was previously part of the main north coast road. However, with the development of the North Coast Highway, this road has become downgraded to a "B" class or local road. The North Coast Highway is 2.5 km from the site on the far eastern side of Green Castle Estate. Tower Road is an internal estate road that may be used by member of the Robins Bay community in the event the main road is impassable.

1.18. The development proposal requires the construction of 4.5 km of new roads (see Table 3). There are two types of roads, the main entrance roads (Jetty Road and Jon-to-Whit) which have a reserve width of 15.24 m (Type I) and all other subdivision roads, which have a reserve width of 9.144 m (Type II). The total area allocated to road reserve is 4.8 ha (11.9 acres). Sixty percent (60% of all new proposed roads) will be built in Phase 1.

	Length in meters				
Road Name	**1A**	**1B**	**2A**	**2B**	**Total**
Jetty Road	118.98				118.98
John-to Whit Avenue	195		590.65	144.48	930.13
Grassquit Terrace	264.26				264.26
Sandpiper Drive	667.48				667.48
Hummingbird Drive		587.99			587.99
Hummingbird Close		429.37			429.37
Patoo Close	83.24				83.24
Mockingbird Close	384.41				384.41
Flycatcher Close			123.53		123.53
Kingbird Close			131		131.00
Parula Close			179.23		179.23
Becard Terrace				576.31	576.31
Becard Close				65.95	65.95
Total Road in Phase	1,713.37	1,017.36	1,024.41	786.74	**4,541.88**

Table 3 Road Lengths by Road and Phase

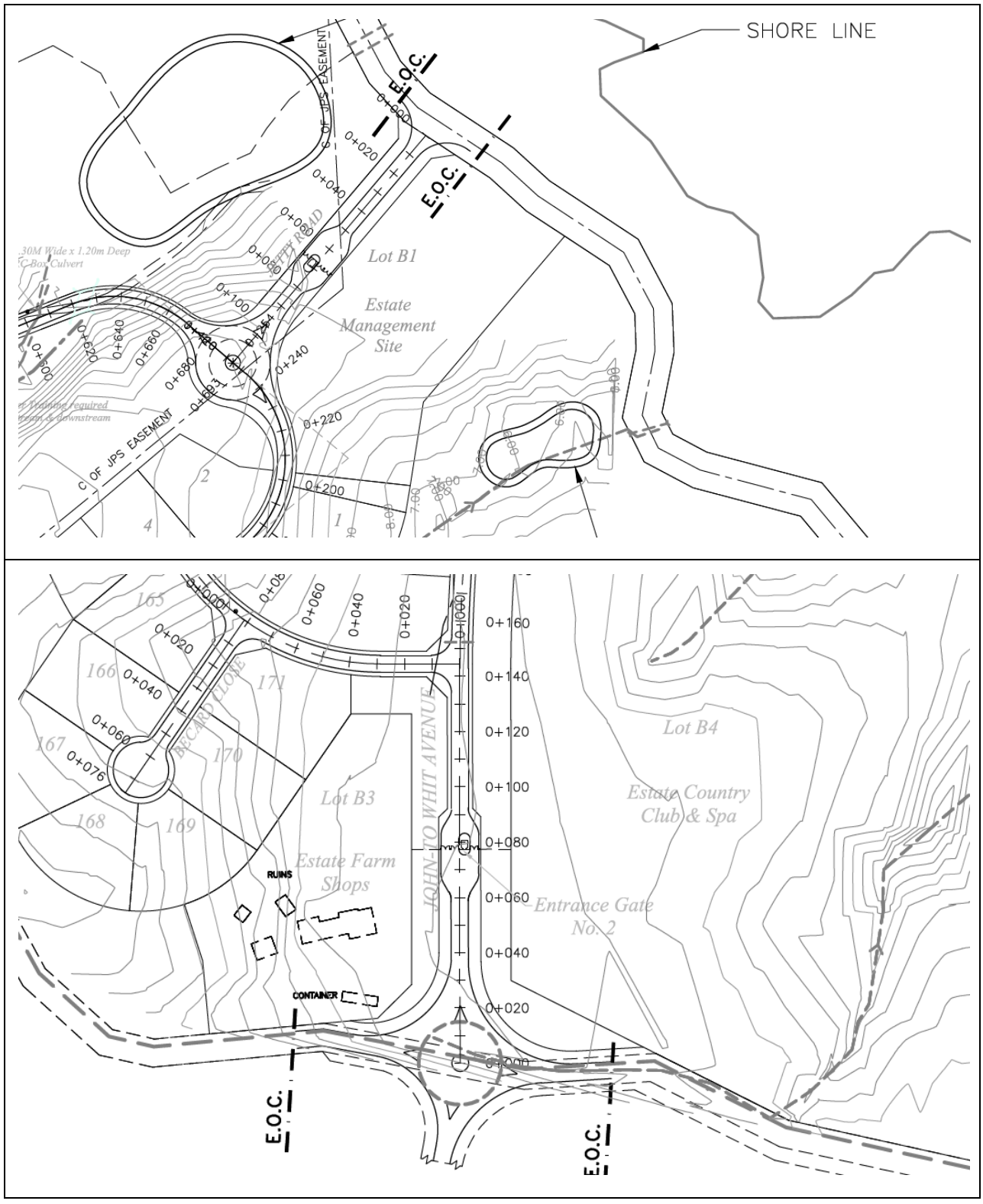

Figure 3 Gated Entrances to the Sub-Division

Entrance #1 (above) and Entrance #2 (below)

Road Design

1.19. Figure 2 also shows the general layout of the roads within the proposed sub-division. To the extent reasonably practicable existing road grades (farm roads) have been incorporated into the design, precluding the need for extensive new road cuts. All roads have a gradient less than 15%.

1.20. The schematic section of the main entrance roadway design (across the central island of a Type I Roadway) is shown in Figure 4 (which is reproduced from the issued site plans). This would apply to both entrance roadways (Jetty Road off Robins Bay old main road, and John-to-Whit Avenue off Tower Road). There is a 2.9 m landscaped verge with a 4% slope comprising compacted fill. This runs into the 5.5 m asphaltic concrete carriageway with a 2.5% slope toward the centre line. The wearing surface is underlain by crushed stone base, marly limestone sub-base and compacted subgrade as shown. The centre island is 5.75 m wide with a 4% slope away from the centre line of the island. All carriageways are protected by kerbs.

1.21. The typical design section of the Type II Roadway (.14 reservation) includes 1.43 m of landscaped verge at a 4% slope (Figure 5) with a kerb. And 2.5% slope on the carriageway back toward the verges from the centerline. The carriageway inclusive of the kerb is 6.3 m wide. Figure 5 also shows associated water line infrastructure.

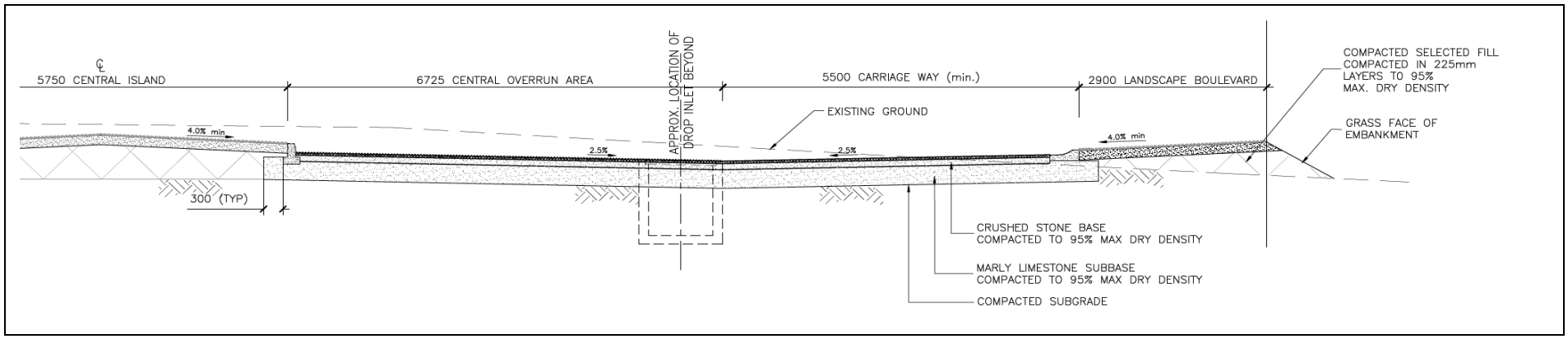

Figure 4 Part of Type I Road Section (Centre Island to Verge)

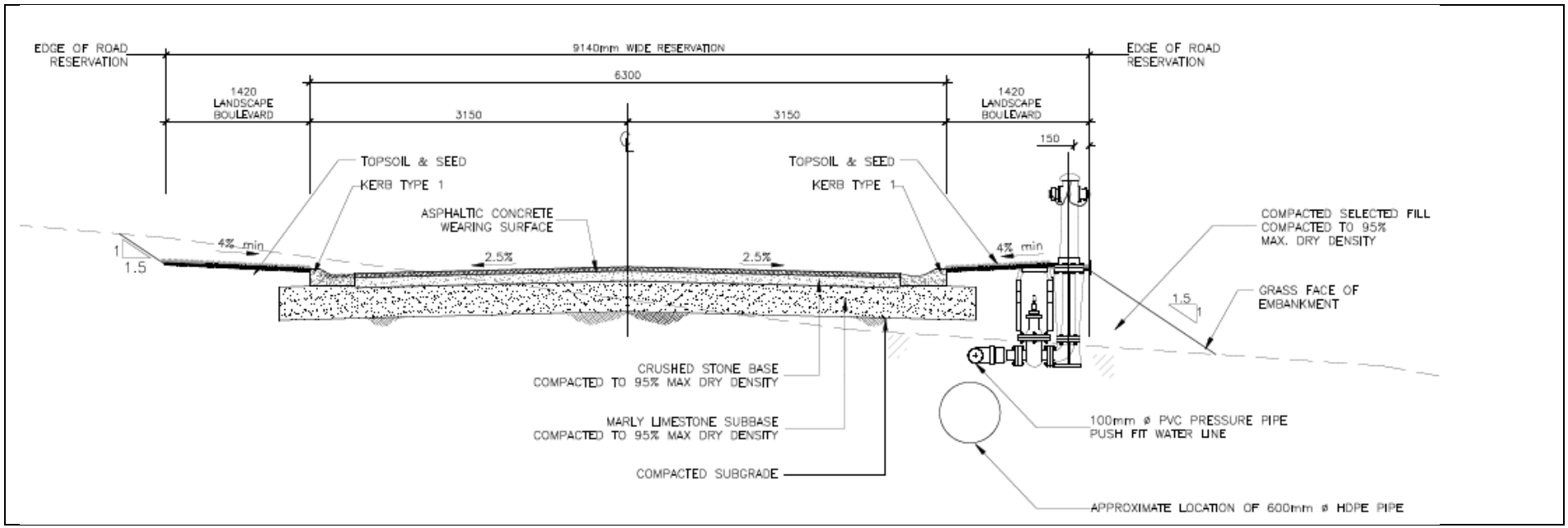

Figure 5 Typical Section (Type II Road)

1.22. As shown on Figure 6, low points in the typical Type II section will vary to allow drainage down slope on one side, instead of the camber from the carriageway centre line.

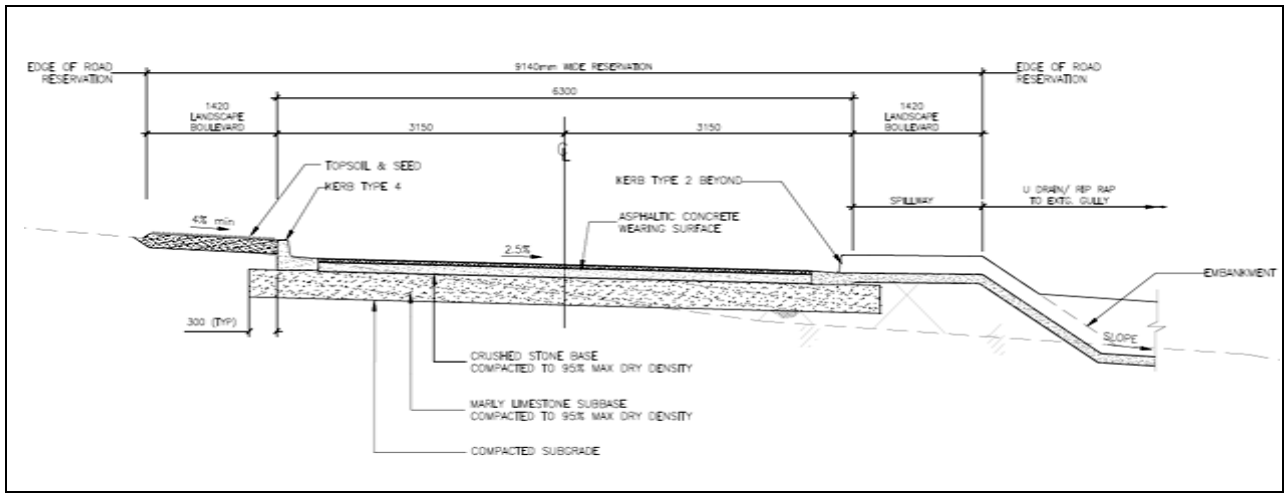

Figure 6 Typical Section (Type II Road) Low Points

1.23. The following Type II roadways terminate as circular all-paved cul-de-sacs with lots all the way around as shown in Figure 7a:

a. Phase 1A: Mockingbird Close
b. Phase 1B: Hummingbird Drive, Hummingbird Close
c. Phase 2A: Flycatcher Close, Kingbird Close
d. Phase 2B: Becard Close

1.24. The following Type II roadways terminate as cul-de-sacs, with lots on one side only (minimum turning area) as shown in Figure 7b:

a. Phase 1A: Patoo Close
b. Phase 1B: John-to-Whit Avenue
c. Phase 2A: Parula Close
d. Phase 2B: Becard Terrace

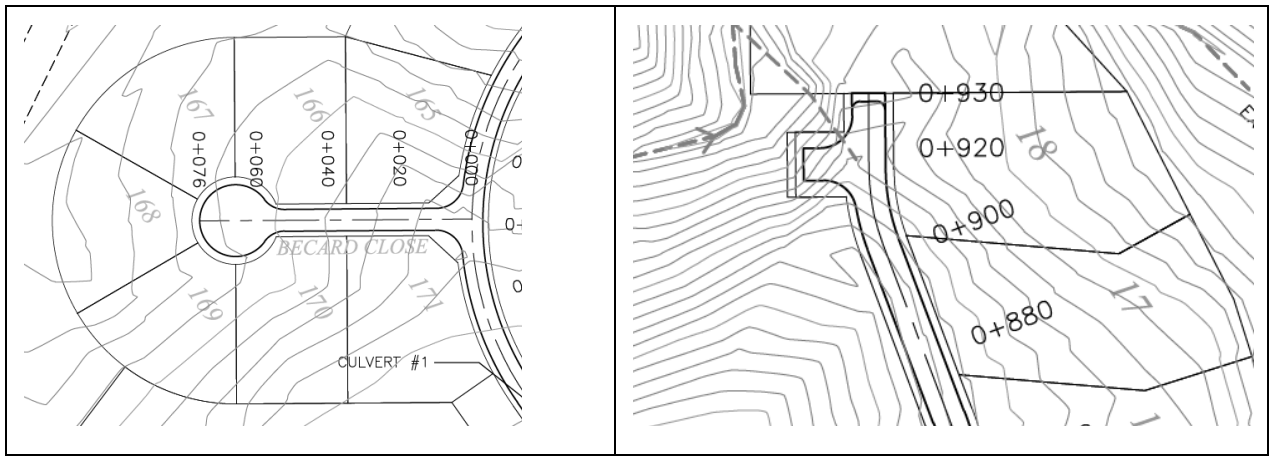

Figure 7 Design of the Cul-de-Sacs: a) left b) right

1.25. Roundabouts are planned for the following major intersections:

a. Jetty Road with Sandpiper Drive and Grassquit Terrace.
b. Tower Road with John-to-Whit Avenue (outside Entrance Gate No. 2).

1.26. The schematic of the two roundabout entrances are shown below in Figure 8.

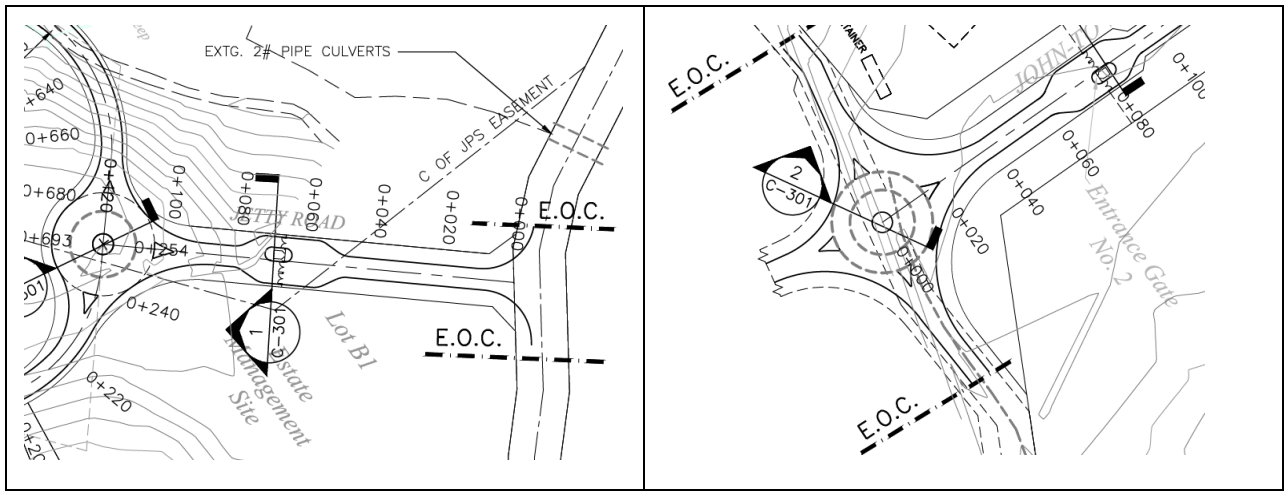

Figure 8 Entrances to the Sub-Division: a) Jetty Road off Robin's Bay main road and b) John-to Whit Road off Tower Road.

Drainage

1.27. The details of the proposed stormwater management system (SMS) are contained in the Engineering Report on SMS prepared by Noel Whyte and Associates Ltd. (March 2012) specifically for the proposed sub-division (Appendix 3). That report includes a hydrologic analysis with pre- and post-development hydrographs for the detention basin (appendix A of that report) and a post-development hydraulic analysis (appendix B of that report).

1.28. The basic elements of the plan are summarized as follows:

a. To create on-lot soak-away pits for lots on the northern boundary (Lots 156-171) in order to minimize any contribution to the gully running to the north of the development.
b. To transmit storm water from the subject lots to the natural gullies via the following structures:
    - Concrete kerb and channel along proposed roads.
    - Spill-ways at low points and along proposed roads.
    - Open concrete u-drains (0.6 m wide by 0.6 m deep) between lots and at low points along road.
    - Rip rap earth drains at drains outlets.
    - River training works.
    - 600 mm diameter pipe culverts with catch basins.
    - Specific culverts include:
        - 600 mm diameter pipe culverts where gullies cross the roads within developments;
        - 600 mm diameter pipe culverts and inlets along Hummingbird Drive and Hummingbird Close in Phase 1B
        - 1.5 m wide by 1.5 m deep box culvert where Sandpiper Drive crosses the main gully (Phase 1A).
c. To maintain and utilize the existing natural gully system to transmit stormwater from the lots to the sea. A minimum setback of 6.1 m from any gully will be observed in respect of lot boundaries and sub-division infrastructure. There is no anticipated need for any relaxation of these setbacks.
d. To intercept and settle first flush storm water discharges from the natural gullies by two detention ponds that overflow via culverts to the sea (Robin's

Bay). These culverts will contain trash grates at the outlets. The sizing of the detention basins is presented in Appendix 3.

e. To retain the existing culverts at Robins Bay as they have been calculated to have adequate capacity to safely convey and discharge run-offs from the gullies draining the property for the design storm event.

1.29. There is no history or geomorphic evidence of flooding had been observed within the footprint of the proposed sub-division.

Water Supply

1.30. An Engineering Report on the Potable Water Distribution System for the proposed sub-division was prepared by Noel Whyte and Associates in March 2012. The proposed system takes into account the requirements of the National Water Commission (NWC) and the Jamaica Fire Brigade (JFB).

1.31. At full build-out and occupancy it is estimated that the sub-division will require a maximum of 111,160US gallons per day[1] (GPD) or 40.6 million gallons per year, which includes residential use, maximum factor, provisions for fire water and commercial lots. This overall estimate includes 62,586 GPD for direct domestic use at the 171 lots (Table 4 below). The domestic water demand will be in direct proportion to occupation of the lots. Table 4 summarizes expected water demand for residential use on a phased basis, assuming 60.75 US gallons (230 liters) per person and 6 persons per household.

Phase	**Estimated Minimum Demand (@60.75 US gallons/person/day with 6 persons per lot)**	
	GPD	**Million Gallons Per Year**
1A (58 lots)	21,228	7.8
1B (51 lots)	18,666	6.8
2A (35 lots)	12,810	4.7
2B (27 lots)	9,882	3.6
	62,586	22.844

Table 4 Residential Water Demand

[1] This was computed based on an average daily water consumption of 60 US gallons per person and 1563 US Gallons per acre[2] respectively, a population of 6 persons per lot for a total of 171 lots, and maximum day factor of 1.25.

1.32. NWC supplies potable to the community of Robin's Bay from a tank located in Nutsfield via a 100 mm main running along Tower Road (which runs alongside the proposed development). NWC has advised of infrastructural issues which are impacting the supply. The developer is engaged in further dialogue with NWC to make them aware of both the phasing of the development and timelines for completion of the phases. The developer feels that the development timetable for building out the sub-division is accordance with the NWC expansion plans and that there should be no conflict.

1.33. It was announced by Minister Pickersgill on March 8th 2013 recently that the agency will be spearheading its $800 million investment by NWC and the Rural Water Supply Ltd (RWSL). Associated infrastructural works include:

a. Development of:
   - A new water sources at Chovey;
   - Three new pumping stations at Bellfield, Nutfield and Highgate;
   - Pipelines between Iterboreale, Bellfield, Highgate, Nutfield and Hopewell;

b. Rehabilitation/improvements of:
   - The Iterboreale water treatment plant and pumping station.
   - The Agualta Vale pumping station.
   - Reservoirs at Clermont, Highgate and Nutfield.
   - The Cresser Spring water intake facility at Iterboreale.
   - The distribution network in Highgate and Islington.

1.34. According to the announcement[2] Minister Pickersgill indicated that "*Detailed engineering designs are now in progress and implementation is scheduled to be carried out over a period of 15 to 18 months, commencing in the second half of this year*". Optimistically, most of these planned improvements are expected to come on stream by 2016.

1.35. An existing water well at Green Castle Estate provides irrigation water for the agricultural use. Preliminary geological opinion is that production from the alluvial aquifer (associated with the floodplain of the Calabash Bottom River, which runs through Green Castle Estate) can be further developed to meet all the

[2] http://m.jamaicaobserver.com/mobile/news/-800m-water-project-for-eastern-St-Mary

water needs of future developments on the estate. Further investigation is required to prove the reliable yield of this aquifer.

1.36. Water will be distributed to the sub-division from the existing 67,000 gallon storage tank at Davey Hill and a proposed 100,000 gallon storage tank. The combination of the two tanks will have adequate capacity to provide peak hour water demand as well water for fire-fighting.

1.37. The water distribution system allows for normal working pressure in the main between 40 PSI and 150 PSI.

1.38. The plan also allows for a maximum fire-hydrant spacing of 137.2 m (450 feet).

Power Supply

1.39. An estimated 850 KW per year (with a load of 10 KVA per lot) will be required by the sub-division at full-build out. This will be supplied from the main grid through the existing infrastructure owned by the Jamaica Public Service Company Ltd (JPS). JPS presently has a high voltage supply 1-PH-3-WIRE (2-PH-HV) from Islington to the centre of Robins Bay village. A new overhead high voltage pole line is proposed to take electricity to the sub-division.

JPS has confirmed that it has the capacity to accommodate the sub-division (Stormwater Management System Engineering Design Report

1.40. Appendix 4).

Sewage Disposal Options

1.41. Sewage will be treated on-site at each lot using septic tanks, evapo-transpiration or reed bed (subsurface). A review of the acceptability of this approach in light of EHU requirements (Minimum Requirements for Wastewater Treatment Systems and Excreta Management in Jamaica, Section 6.4.1. page 26, 2007)[2] is presented below. According to that document, no approval will be given for onsite soil absorption treatment methods if any of the conditions listed apply to the site location.

a. *Connection to public sewer system is practical*. There is no central municipal sewer system available for connection at this location.

b. *Soil conditions or topography are such that individual disposal systems cannot function satisfactorily*. This speaks to the rate of percolation. For tile

fields and absorption beds soils should have percolation rates between 0.8 and 24 min/cm2. Percolation tests were conducted at three sites on the property representing different lithological conditions. Pit 1 was located at the highest elevation (79 m above mean sea level) and had a percolation rate that was very slow (97.8 min/cm). Pit 2 was located at an elevation of 47 m amsl and had a percolation rate that fell within the range (1.31 min/cm). Pit 3 was located at the lowest elevation (21 m amsl) and had the most rapid rate of percolation, ~0.4 min /cm. Based on these results, it was concluded that a range of solutions (including septic tank, tile-field and reed bed/constructed wetlands) will have to be utilized based on the observed rate of percolation at each lot.

c. *Groundwater conditions are of such that individual disposal systems may cause pollution of the groundwater supply*. Soil absorption systems are allowed on the recommendation of the Water Resources Authority (WRA) where the highest ground water levels are below 1.2 m from the bottom of the absorptive system[3]. The minimum elevation of any lot on the sub-division is 15 m above sea-level.

d. Installations may create unsanitary condition or public health nuisance (over time). The project engineers (NOWAL) have recommended this option in full consideration of potential effects on public health. No nuisance is expected to develop.

e. *Densities higher than 7 dwelling units per acre or the aggregation exceeds 300 persons.* With an overall minimum lot size of a third of an acre (allowing a maximum of 3 dwellings per acre) the sub-division easily satisfies the requirement that densities should be less than 7 dwellings per acre for use of onsite absorption treatment methods.

1.42. Lot purchasers shall be advised of the EHU design and construction standards for septic tanks and evapo-transpiration beds and minimum proximity requirements.

[3]http://www.jamaicatradeandinvest.org/pdf/vol3/section3_water_sewerage_services.pdf

Amenities and Services

1.43. Schools. The proposed sub-division targets vacation home owners, and retirees. Consequently, it is not expected that development would create pressure on the existing school system in the parish. Greencastle Estate owns and supports the primary school located in Robins Bay, which presently runs at ~56% capacity.

1.44. Recreation. Lot B2 (approximately 0.4 ha or 1 acre) located in Phase 2 has been allocated as a community park/playfield. In additional all the riparian reserves can be considered parks, and will have maintained walking/jogging/biking trails. Lot B4 in Phase 2A (5.7 ha) has been allocated for the Estate Country Club and Spa (recreational land use).

1.45. Commerce and Management. Lot B3 (0.7 ha) in Phase 2A and Lot B1 in Phase 1A has been allocated for commercial development, inclusive of estate management and farm shops. In addition, various commercial establishments including restaurants are already available in the community of Robins Bay.

1.46. Fire-safety. Appropriate placement of fire-hydrants and design of cul-de-sac have been taken into account in the layout of the sub-division. In addition, fire-water storage and pressure have also assured in the water supply plan. The nearest municipal fire station is located at Annotto Bay ~5.5 km away.

1.47. Security: During construction of the sub-division infrastructure, security will be provided by the developer to safe-guard construction materials. During the operational phase, the Owners Association will be responsible for employing a security company to patrol the neighborhood and provide emergency response capability. Police Station at Islington (8.5 km away) has responsibility for this area, so any major incidents shall be reported at this location.

1.48. Health Care. The nearest hospital is located at Annotto Bay. Another smaller one is located at Port Maria. Basic emergency care can be obtained at these locations. In the case of a major medical emergency, it may be necessary to travel to Kingston.

1.49. Disaster Management. Although the site is not flood-prone, it is vulnerable to hurricanes and earthquakes, as is the rest of the parish. To the extent possible, sub-division electrical wires will be located below ground to reduce the possibility of wind-damage during a storm. The home-owners agreement will impose construction standards on lot purchasers that take into account the recommended

national building standards for hurricane and earthquake safety as stipulated by the ODPEM[4].

1.50. Maintenance. During the operational phase, the home-owners association will ensure that storm drains are kept clear of debris at all times. It will also be responsible for ensuring that all sub-division roadways are passable as soon as possible after the occurrence of a storm or earthquake event. The home-owner's association will liaise with Parish Council and the Office of Disaster Preparedness to remain updated about emergency shelter information as necessary.

1.51. Solid Waste. Lot owners will be required to put waste in polyethylene bags and have designated waste receptacles, from which bags can be collected. The base of the receptacles should allow rain water to drain out. The developers will discuss routine municipal collection and disposal with the North Eastern Parks and Markets (NEPM).It is estimated that at full build-out the sub-division will generate around 0.6 metric tons of domestic waste per day[5]. NEPM presently provides collection and disposal services to the community of Robin's Bay. NEPM charges a disposal cost calculated on the basis of the daily tonnage being collected.

Impact-Causing Aspects of Activities

Sub-Division Development Phase

1.52. The construction phase of the project is taken to include phased pre-sale activities associated with sub-division development and not the construction of individual housing units, which will be considered separately. Sub-division development activities include the following:

- Land clearance for roads or other infrastructure or views.
- Surveying and marking of lot boundaries as finally approved.
- Haulage of construction materials between suppliers and construction camp.
- Construction camp (at Lot B1): workers facilities, material stockpiling, site office, storage and maintenance of construction equipment.

[4]Hazard Mitigation Guidelines for development in High Risk Areas. ODPEM – Volume 1, Section 3, Jamaica Trade and Invest Development Manual.

[5] NSWMA uses an average of 3.5 persons per household, assuming 171 households, 1 kg of solid waste per day per person.

- Installation of the water and power distribution mains and connection to the municipal service mains.
- Landscaping/plantings will be limited to main entrances, roundabouts and verges.
- Earthworks for storm water detention ponds, roads, drainage and buried pipes/conduits.
- Construction of civil structures as outlined in the roads and drainage plan.
- Construction of Estate Farm Shops and the Country Club and Spa will be completed in Phase 2. No details on the footprint of these are as yet available.

1.53. Anticipated consumption of resources during the construction phase include:

- Construction aggregates and steel for roads and civil structures. This is likely to include marly limestone will be needed for the road base and sub-base and coarse aggregate will also be needed for the asphaltic concrete surface. Additional stone (rip rap) and sand will be needed for the concrete drainage works. No bills of quantity are as yet available for the project.
- It is assumed that a semi-permanent site office building will be constructed. This will require inputs as listed in paragraph 1.89 below.
- Fossil fuels for equipment and haulage vehicles.
- Water for construction, domestic and landscaping.
- Equipment: dump trucks, front-end loaders, excavator, bull-dozer, graders/compactors, backhoe loader, cement mixers.
- Labour demand: construction workers; supervising engineers.
- Vegetation for landscaping: grass, ornamental plants.

1.54. Anticipated construction waste streams include:

- Air emissions: fugitive dust and diesel combustion emissions.
- Effluents: storm water run-offs with sediment load, run-offs from wash-down areas. All stockpiles will be protected from water flows and rain to prevent mobilization of particles. The main source of suspended sediment is likely to be bared soils and site excavations (roads and drainage works).
- Sewage: pit latrines will be used for construction workers.
- Solid waste: mainly domestic waste from workers (e.g. Styrofoam boxes, juice boxes, bottles, bags etc).

- Earth materials from excavations will be re-used on site as fill. The major excavation works would be the proposed detention basins. Approximately 16,115 m^3 of earth material is expected to be generated from the excavation of the detention ponds. This material is expected to comprise a combination of alluvium and marl. Some of this may be suitable for re-use as engineering fill or top-soil, or creation of grassed embankments. Most of the other excavations will re-use the excavated material in situ (e.g. trenches for sub-surface conduits). Minor cut and fill for road works is also expected to utilize the cut material for fill.

Post-Sale Construction

1.55. This will include post-sale activities occurring at the sub-division, whether or not they are undertaken directly by the applicant. On-lot construction activities are likely to include:

- Clearance and grading of the building footprint.
- Earthworks: excavation of foundations, pool and sewage disposal areas; compaction of foundations.
- Connection to the distribution lines for water and electricity.
- On-site storage of construction materials: aggregate (stone and sand), cement, steel, pre-fabricated concrete blocks, roofing and flooring materials, pvc pipes, electrical wires, windows, doors, paint, etc.
- Construction of dwelling: masonry, plumbing, electrical, painting, roofing, flooring and installation of fixtures including windows, doors, cabinets, gutters, plumbing, etc.
- Construction of pool and sewage treatment system: concrete septic tank, tile-fields (pvc pipes with sand filters), concreting and tiling of the pool.
- Final site landscaping and filling of the pool.

1.56. Anticipated post-sale consumption of resources during the operational phase include:

- Construction materials (as listed above), construction screens (zinc sheets) construction plywood (for concrete framing etc), and possibly scaffolding (wood or steel).
- Fossil fuels for equipment and haulage vehicles.

- Water for construction, domestic and landscaping.
- Equipment: dump trucks, front-end loaders, excavator, bull-dozer, backhoe loader, cement mixers.
- Labour: construction equipment operators, construction workers and skilled contractors (masons, plumbers, electricians, carpenters, painters).

1.57. Anticipated post-sale construction waste streams include:

- Air emissions: fugitive dust and combustion emissions.
- Effluents: storm water run-offs with sediment load.
- Sewage: pit latrines will be used for construction workers.
- Solid waste: domestic waste from workers (e.g. Styrofoam boxes, juice boxes, bottles, bags etc); packaging waste (plastic and paper bags, cardboard boxes, wooden pallets, plastic sheeting, containers etc) and cuttings (steel, sheet rock, pvc, zinc sheets, tiles, wood etc). Typically, a 5,000 sf house may generate 14 tonnes of construction solid waste[6].
- Earth materials: On average, site excavation for sewage disposal and for swimming pools is expected to produce between ~150 and ~300 cubic metres (200 to 400 cubic yards) of excavated material depending on the size of the pool. Lot owners will be required to re-use earth materials on site to the extent reasonably practicable. Material that cannot be so re-used on-site will be disposed of elsewhere on the estate where fill material is required. Until the end of Phase 2B, the site office will remain operational and will serve to advise on this.

Occupancy (Operational)

1.58. Upon completion of marking out of lots in Phase 1A and installation of necessary infrastructure, sales of the first 109 lots are expected to commence. Lot purchasers will be free to commence construction on their lots upon execution of the sales agreement. It is therefore anticipated that while villa/home construction is going on, development of other phases of the sub-division would also be continuing (i.e. extension of the infrastructure and lot surveys).

[6] http://peakstoprairies.org/p2bande/construction/c&dwaste/whatsC&D.cfm - this site estimates construction wastes to range between 2.41 and 11.3 lbs per square foot, with an average of 6.14 per square foot, although home size is just a rough guide as choice of construction materials, contractors and other factors may control solid waste generation.

1.59. The main construction entrance to for both phases will be Entrance No. 2, off Tower Road. Upon completion of Phase 1, all construction traffic (associated with individual lot development) will be required to use Entrance No. 2 so as to minimize nuisance construction traffic.

1.60. Once villas are completed it is expected that a range of normal domestic activities will occur within the sub-division. These include:

- Population increase: 171 house-holds at full build-out (~1,026 persons).
- Roadway lighting.
- Maintenance of public areas: grassed embankments, planted areas by the home-owners association.
- Routine clearance of storm drains and grates.
- Increased use of personal vehicles (up to 200 are expected at full-build out).
- Daily or weekly influxes of domestic workers (house-keepers, gardeners, security guards, drivers etc).
- Introduction of pet species: dogs, cats, possibly birds and ornamental fish.
- Possible invasion of pest species: roaches, rodents, mosquitoes.
- Routine garden maintenance: lawn mowing, planting and trimming of bush.
- Recreational use of public areas: hiking, biking and jogging.
- Installation of low fences.
- Night-time security lighting around house.

1.61. Anticipated resource consumption during the operational phase at full occupancy is summarized below:

- Water demand: ~41 million gallons per year.
- Electricity: ~850 kW per year
- Landfill space and garbage collection services: 220 metric tons per year.
- Labour: domestic employees (housekeepers, gardeners, security, drivers etc).

SECTION 2 ANALYSIS OF ALTERNATIVES

The purpose of this section of the EIA is to examine feasible alternatives to the project. The following land use options will be rigorously evaluated: tree crops, pasture land, residential, eco-tourism. This shall include an examination of the environmental, social and economic costs of (a) leaving the land as is (status quo), versus (b) the proposed option. Feasible land use options are compared below in terms of potential benefits and costs, using a range of factors or normative criteria.

This section should highlight the benefits of and general rationale for the project that need to be considered against any potential environmental cost. It should outline in balanced way, the wider societal benefits of the development proposal that could arise if the environmental permit is granted.

Land Use Options

2.1. The proposed change of use of this 78 ha (191.5 acres) site from disused pasture and tree crop plots to middle to upper income residential income will bring these lands back into productive use, and is probably the land use that will bring the highest economic value to the owner.

2.2. The site is well-suited to low-density (0.36 to 0.42 acres) residential development:

- The Green Castle Estate is located less than an hour away from both Ocho Rios on the North Coast and the nation's capital, Kingston, on the South Coast. This would make it attractive as a country villa site, to professionals in Kingston, which is rural in character but is neither too isolated nor too remote (particularly with the North Coast Highway).
- The proposed site is easily accessible from North Coast Highway. Entrance #1 is only 4 km from the turn-off the highway near Orange Hill via Newry and the old coastal main road. This entrance can also be accessed from the western side, via the main road between Robin's Bay, Nutfield, Islington and White Hall (near where a section of the North Coast Highway collapsed), which is less than 10 km away. Most visitors from the west prefer to continue driving on the highway to the Orange Hill turn-off to Green Castle due to the uncertain road conditions between White Hall and Robin's Bay.
- Driving time from Norman Manley International Airport at the Palisadoes in Kingston is approximately one hour and driving time from Sangster's International Airport in Montego Bay is less than 2 hours. The site is less than 30 minutes driving from the Ian Fleming International Airport at Boscobel in St Mary. This would make it attractive to overseas owners.
- There is an existing network of farm roads that have been laid out according to "farmer logic" which coincide with modern standards for grade and sub-base. This minimizes the need to cut extensive new rights of way (ROW) into vegetated areas.
- Public services are available for this area including existing power and water mains at Robin's Bay. In addition there are also garbage collection services.

Other services such as hospital and police are available at Islington and Annotto Bay.

- Although hilly, the terrain allows for residential lots in this range of sizes that require little or no site grading.
- The available acreage allows for adequate open space while having a housing density that allows for the venture to financially viable.
- The site is very well drained with no major flood or landslide risk.
- Residential land use is consistent with the adjacent land use: mixed urban land use at Robins Bay.

2.3. Although the preferred land use option for this site is low density residential land use, there are other possible land uses for this site, including:

- The present use (status quo), which is essentially ruinate lands, consisting of a mixture of wild trees and disused tree crops (such as pimento) in the upland areas and pasture in the lowland areas; or,
- Returning to some form of agricultural production that would be economically viable in this location. It is suggested that sub-dividing the land as homestead lots for sale to farmers is a relatively feasible option.

2.4. Eco-tourism is not considered a viable option at this site as there is already an eco-tourism tour of the greater Green Castle Estate.

2.5. These options are compared in a range of normative cost and benefit criteria. The costs include physical, ecological, socio-economic aspects and implementation costs.

Status Quo (No Change in Land Use)

2.6. Green Castle Estate has been under agricultural land since it was first occupied. During colonial rule the Green Castle Estate and much of the surrounding lands within close proximity to the Estate were transformed into large plantation estates cultivating sugarcane, cocoa, coconuts, pimento, and cattle. The adjacent lands Robins Bay that were used for plantation cultivation were sub-divided and sold to numerous settlers during the period or occupied by informal settlers.

2.7. The boundaries of the Green Castle Estate were demarcated during the late 19th century and its total acreage was estimated to be between 900-1000 acres. Historical data points to agricultural land use being the only active land use on the estate during this period. From the early 1950s to the ending of the 1990s, lands at the Estate were used mainly to cultivate tree crops such as coconuts, cocoa and pimento and undertake cattle herding. With the purchase of the adjoining Newry property in 1983, sugarcane and banana were introduced. During the mid 1980s, papaya was introduced at the estate, expanding agricultural land use. By the late 1990s, an orchid farm was started at the estate. At the proposed sub-division site, remnants of tree crops that were cultivated up to at least 2002 can still be found. However, in the past decade, agricultural use in this area has largely been abandoned.

2.8. The costs and benefits of the status quo option are identified in Table 5.

	Costs	**Benefits**
Physical	• Soil erosion from previous agricultural land use and grazing animals. • Bacterial contamination of water from animal grazing. • Poor visual aesthetic of disused agricultural plots overgrown with weeds. • Uncontrolled run-off of storm water from catchments into the culvert across the road and then into the coastal water – culverts are presently in a bad condition.	• Soils remain unpaved so that the infiltration rate is lower than a land use that includes development.
Ecological		• Green space that would eventually transition to a climax vegetation community if left undisturbed. • Habitats for birds, reptiles etc.
Socio-Economic	• Opportunity cost of not utilizing the land for a more productive purpose.	
Implementation	• No return on investment (from land purchase and property taxes being paid).	

Table 5 Costs and Benefits of the Status Quo Option

Agricultural Homestead Sub-Division

2.9. A feasible option for land use in this area is to maintain the agricultural use (Table 6). Since tree crops have been abandoned for reasons that are likely to be still valid (economic and/or disease related), the option of sub-dividing the lands for farm plot homesteads is considered an alternative feasible agricultural land use. This would involve a much lower density lotting size (1 ha lots), which would result in possibly not more than 30 homestead lots being created. The homestead sub-division would require basic infrastructure (water and electricity, storm water management and access road development). For this land use, it is unlikely that the developer would be able to get over $4 US per square foot for the land.

	Costs	**Benefits**
Physical	• Soil erosion from agricultural land use and grazing animals. • Bacterial contamination of water from animal grazing • Use of pesticides and fertilizers for agriculture – pollution of coastal waters. • Very localized soil pollution due to on-lot tile-fields.	• Larger lot sizes: agricultural lots could be in the range of 1 ha, resulting in lower density.
Ecological	• Loss of biodiversity from agricultural use, and grazing animals. • Possible sprawl into the wooded areas as farmers try to rotate fields. • Possible unsustainable practices such as burning of fields could result in ecological damage (e.g. forest fires).	
Socio-Economic	• Construction nuisances (associated with homestead homes) • Nuisances associated with animal pens (odours, noise).	• Increased produce availability. • Maintenance of traditional agricultural lands.
Implementation	• No spending on road upgrades as farm roads would be adequate with minor widening and re-surfacing. • Storm water upgrades would not be as extensive. • Power and water would still be needed. • Return on investment expected to be lower than other options.	• Some farm labour might be created but, the number of jobs created is expected to be substantively less.

Table 6 Homestead Agricultural Sub-Division

The Proposed Residential Sub-Division

2.10. Considerable investment has already been made in developing the preferred option, in terms of feasibility assessments, costs analysis, environmental surveys and site planning (lotting schedule/layout, road design, water and power distribution, and storm water engineering). The applicant has made an informed decision that this is the best option for return on investment, and the advancement of larger master planning objectives for Green Castle Estate.

2.11. Table 7 below summarizes the wider costs and benefits that arise from the implementation of the project.

	Costs	**Benefits**
Physical	• Construction impacts/nuisances are protracted. • Risk of soil contamination from fuel spillage at site office and vehicle fuelling area. • Heat island effect. • Increased run-offs. • Vehicular emissions. • Increased night-time lighting. • Increased ambient noise levels. • Changes to coastal water quality in Robin's Bay. • Very localized soil pollution due to on-lot tile-fields. • Pressure on municipal services.	• Improvement of the visual aesthetic from disused ruinate lands to ordered residential space with abundant open space. • Installation of detention basins to off-set coastal pollution from sub-division. • Eliminating impacts of existing use, including grazing animals (bacterial contamination of water, soil erosion, and impacts on biodiversity).
Ecological	• Reduction in biomass and habitats. • Potential vector and pest infestation. • Ecological barriers: roads, fencing, lit areas.	• Creation of new habitats: detention basins as wetlands (waterfowl habitats). • Preservation of wooded areas which also serve as storm drains and habitats for wild-life. • Lot sales enable large areas of Green Castle Estate to be kept under forestry as well as development of other aspects of the property.

Socio-Economic	• Construction nuisances. • Increased hazard vulnerability. • Potential increase in traffic. • Increased demand for municipal solid waste collection and disposal services.	• Job creation in sub-division development, construction and operational phases. • Availability of lots for sub-division: stimulates the construction industry. • Attraction of overseas buyers who would bring foreign revenues through lot purchase, as well as construction and purchase of goods and services locally. • Possible increased value to neighbouring property from the development. • Increased access to a wilderness type recreational experience that increased the diversity of tourism opportunities available in the area.
Implementation	• Engineering, design and construction cost of the proposed facilities. • Environmental mitigation and monitoring costs. • Consumption of government services and municipal resources. • Maintenance: drainage.	• Permitting fees to government. • Well-planned sub-division offering. • Return on investment to land owner which would enable further development of the property, job creation and economic stimulation of the parish.

Table 7 Costs and Benefits of the Preferred Option

Simple Comparison of Costs and Benefits

2.12. The three land use development options outlined above are compared in terms of most benefits and least costs using a range of factors or normative criteria given in Table 8 below. This approach tries to evaluate the economic, technical, social and environmental consequences of each option. These options are compared using a simple ranking system in relation to the normative criteria. A rank of number 1 indicates that the option is best suited to satisfying the normative criterion, and a rank of 3 indicates that the option is least suited to satisfying the normative criterion. The option scoring the lowest total score may be regarded as the most suited overall. These scores are un-weighted.

	SQ	HS	RS
Least physical costs (hydrology, pollution, etc)	1	2	3
Least ecological costs	1	2	3
Least socio-economic costs	1	2	3
Least implementation costs	1	2	3
Most physical benefits or improvements	3	2	1
Most ecological benefits or improvements	1	3	2
Most socio-economic benefits or improvements	3	2	1
Most implementation advantages	3	2	1
Total	14	17	17

SQ = Status Quo (No Development) HS = Agricultural Sub-Division (Homesteads) RS = Residential Sub-Division (Preferred Option)

Table 8 Ranking of Most Benefits and Least Costs Criteria

2.13. Based on these criteria, the "no action" alternative scored the lowest (14 points). However, this option is not necessarily the best use for the land, especially from the perspective of the landowner. To be able to implement this option, the government would have to purchase the lands, and compensate the landowner for his investment in his property thus far.

2.14. Although the agricultural sub-division option came out roughly on par with the preferred option, it is unlikely that this would be implemented by the developer as the return on investment would not make it financially viable.

SECTION 3 LEGAL AND INSTITUTIONAL FRAMEWORK

The objective of this task is to provide an outline the relevant environmental regulations, policies and standards governing. This shall include a regulatory controls and institutional frameworks with jurisdiction over the following main areas as they relate specifically to this site and project: (a) Development and Land Use Control; (b) Environmental Conservation (c) Waste Management. In all cases the roles of agencies with responsibility for implementing legal mechanisms will be described. Where Jamaican standards or policies are insufficient, international standards and policies will be outlined.

This section summarizes the key regulatory controls on the project (including environmental quality criteria, physical planning restrictions, building codes etc.). The degree of compliance with these controls (general acceptability) is a key criterion used in determining of the relative significance of environmental impacts.

General Planning Context

3.1. The Land Development and Utilization Act (1966) authorizes the Land Development and Utilization Commission (LDUC) to designate suitable lands as agricultural. The LDUC is mandated to ensure that agricultural lands are properly developed. The lands that are now proposed for sub-division land use have been historically used for agriculture as part of the Greencastle Estate, with remnants of pimento plots still occurring on the site. The developers have obtained approval for the "*change of use*" from agricultural to residential/commercial use.

3.2. The site is not within an area classified as having high importance as a groundwater recharge zone or surface water source. Water for domestic is supplied to the Robins Bay area by the National Water Commission (NWC) from its White River and Grants Level water uptake/treatment plants.

3.3. The site is not located within or adjacent to a protected area under the National System of Protected Areas. Protected areas in Jamaica are declared under four main Acts: the Natural Resources Conservation Authority Act, the Wild Life Protection Act, the Forestry Act and the Jamaica National Heritage Trust Act, and administered by NEPA.

3.4. National Forest Management and Conservation Plan (Forestry Plan) as required under the Forest Act of 1996 has been developed to promote and improve the conservation and sustainable use of forest resources. The plan outlines the management and restoration of forest resources to continuously meet the local and national needs of the country. Under this plan, this area is mapped as non-forest cover (plantations and tree crops).

Development Control

3.5. NEPA is responsible for balancing development and natural resource conservation, under the Natural Resources Conservation Authority (NRCA) Act, (1991) which makes provisions for Environmental Impact Assessments (EIA) in addition to the requirements of the Permit and Licensing System for a development proposal.

3.6. In determining applications for environmental permits and licenses and the supporting documentation, NEPA relies on the advice of an inter-agency committee called the Technical Review Committee (TRC), which comprises representatives from the NRCA and various other public agencies including the Water Resources Authority (WRA) , Environmental Health Unit of the Ministry of Health (EHU), National Works Agency (NWA), and Mines and Geology Division (MGD).

3.7. The EIA document is also reviewed by the Office of Disaster Preparedness and Emergency Management (ODPEM) and the Jamaica National Heritage Trust, along with other agencies and stakeholders that NEPA has deemed relevant to the project. Once an EIA is required, the applicant is required to hold a public meeting not less than 3 weeks after the document has been made available for public review. The public can submit their comments on the EIA and project within 30 days of the requisite public meeting. The Authority has 90 days to return a decision once all information requested by NEPA has been provided.

3.8. The Town and Country Planning Authority (TCPD) administers the Town and Country Planning Act (1957), which regulates the development and use of land in Jamaica. Subdivisions are also regulated under the Local Improvements Act. Sub-divisions in excess of 10 lots or 5 acres require the input of the Government Town Planner. All development projects must be granted planning and building permission, with due consideration to planning constraints such as zoning, parking and availability of municipal services, from the Town and Country Planning Authority and the St Mary Parish Council.

3.9. Road access to the site will be off the North Coast Highway then via the old coast road to the village of Robins Bay. The main entrance to the site will be located off this coast road near Robins Bay. The National Works Agency (NWA) operates under the Main Roads Act (1932) as the primary regulator of road maintenance and construction. The Act regulates the detailed procedures and requirements for major roads, inclusive of the laying out, making, repairing, widening, altering, deviating, maintaining, superintending and managing of main roads. The NWA also administers the Flood Water Control Act which regulates the management of watercourses. The NWA reviews and approves the development proposal of any road or drainage works particularly as they connect to municipal roads or drainage

systems. The proposed storm water drainage plans and road access plans will have to be approved by the NWA.

3.10. The applicant intends to apply to the National Water Commission to connect to the municipal mains that presently serve Robins Bay. Sub-division lots will be individually metered for water supply.

3.11. The development does not include a proposal for a centralized sewage treatment facility. Individual lot owners will construct small single family sewage disposal systems (septic tank with tile fields) that are acceptable to the St Mary Parish Council for this site.

Conservation of Environmental Resources

3.12. The NRCA under the Natural Resources Conservation Authority Act (1991) is the public agency responsible for effectively managing the physical and natural resources of Jamaica so as to ensure their conservation, protection, proper use and to promote public awareness of Jamaica's ecological systems. The NRCA Act includes a list of fourteen animals designated as protected in the Third Schedule of the Act. The Act further states that all birds except those listed in the Second Schedule of the Act are protected.

3.13. Jamaica is signatory to the Convention on Biological Diversity, which requires inter alia, the establishment of regulatory provisions to protect threatened species and populations. The NRCA through its Biodiversity Branch (NEPA) has the responsibility of administering the Wildlife Protection Act (1945). This act involves the declaration of game sanctuaries and reserves, game wardens, control of fishing in rivers, protection of specified rare or endemic species. Section 6 of the Act prohibits the hunting of protected species (listed under the 3rd Schedule of the Wildlife Protection Act).

3.14. Jamaica signed the Protocol Concerning Specially Protected Areas and Wildlife in the Wider Caribbean (SPAW) on January 18, 1990. Inter alia the Protocol requires signatories to establish specially protected areas to conserve rare and fragile ecosystems, and threatened or endangered species. No rare, protected or endangered species have been identified in this area during the course of the baseline ecology surveys.

3.15. The lower (northern) site boundary is located within 200 m of the high water mark of Robins Bay, and there is one major outfall (gully) from the site into this bay. Consequently there is potential for activities in this area to impact on the bay. The main coastal legislation in Jamaica is the Beach Control Act which includes encroachments into the foreshore and water column. The project will not have any physical encroachment into this area. However, future modification of the coastline or beach for recreational purposes will require a beach license under this legislation.

3.16. Watersheds and water resources are protected by various acts. The NRCA administers the Watershed Protection Act (1965) through NEPA, and is thus mandated to ensure the proper, efficient and economic utilization of land in watershed area. WRA administers the Water Resources Act of 1995 and is thereby mandated to regulate ground and surface water resources, specifically, supply, flood risk and water quality. WRA also implements the Water Sector Policy Strategy/Action Plan (Ministry of Water, 1999), which addresses water resource management, urban water and sewerage, rural water and sanitation, urban drainage and irrigation. The Forestry Department (pursuant to the Forestry Act of 1996) is responsible for the preservation of forests, trees, plants, fauna, stones, sand and soil existing in or taken from a forest reserve, crown land, or a forest management area.

3.17. The Jamaica National Heritage Trust (JNHT) enforces its mandate under the Jamaica National Heritage Trust Act. The Act serves to protect and control the development of national monuments and national heritage. This includes anything that can be designated as a part of the national heritage. The JNHT mission statement states: "*to inspire a sense of pride through the promotion, preservation and development of our material cultural heritage…*" No specific archaeological or cultural resources have been identified at the sub-division site, although it occurs in proximity to an historic stone tower, and Taino middens sites at Davey Hill and Newry.

Pollution Control

3.18. NRCA Act (1991) administers the Natural Resources Conservation Authority (Air Quality) Regulations (2006) under its mandate. The Ambient Air Quality Standards (AAQS) are the maximum concentrations of air pollutants allowed in the atmosphere. There are six major contaminants referred to as criteria pollutants. These pollutants are total suspended particulate matter (TSP), particulates with aerodynamic diameter less than 10 μm (PM10), sulphur dioxide (SO_2), carbon monoxide (CO), nitrogen dioxide (NO_2), lead and (photochemical oxidant) ozone (O_3). The regulations also speak to Greenhouse Gases (GHGs) which include carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perflouorcarbons and sulphur hexafluoride. Aside from vehicular emissions, the project is not expected to be a significant source of emissions, and will not require an air emissions license.

3.19. The Noise Abatement Act (1997) regulates "public peace" in terms of the generation of nuisance noise audible beyond 100 m from the source in day or night time. According to this act, "specified equipment" shall not be operated later than 11 0'clock at night at "a public meeting", and later than midnight at a political meeting held between nomination and elections nor from Sunday to Thursday. The World Health Organization (WHO) Noise Standards may be used for noise emission regulations. These standards fall into one of three major categories – residential, commercial and industrial. A residential zone generally includes areas where people sleep or where quiet is essential. Some countries have also introduced a silence zone near noise-sensitive receptors (such as hospitals and educational institutions), which involves the prohibition of certain activities (e.g. car horns and loudspeakers) within 100 m of the receptor. Commercial and industrial zones are required to operate within 70 dBA for both night and day. Residential zones have a 55 dBA restriction in general.

3.20. Three gullies drain into Robins Bay. One drains the sub-division site and thus has the potential to impact on water quality in Robins Bay, along with other sources. NEPA has enforces ambient water quality standards, which are summarized in Table 9.

Standards	BOD	Faecal Coliform	Nitrate	Phosphate	pH	TSS
	mg/L	*MPN/100mL*	*mg/L*	*mg/L*		*mg/L*
Ambient Marine Water Draft Standards 2009	0 - 1.16	<2 – 13	0.007-0.014	0.001-0.003	8 - 8.4	-
Ambient Marine Water Draft Wastewater and Sludge Regulations, 2010 (unpublished)	0.57-1.16	<2 – 13	0.001-0.081	0.001-0.055	8 - 8.44	-
Ambient Freshwater Draft Standards 2009	0.8 - 1.7	-	0.1 - 7.5	0.01 - 0.8	7.0 - 8.4	-
Ambient Freshwater Draft Wastewater and Sludge Regulations, 2010 (unpublished)	0.8 - 1.7	-	0.1 - 7.5	0.01 - 0.8	7.0 - 8.4	120-300

Table 9 Draft Jamaica Ambient Water Quality Standards

3.21. The table comprises the draft standard from 2009 which is posted on NEPA's website but was never gazetted. The second standard is the one that is included in the Natural Resources Conservation (Wastewater and Sludge) Regulations which has been drafted but not yet published. No ambient water quality standard has been set for Fats Oil and Grease (FOG) in marine and fresh water or for TSS in marine water. In addition to setting a standard for TSS in fresh water, it also adjusts the upper limit for Nitrate and Phosphate reflecting the findings of new water quality research on pristine waters.

3.22. This project does not include any provisions for a centralized sewage treatment plant, and is designed for individual lots to have their own sewage solutions (tile-fields). All residential lots are expected to occur at distances between 200 m and 1,300 m from the shoreline, at elevations between 15 m and 80 m amsl. Further, lots are large enough to allow for adequate on-site treatment. The Pollution and Prevention Control Branch of the Integrated Planning and Environment Division at NEPA is responsible for pollution control, including sewage disposal. EHU also the responsibility to review and approve the designs for sewage disposal.

3.23. At full build-out, the project could generate as much as 0.6 metric tons of solid waste per day. The National Solid Waste Management Authority (NSWMA) is the governing body in charge of solid waste management, in accordance with the provisions of the National Solid Waste Management Act (2001). This includes the regulation of environmentally sound waste collection, transportation, re-use and

re-cycling, and the development of a licensing system for operators of solid waste management and collection facilities.

3.24. Volume 5, Section 6 of the Jamaica Trade and Invest Development Manual outlines the official procedures, requirements and financial responsibilities in respect of solid waste management. The developer is required to submit a letter of application to the NSWMA (Planning and Research Department) requesting collection services for the sub-division. The application should include the site plan (with boundary shown), and the following basic information:

- Number of units from waste is to be collected.
- The types of units (detached houses).
- Road gradients.
- Height of electrical wires (or a statement that there will be no overhead wires).
- The type of receptacle that would be used by residents (perforated plastic drums or open metal cages to received bagged domestic solid waste).

3.25. NSWMA representatives will conduct a site visit to determine the condition of the road etc.

3.26. Other relevant legislation includes the Country Fires Act (1942) which prohibits incineration of trash without notice being given to the nearest police station. Outdoor burning of solid waste must be done in accordance with the act, which requires a cleared 15-foot buffer zone around the fire, burning trash between 6 pm and 6 am and attending to fires.

SECTION 4 DESCRIPTION OF THE ENVIRONMENT (BASELINE)

The EIA must include an overall evaluation of the existing environmental conditions, values and functions of the proposed development area. The purpose of this section is to describe sensitive environmental receptors in terms of pre-project status and trends (if the project is not implemented). This therefore provides a baseline against which future monitoring data can be compared to determine whether and how a project is actually impacting specific receptors.
It also allows for evaluation of contributions to environmental degradation from other sources (or cumulative impacts), and the carrying capacity of the environment in respect of specific stresses. The most basic use of the data is terms objectively determining the effect level of impacts, using a classification system.
Based on the preliminary environmental scoping, the following parameters should be included in the description of the environmental baseline, as they are considered to be valued environmental receptors that could potentially be impacted by implementation of the project.

Physical Environment

Climate

4.1. The climate of the site is controlled by a number of factors including its tropical latitude (~18.3° N), the moderating effects of the sea, the effects of the Northeast Trade Winds, and its location in the lee of the Blue Mountains. Climate at this location is humid tropical characterized by pronounced wet and dry seasons. Weather is affected by a range of tropical weather systems (Tropical Waves, Tropical Depressions, Tropical Storms and Hurricanes and cold fronts), which affect Jamaica from April to December. Cold fronts coming down from the North American continent occur between mid-October to mid-April.

4.2. The 30-year mean total annual rainfall for the parish is 1,818 mm (1971-2000). St. Mary has the typical bimodal rainfall pattern (Figure 9) with a major wet season between September and January (when mean monthly rainfall exceeds 140 mm), and a relatively minor one in April/May. The remaining months have mean monthly rainfall ranging between 136 mm (February) and 82 mm (June). The 2005 and 2006 rainfall data collected at Green Castle Estate seem reflect much more pronounced dry and wet periods. The wettest months were April 2005 and November 2006 with precipitations of 559 mm and 631mm respectively. The dry seasons in 2005 and 2006 were also much dryer with as little as 3 mm of rain in February 2005 and in March 2006.

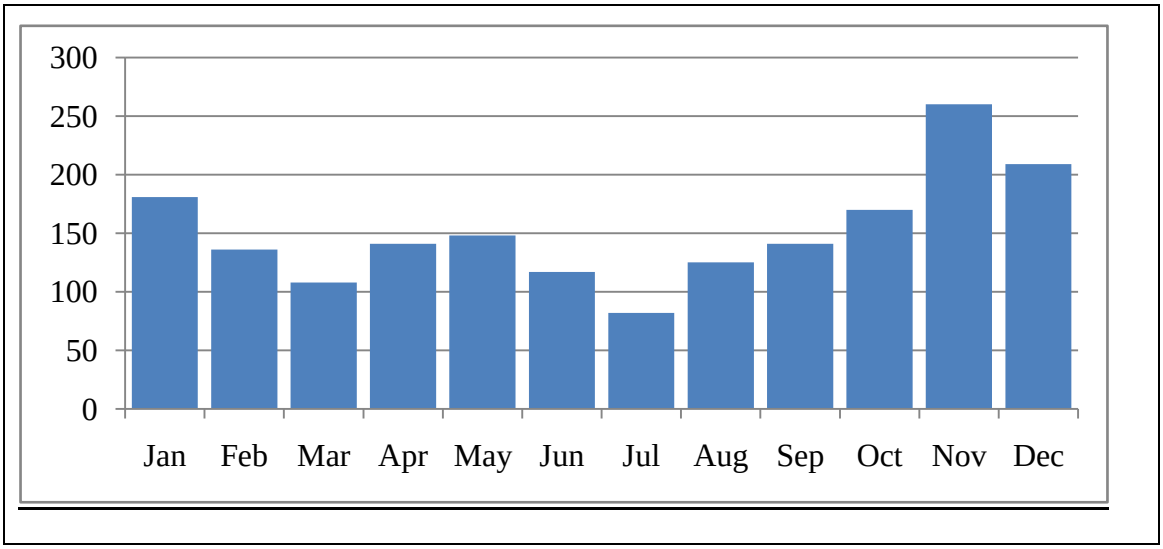

Figure 9 Rainfall Distribution for St Mary (in mm) for the period 1971-2000

(Source: National Met. Office)

4.3. Orange River, near Highgate is the nearest location for which the Meteorological Service of Jamaica could provide a nearly complete set of temperature readings (1999 – 2004). Mean monthly temperatures range between a low of 22°C in February and a high of 25°C in August (Figure 10). Maximum daily temperatures range between ~27°C in February and 31 °C in August. Minimum daily temperatures range between 18 °C (February) and 20 °C (July).

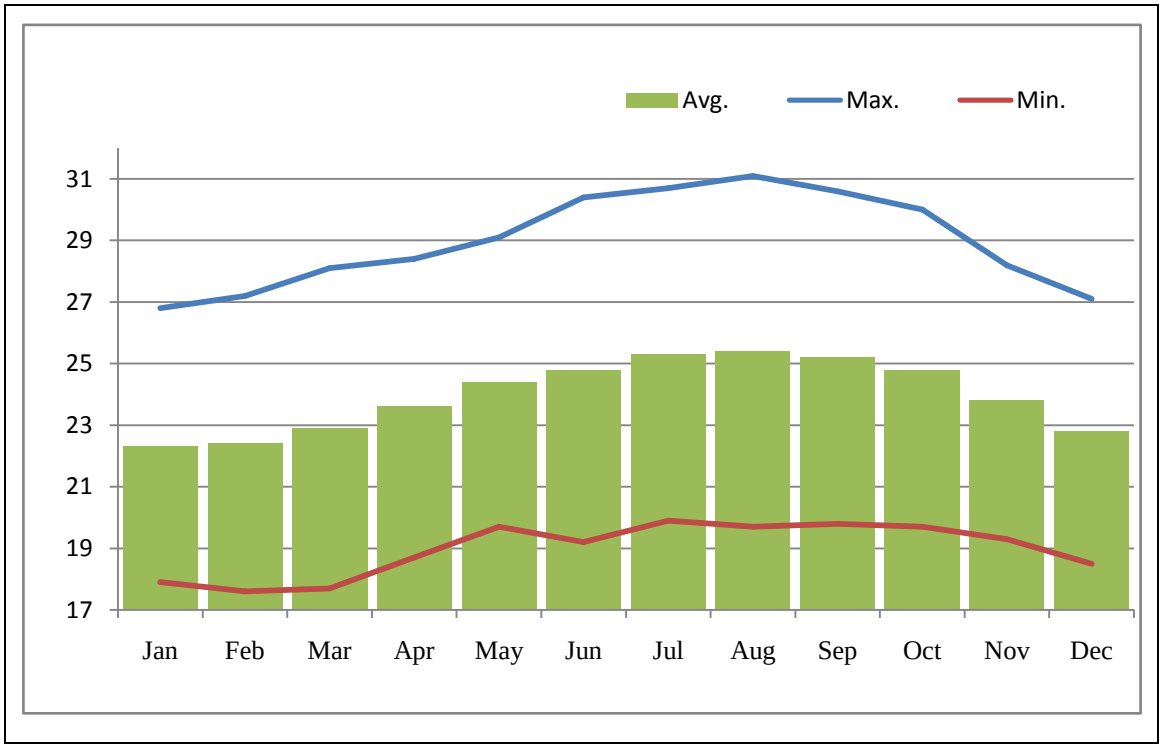

Figure 10 Average Monthly Temperature Distribution (Orange River)

(National Met Office: 1999-2004)

4.4. Consistent detailed relative humidity readings are only available for the Donald Sangster and Norman Manley International Airports. The highest readings are recorded near dawn when the temperatures are the lowest. The humidity decrease until the maximum temperature is reached in the early afternoon. The average relative humidity at the coast is 84% at 7 a.m. and 71% at 1 p.m. Near the foot of the hills the average relative humidity goes up to ~77% as a result of the afternoon showers. During the wet season and prolonged rainfall is not uncommon for the relative humidity to spike to values between 90 and 100%.

4.5. Wind data are only available for the two international airports. The Meteorological Office of Jamaica asserts however that the wind data from the Donald Sangster International Airport adequately represents the wind condition for the whole of the north coast. The data presented here covers the period 1997–2009 (Figure 11). The E to ENE Trade winds are the prevailing winds right through the year with standard wind speeds between 11 and 17 knots. The other prevailing wind direction are the onshore wind from the north with regular wind speeds between 4 to 11 knots and higher and the offshore wind coming from the SE to SSE with wind speeds between 1-4 knots. The offshore winds become relative more important in the period August to October but are always significant weaker then the Trade Winds and onshore winds from the north.

Views, Ambient Noise, Air and Artificial Light

4.6. The site has spectacular views of the sea to the north, and of the hills and mountains in most other directions. The topographic divide of the Davey Hills effectively block any visual intrusions arising from activities elsewhere on Greencastle Estate.

4.7. Ambient noise, air and light are typically influenced by land uses at the site and in proximity to the site. There are no sources of noise, air pollution or artificial lighting presently on site, with the exception of the very infrequent vehicle driving along the farm tracks in the area. It has been reported that there is some relatively minor effects of noise from Robin's Bay affecting the site during periods when there are festivities or dances ("sessions") in the village.

4.8. The level of vehicular traffic along the coast road between Robin's Bay and Tower Road is negligible and is unlikely to represent a significant source of pollution. The North Coast Highway is located more than 2.5 km from the site, and also does not represent a significant source of air pollution to the site.

4.9. Activities within the Greencastle Estate do not represent a significant source of either noise or air pollution to the site. Minor night time lighting would be blocked by the range of hills called Davey Hill 1 and 1, which are located to the east of the site.

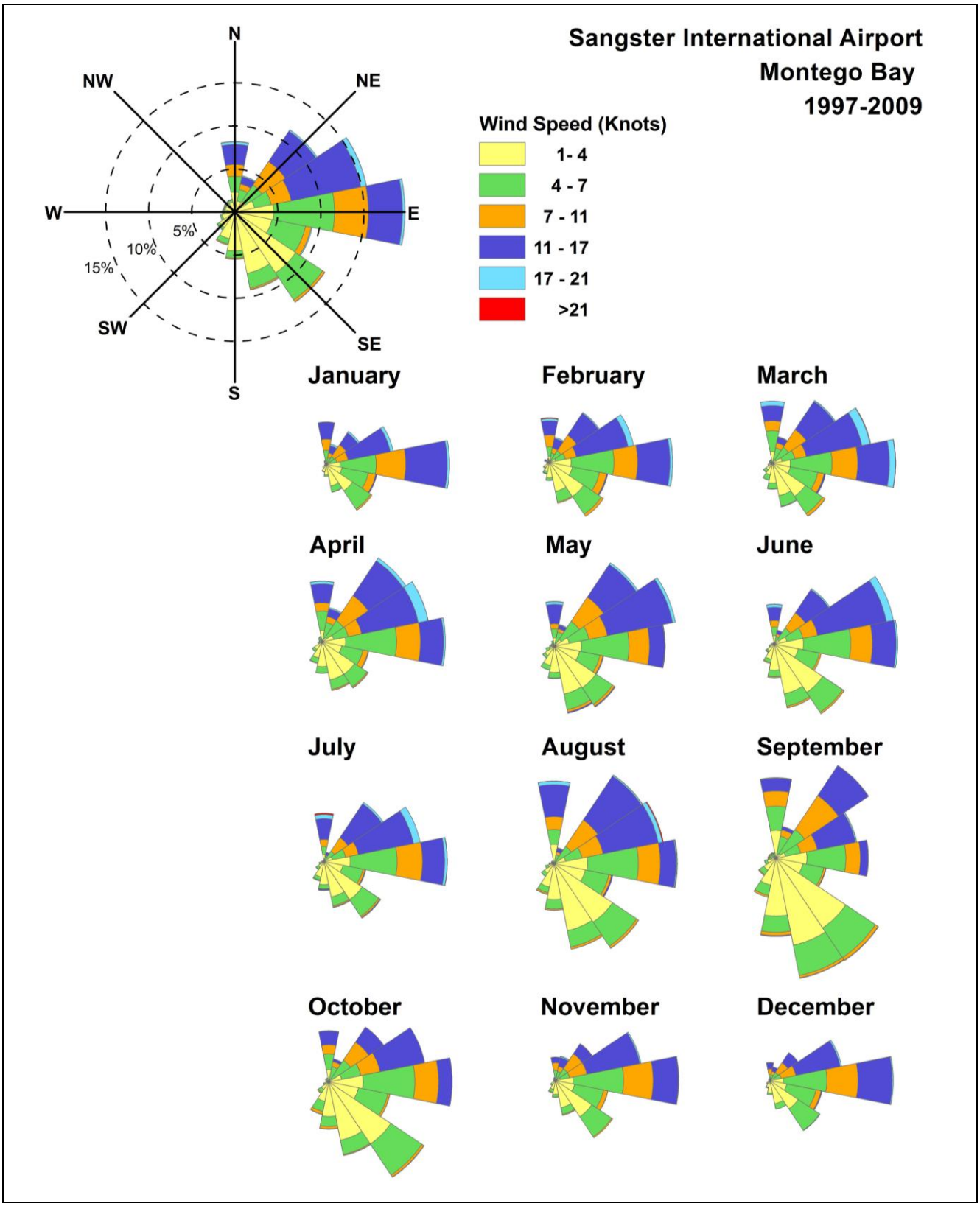

Figure 11 Wind rose Sangster's International Airport Montego Bay 1997 – 2009

Topography & Landforms

4.10. The topography of the site is characterized by a series of gently sloping terrace levels which have been deeply incised by short ephemeral rivers. Three terrace levels can be seen within the boundaries of the proposed subdivision. They are located between elevation 15to 25 m, 35 to 50 m and 65 to 80 m (Figure 12). These terraces are likely to correspond with harder, more competent layers or lenses in the underlying bedrock. In general, elevations at the site range from ~15 m (about 200 m from the shoreline) to 80 m above mean sea level (at the ~1300 m from sea level).

4.11. Drainage in this area is generally ephemeral, characterized by relatively short streams (1 to 2 km) with deeply incised valley floors (up to 35 m deep). Flat valley floors, meandering of the stream channels over the valley floor and the low gradient of the stream channel, suggest that these streams are mature and have almost reached their base level. The valley floor is scoured out irregularly by the river indicating turbulent flows during heavy rainfall. Although water stops flowing shortly after the rain ceases, the puddles in the valley floor can contain water for a long time after the rain has ceased. Although no faults are represented on the provisional geological map of the area, a rectangular drainage pattern of the rivers suggest that these streams are likely to be controlled by geological structures (joints and faults).

4.12. Based on the latest topographic survey (12 December 2011), a slope map was produced. The slope map was overlain with the subdivision plan of 4 January 2012 and compared with the slope classes considered in the Hillside Development Manual for Jamaica (Draft June 2011) by Mines and Geology Division. (Table 10 and Figure 13). Fifty three (53) percent of the area that is being considered for subdivision varies has slopes that vary from 0 to 17%. Land with slopes up to 17% is classified as gently sloping and is not considered a hillside property by the Mines and Geology Division. Development on such terrain is not subject to the guidelines of the Hillside Development Manual for Jamaica (draft June 2011) and does not require special considerations beyond the standard development guidelines.

SLOPE		AREA (% of total)	Slope Category	**The Hillside Development Manual for Jamaica (draft June 2011)**
% grade	degree			
0 – 5	0 - 3	16	Gentle	Not considered hillsides, Subject to existing regulations and guidelines only.
>5 – 10	3 - 6	19		
>10 – 17	6 - 10	18		
>17 – 26	10 - 15	18	Moderate	Development is permitted subject to geotechnical evaluation where problematic rocks or soil dominates the slope. erosion and slope protection may be required in the upper ranges of this category
>26 – 34	15 - 19	10		
>34 – 50	19 - 27	12	Steep	Requires geotechnical evaluation. Development on these slopes requires extensive grading. Landslides are an issue. Development is permitted except on active or reactivated landslides or on colluvial deposits and scree slopes. Of special concern are sections of the hillside that exhibit sharp topographic changes.
>50 – 58	27 - 30	4	Very Steep	Development may be permitted where geology is stable or the landslide susceptibility is low. Only limited grading is permitted. In weak or unstable rocks and in areas susceptible to landslides development will only be permitted subject to extraordinary provision and minimal disturbance
>58	>30	3	Very Steep to Near Vertical	No development

Table 10 Summary of slope classes and their Development Implications

4.13. The slope angle is not an eclusive consideration to determine the suitability for housing development. For example a flat piece of land can be excluded from development because it is prone to flooding. On this property the flat valley floors in the gully channels would have to be excluded. This applies also to the flat areas at the mouth of the river channels below the 8 m (25 ft) contour line, unless something can be done to improve the drainage of the area. Twenty eight (28%) percent of the site area currently has moderate slopes between 17 and 35 percent.

4.14. Such moderately slopeing terrain is considered to be generally suitable for development as long as care is taken to protect cut slopes and control erosion. Eighty one percent (81%) of the property poses little or no problem for development; the remaining 19% is considered to be prohibitively steep (3%) or difficult (12%) to very difficult (4%) to develop. All lots in the updated subdivision plan of 4 January 2012 satisfy the MGD Draft Slope Criteria. A few of the lots include small sections of steeper terrain within their boundaries but in comparison to the size of the lot these steeper sections are negligibly small, and are not expected to significantly impact the use of the land.

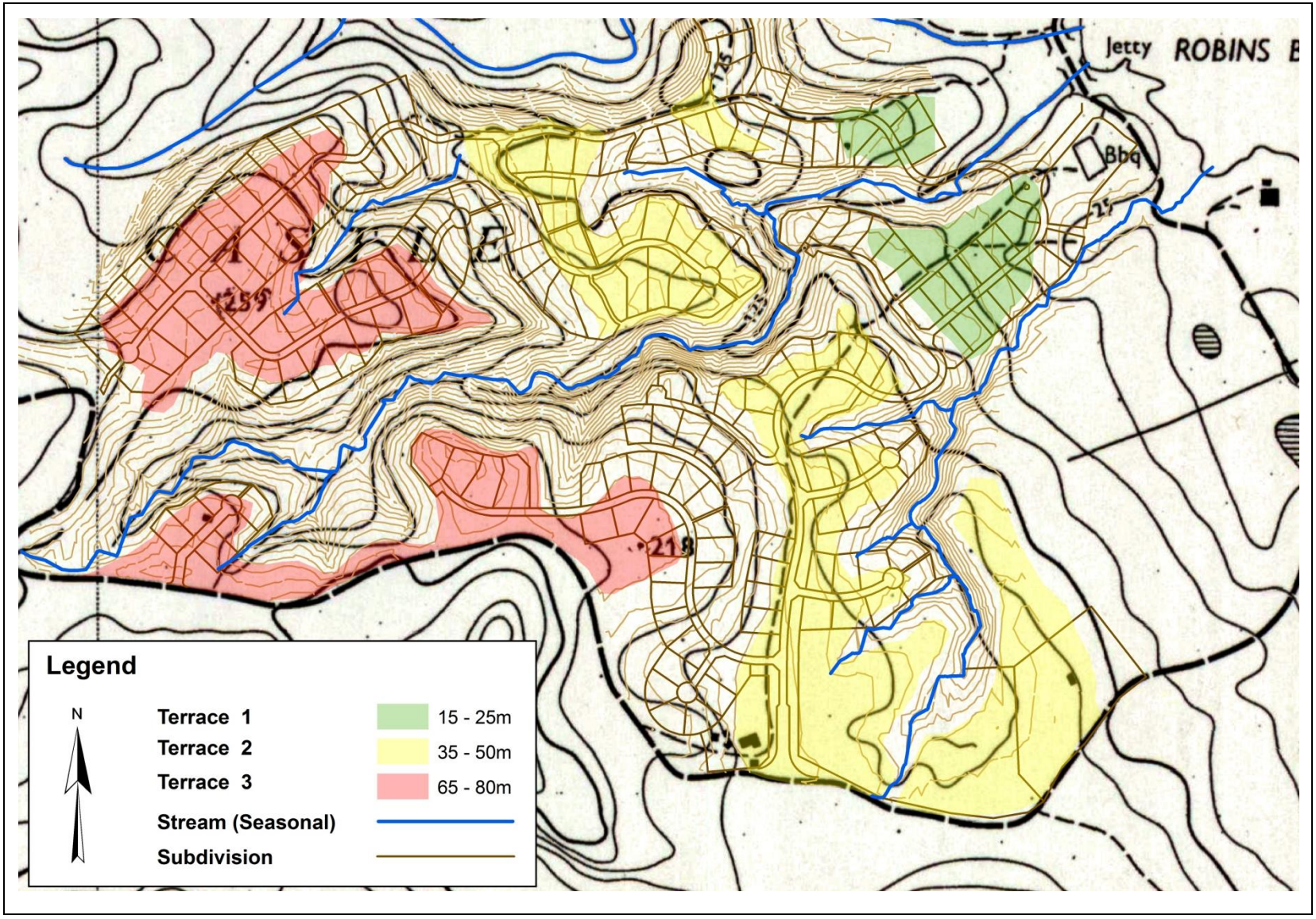

Figure 12 Terraces

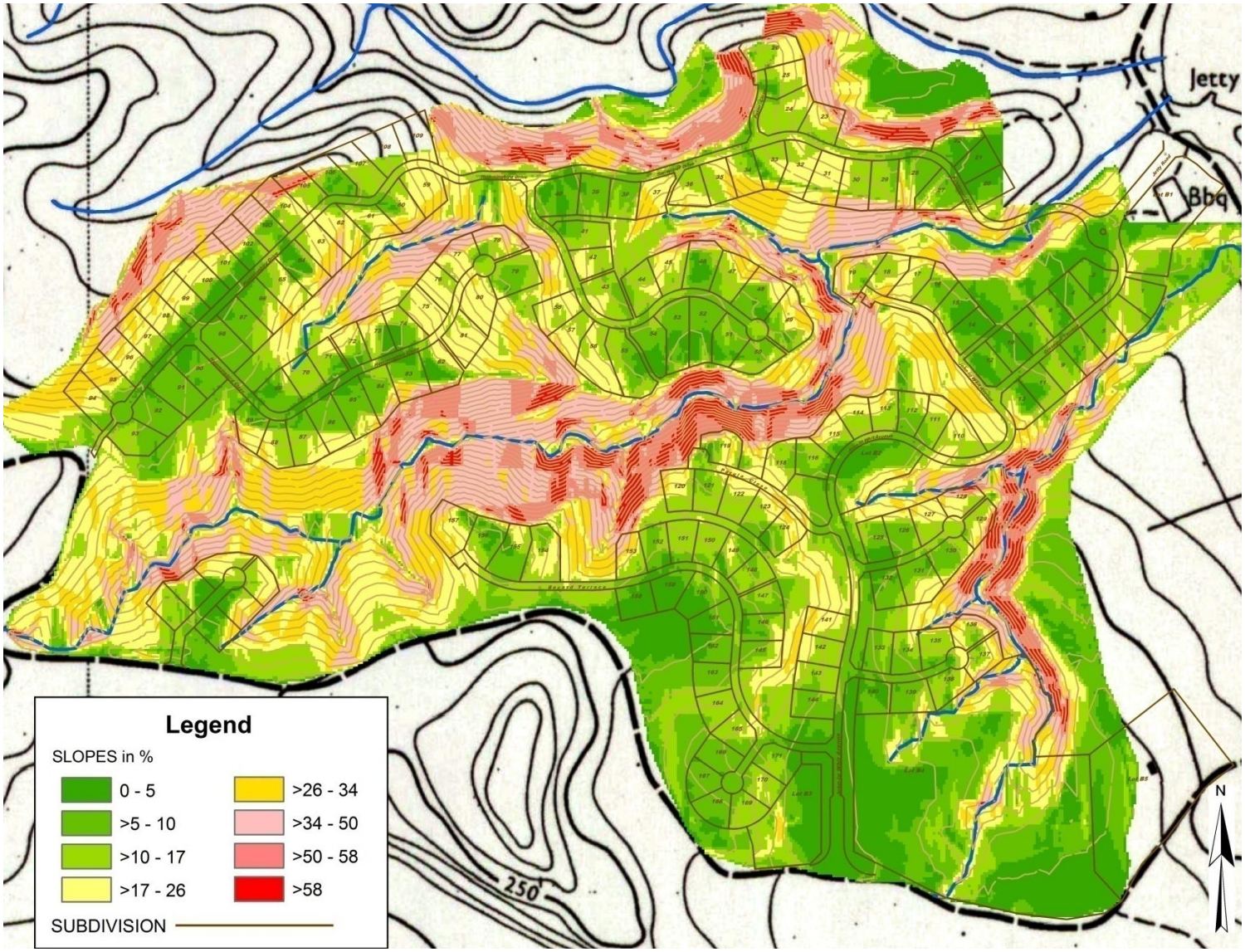

Figure 13 Slope Map

Geology & Soils

4.15. The main site bedrock has been (provisionally) mapped as comprising undifferentiated "Coastal Group". This group of rocks comprises the youngest (Pleistocene to Recent) rocks in Jamaica, and are restricted in their distribution to coastal areas. These carbonates are likely to have onlapped onto the older (Eocene) Richmond Formation, which is a succession of bedded clastic shale, siltstones and sandstones. The geology map prepared for the site (Figure 14) shows the boundary between the Richmond Formation and the Coastal Limestone Group intersecting the parochial road at an elevation of 99 m (325 ft) amsl, approximately 300m before the Great House. This map put the boundary between the Richmond Formation and the Coastal Limestone Group approximately 500 m further to the West than the provisional Geological Map Sheet 24. This correction is based on field work carried out in preparation for the proposed development.

4.16. The Coastal Limestone Group is the sole geological unit that outcrops within the boundaries of the proposed development. Four (4) distinct lithologies have been identified within the Coastal Group but due to the general lack of outcrops on the site it was not possible to separately map these lithological units. Unit 1 (Figure 15, outcrop 1 on Figure 14) is a fine grained muddy carbonate rock (wackestone). This unit is grey and case hardened on the exposed surface. Below the surface, the fresh limestone is creamish to yellow in colour and apparently lacking bedding. It is very soft and can easily be excavated. The best example of this can be observed around the copra house ruins on the second terrace level.

4.17. Unit 2 (Figure 16, outcrop 2 on Figure 14) is a rudstone (a limestone containing large boulders). This unit may be representative of a submarine talus or apron system which occurred down-slope of an ancient coral reef. Although no in situ coral reef lithology was found during the fieldwork, it is likely that it may be found above this level. Outcrops are extensive along the existing farm road around proposed sub-division lots 55, 56 and 46 to 49 on Terrace Level 2. This unit is laterally variable with some areas of poorly cemented rubbly limestone, and other areas of well-cemented hard rock.

4.18. Unit 3 (Figure 17; outcrop 3 on Figure 14) is a coralline limestone. This unit is white to yellow, outcrops are well cemented. Large overturned coral heads can be observed within a marl matrix. Large boulders of this unit were seen near Lot 46.

4.19. Unit 4 (Figure 18 outcrop 3 on Figure 14) is a calcareous, bedded sandstone with imbricate pebbles, likely to be an alluvial or fluvial deposit. This is a red brown pebbly sandstone, moderately cemented within a calcareous matrix. It outcrops on the lower elevations only. These are interpreted as a part of a fluvial terrace deposit, with much of the material derived from the Coastal Limestones and (the non-carbonate) Richmond Formation in the hinterland. This unit is generally found at elevations below 25 m amsl.

4.20. Faulting (Figure 14) is inferred from the interruption of stream flows patterns. The plan view of the rivers shows two near-perpendicular changes in direction in several streams. All the streams and their tributaries are flowing towards the sea, parallel to each other, in a general WSW –ENE direction. The stream and their tributaries are coming together at right angles following SSE-NNW lineaments. The most obvious SSE-NNW lineament is shown on the geology map. It defines the upper reach of the John-to-Whit Gully, the confluence of the Parula and Sandpiper gully, and a significant right angle change in the course of the Robins Bay Gully. The gully segment forming the right angle confluence of the Parula and Sandpiper gullies is also defined by a 6 meter high escarpment of a landslide. Although no displacement could be demonstrated with the current information, this SSE-NNW lineament is expected to be a fault.

4.21. The Coastal Limestone Group appears to dip at a very small angle towards the sea as can be expected. Lack of suitable outcrops precluded any reliable measurements of dip.

4.22. The dominant soils in areas of the site above 25 feet amsl is the Sea-Wall Stony Clay, which is a residual soil developed over the Coastal Group. It is a thin brown soil developed over the coralline limestone with very poor water retention capacity and very little organic matter. The Belfield Clay develops over the Richmond Shale (above the site). This soil has moderate internal drainage and moderate to high water supplying/retention capacity because of its montmorillonite clay content. An alluvial soil with a mixture of materials from the Richmond Formation (sandstone and shale flagstones as well as loose clastic silt and sand) and limestone cobbles from the Coastal Group can be expected to occur in the floodplains of the major gullies draining the site and on the terraces near the contact of the Richmond Formation and the Coastal Limestone Group.

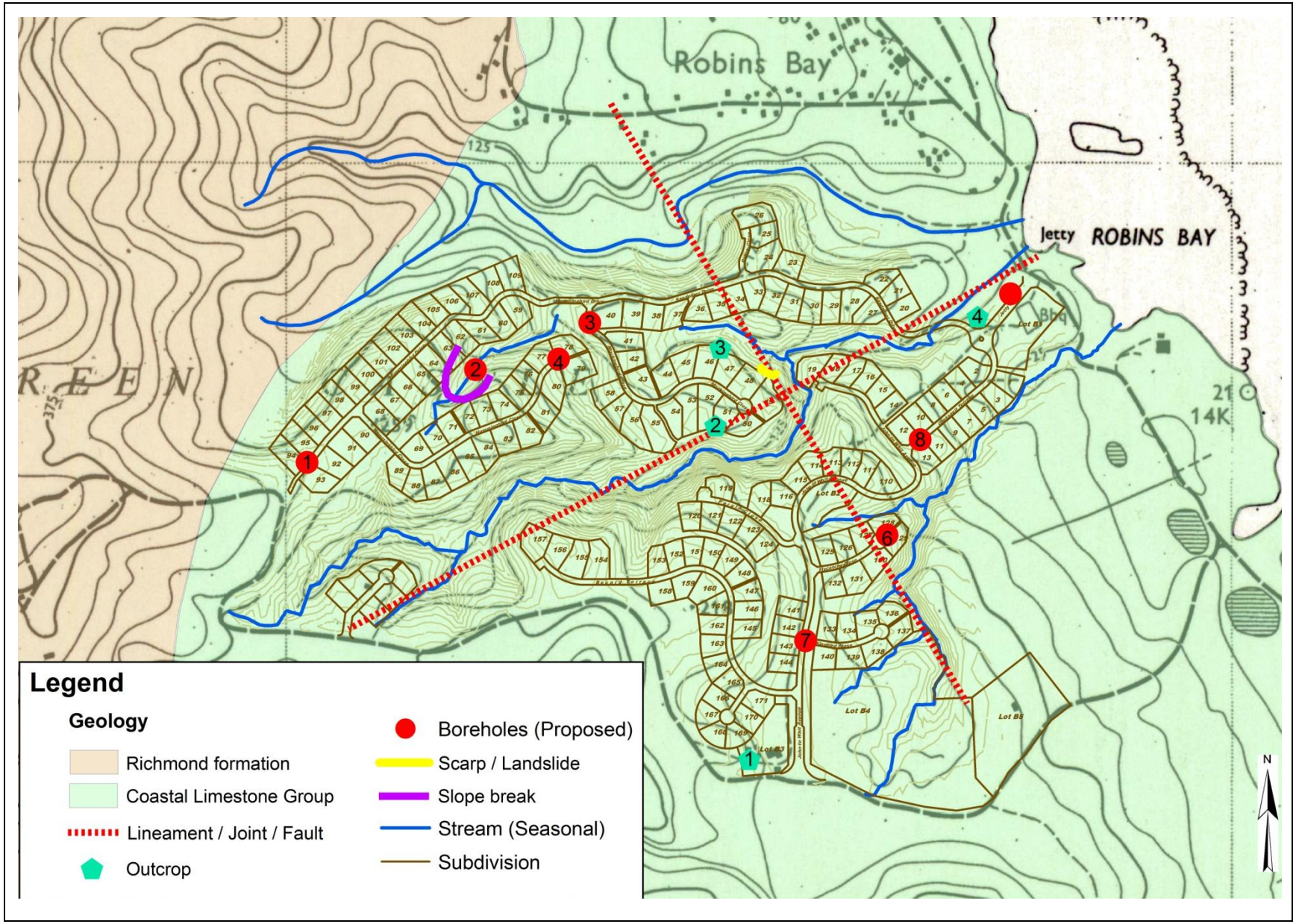

Figure 14 Site Geology

Figure 15 Unit 1: Case-hardened Wackestone (marl)

Figure 16 Unit 2: Rudstone

Figure 17 Unit 3: Coralline Limestone

Figure 18 Unit 4: Pebbly Sandstone

Hydrology

Surface Drainage

4.23. Most of Green Castle Estate property falls within the Wagwater Catchment (Watershed Management Unit #9) while the adjacent Robins Bay community falls within the Oracabessa-Pagee River Catchment (WMU #8). The section of the Green Castle Estate Property Northwest of the Davey Hill Ridge, which is being considered for subdivision, consists of three basins which all drain into Robins Bay. The streams associated with these three basins are ephemeral, flowing only for a short time after heavy rains.

4.24. The river channels in the three watershed basins have a rectangular (or lattice) drainage pattern. This drainage pattern is characterized by straight channel segments and right angle bends and confluences and indicate that the location of the rivers is controlled by the geological structure of the rocks especially faults and joints

4.25. Figure 19 shows the watershed in and around the site. The most northerly basin is the largest of the three draining an area of 1.16 km^2 (286 acres). For ease of reference it is herein referred to as the Robins Bay Gully. There is only marginal overlap between the development site boundaries and this basin; therefore, only very negligible run-offs from the site is expected to contribute to flows in that system. Larger peak flows are generated in this basin due to the larger catchment area and the higher levels of development and deforestation in that system. This is reflected in the relatively larger size of the box culvert that transmits flows from that system to the bay. Figure 20 below shows that this box culvert has fallen into severe disrepair and is now threatening the stability of the parochial coast road to Robins Bay. The invert of the box culvert is slightly above the channel floor of the stream. Replacing this culvert by a bridge structure or an open arch structure would improve the drainage of the low lying lands near the mouth of the stream.

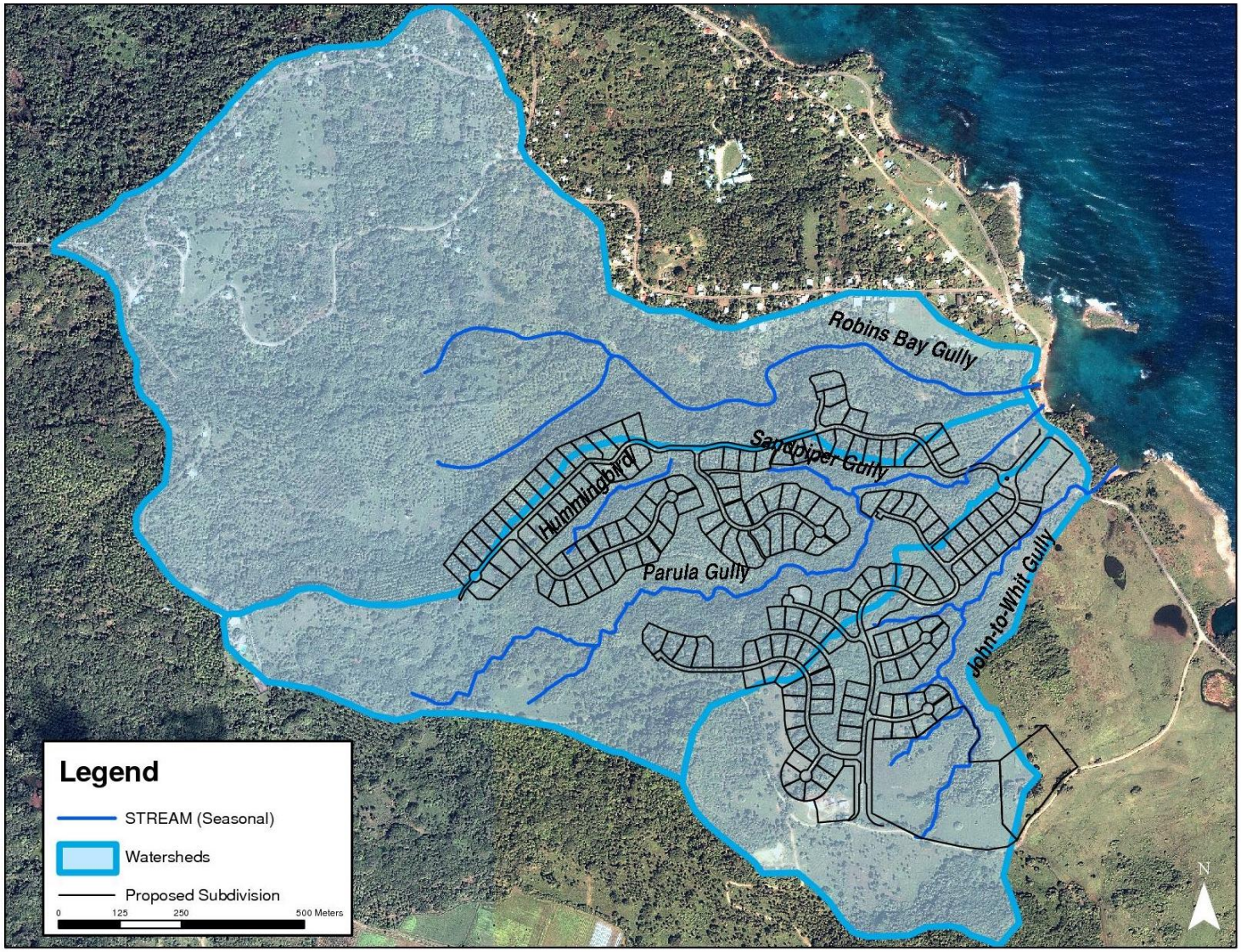

Figure 19 Watershed boundaries and main streams North of the Davey Hills

Figure 20*Box Culvert at the end of the Robins Bay Gully*

Figure 21Cross Drain Headwall at the source of the Parula Gully

Figure 22 Pipe Culverts at the end of the Parula Gully

Figure 23 Pipe Culverts at the end of the John-to-Whit Gully

4.26. The central basin (referred to herein as the Parula Basin for ease of reference) that drains into Robins Bay has a catchment area of ~0.58 km² (143 acres). This basin has two channels, the larger of which (called herein Parula Gully) starts below the contact between the Richmond Formation and the less permeable marly limestones of the Coastal Group. The gully starts as cross drain under the old parochial near the entrance of the Great House. The smaller gully (called the Hummingbird/Sandpiper Gully) draining the northern sub-basin of the Parula Basin) comprises two segments.

4.27. These two gully segments clearly line up and are expected to be connected. However it is uncertain whether and how water flows from the upper part to the lower part. It is also possible that water ponds in depressions within the upper section.

4.28. The Parula and Hummingbird/Sandpiper gullies merge at an elevation of ~ 100 feet (30 m) amsl and then flow westwards towards the central part of Robins Bay coastline (~400 m), giving an average slope of this lower course of ~ 8 %. The Parula Gully empties into the bay through a pipe culvert. Like the box culvert of the Robins Bay River the inverts of these pipes are above the channel level and impede the drainage of the flat lands behind the coastal road.

4.29. The southern basin delineated to east by Tower Road is (~0.41 km² or 141 acres). This channel is referred to herein as the John-to-Whit Gully as it parallels the John-to-Whit Avenue. It starts at a maximum elevation of ~150 feet (46 m) amsl and terminates at the eastern corner of Robins Bay. The average slope of this gully between Tower Road and the coast is ~5.5%. A single pipe culvert connects this gully with the sea. During heavy rain the road is expected to be flooded by the overflowing gully.

4.30. The proposed subdivision extends over three small unnamed watersheds which for the purpose of this report have been named from north to south the Robins Bay Gully Basin, the Parula Gully Basin and the John-to-Whit Gully Basin (Figure 19). Except for the Robins Bay Gully Watershed, these watersheds fall completely within the property boundaries and the control of Green Castle Estate.

4.31. In general farming has ceased in the section of the Green Castle Estate north of the Davey Hill ridge. Low intensity cattle farming is taking place in the John-to-Whit Gully basin on pasture lands in the headwaters and east of the gully. Agricultural

activity in the Parula and the Robins Bay Gully basins is limited to harvesting of coconut and pimento where it is accessible. These crops are organically labelled and the fields are not fertilized. No vegetation removal is happening, except for a minimal amount to reopen existing farm roads and to cut survey lines.

4.32. The Green Castle Estate House is currently used as eco-resort but with a maximum occupancy of 10 people, it has the environmental footprint of a regular family home. More than 50% of the Robins Bay gully watershed is located beyond the property boundaries. The water quality of the Robins Bay gully is to a large extend function of the activities and potential sources of pollution of that area. The main land use is residential along the roads and some subsistence farming in between. Currently there are no obvious sources of pollution that could have a significant adverse affect on water quality.

4.33. The western section of Robins Bay, the bay in which the Robins Bay Gully and the Parula Gully terminate, is used as a fishing beach for a small number of motorized fishing canoes. At no time where there more than 4 boats in the bay. While the beach was covered with the trash (floatables), there was no visual evidence of pollution that could be directly linked with the fishing activities on the beach.

Groundwater

4.34. As shown in Figure 14 (Site Geology), the site is underlain by the Coastal Group. This unit is typically classified as a coastal aquiclude, with relatively low transmissivity. However in reality, the Coastal Group is a designation for a wide range of lithologies that are undifferentiated in the provisional geological maps issued by the Mines and Geology Division. At this site four completely different lithogical units were identified (see paragraph 4.15). Each of these lithologies are likely to have very different hydrogeological properties.

4.35. Percolation tests (Figure 24) were conducted at each of the three geomorphological units (terraces), taking into account the lithological variations therein, to obtain a broad indication of percolation variability across the entire site. Test pits were excavated to a depth of 2 m. No groundwater was encountered at any of the pits.

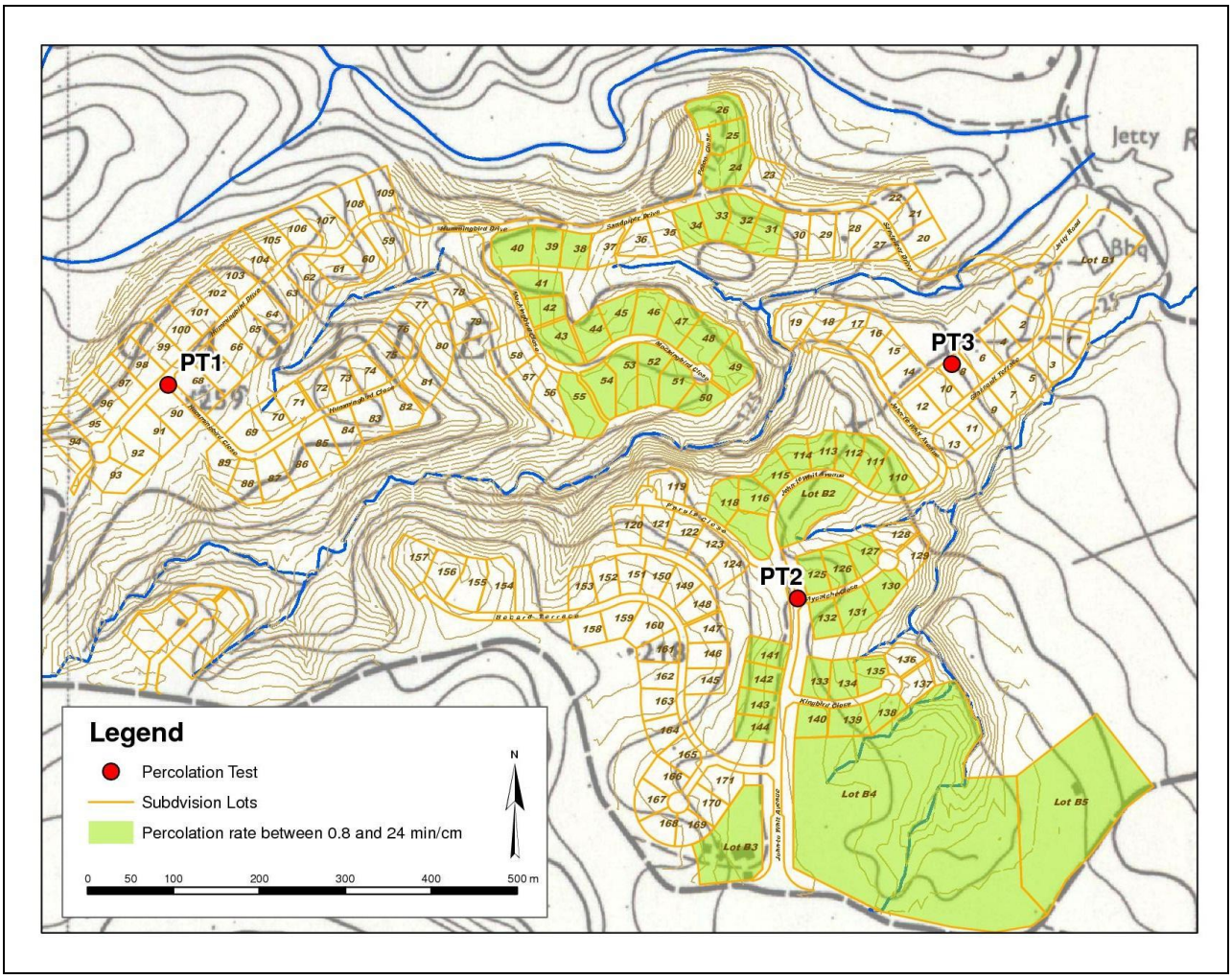

Figure 24 Locations of the Test Pits

Test Pit	Elevation (amsl)	Lithology at base	Estimated Depth to Groundwater	Percolation Rate
PT1	79 m	Coralline limestone	19 m	97.81 min/cm
PT2	47 m	Arenitic limestone	15 m	1.31 min/cm
PT3	21 m	Sands and gravels	13 m	0.37 min/cm

Table 11 Percolation Test Results

4.36. Based on the results obtained from these three tests (Table 11 above), it is clear that there is a very wide range of variability in percolation rates across the site. While these may be largely controlled by general lithological units, it must be emphasized that even within these units considerable lateral variability in primary and secondary porosity can be expected. Generally speaking, percolation in the upper terrace, where there are relatively well-cemented limestones the observed

rate of percolation in the test pit was very slow (~ taking about an hour and a half to drain 1 cm). Percolation rates were considerably faster in the locations with more sand and gravel sized material.

Water Quality

4.37. The objective of the water quality sampling program was to collect a representative water sample from the three types of water bodies that can be found within the project area, the gullies, the ponds and the sea. Two sets of 3 water samples have been taken. The first set was collected on 14 July 2011 between 1 and 2 pm, the second seton the 14 January 2012 between 12 and 1 pm in the same locations as the first set except for the sample at mouth of Robin's bay Gully (Figure 25).

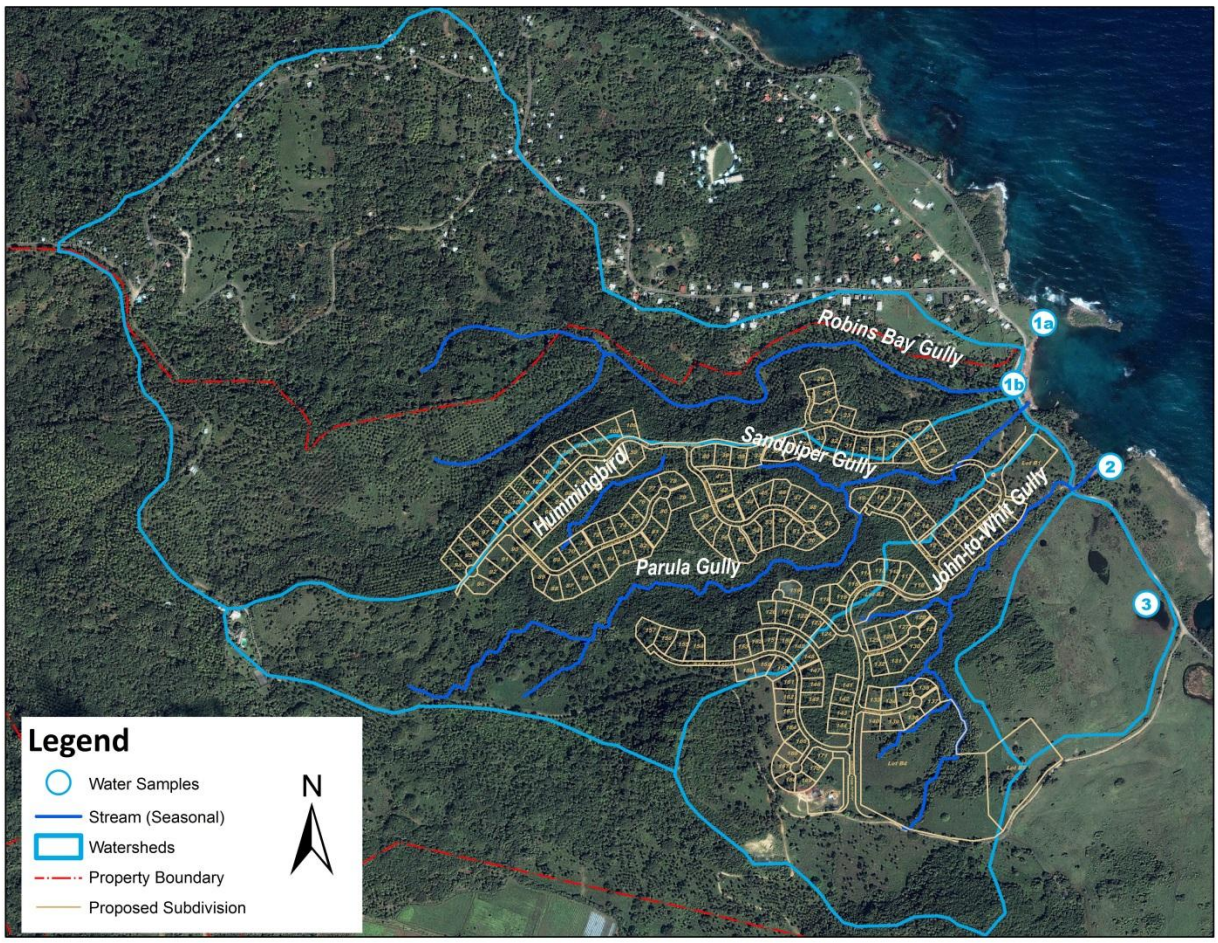

Figure 25 Watersheds and Water Sample Stations

4.38. Because the gullies within the project area carry water only during or shortly after heavy rainfall (i.e. ephemeral), it was not possible to get a sample from the Robin's bay Gully when the first set samples were taken. Although the weather was overcast on 14 July 2011 and rain showers fell the days before, it was not enough to sustain a flow to allow us to take a fresh water sample from the gully. The freshwater sample from the Robin's bay Gully was substituted with marine sample which was taken near the mouth of the Gully. (Sample 1a). During the second campaign on 14 January 2013, St. Mary got some rain for a few day of persistent rains associated with a cold front. The Robin's bay was discharging at that time just enough to be able to take a sample at the box culvert.

4.39. Station 1a was selected as a reference sample in the western section of the bay. Being furthest removed from the main potential source of pollution, the Robins Bay Gully, and with the currents coming into the bay from the Northwest at the time of sampling, it was expected to be the more pristine location in the bay. The sample meets the Draft Jamaica Ambient Water Quality Standards for Marine Water of 2009 (Table 13) for all tested parameters except for Phosphate. It should be noted that the Phosphate does meets NEPA's Ambient Freshwater standard in the unpublished guideline to waste water and sludge regulations, 2010 .

4.40. The samples were transported on ice and delivered to ETAS laboratory in Hope Pastures in Kingston within 3 hours of collection. ETAS tested for BOD (Biological Oxygen Demand), Faecal Coliform, Nitrate, FOG (Fats, Oil and Grease), Phosphate, pH and TSS (Total Suspended Solids) using standard methods.

4.41. The results are given in Table 12 below.

#	Date	BOD	Faecal Coliform	Nitrate	FOG	Phosphate	pH	TSS
		mg/L	*MPN/100mL*	*mg/L*	*mg/L*	*mg/L*	*@ ºC*	*mg/L*
Marine								
1a	14 July 2011	0	<1.8	<3.52	7.0	0.02	8.31 *@ 20.3°C*	190
2	14 July 2011	2.3	<1.8	<3.52	2.7	<0.02	8.35 *@ 18.2°C*	180
2	14 Jan 2013	<2	4.5	<0.0066	1.4	0.09	8.15*@ 22.9°C*	5.1
Fresh Water								
1b	14 Jan 2013	0.4	**920**	0.0069	1.5	0.38	7.98*@ 22.0°C*	4.5
3	14 July 2011	<10	**170**	<3.52	3.6	0.22	6.45 *@ 19.6°C*	10.8
3	14 Jan 2013	3	**540**	<0.0066	2.5	0.26	6.84*@ 21.0°C*	19

Table 12 Water Quality Test Results

Standards	BOD	Faecal Coliform	Nitrate	FOG	Phosphate	pH	TSS
	mg/L	*MPN/100mL*	*mg/L*	*mg/L*	*mg/L*		*mg/L*
Ambient Marine Water Draft Standards 2009	0 - 1.16	<2 - 13	0.007-0.014	-	0.001- 0.003	8 - 8.4	-
Ambient Marine Water (in unpublished Guideline to Waste-water and Sludge Regulations, 2010)	0.57-1.16	<2 - 13	0.001-0.081	-	0.001-0.055	8 - 8.44	-
Ambient Freshwater Draft Standards 2009	0.8 - 1.7	-	0.1 - 7.5	-	0.01 - 0.8	7.0 - 8.4	-
Ambient Freshwater (in unpublished Guideline to Waste-water and Sludge Regulations, 2010)	0.8 - 1.7	-	0.1 - 7.5	-	0.01 - 0.8	7.0 - 8.4	120-300

Table 13 Draft Jamaica Ambient Water Quality Standards

4.42. The test for Fats,Oil and Grease (FOG) at station 1a returned higher than expected reading of 7 mg/l. This is can be considered acceptable as it well below the maximum level of 10mg/l. set by standard for Sewage Effluent to be used for Irrigation. No standard has been set for FOG in the Ambient Water Quality Standards for Marine Water, either published or unpublished.

4.43. Station 2 is a marine station in the eastern section of Robin's bay, near the mouth of the John-to-Whit gully. This station was sampled twice. The test results for the station meets the Draft Jamaica Ambient Water Quality Standards for Marine Water of 2009 for all tested parameters except for BOD in the 2011 sample and for Phospate in the 2013 sample. The 2.3 mg/l reading for BOD while not particularly high is surprising considering that test result for Faecal Coliform, Nitrate and Phosphate were all below the detection limit. As a matter of reference the BOD limit for irrigation water is set at 15 mg/l. The Phosphate in the 2013 sample exceeds the Ambient Marine Water Standard both of 2009 and 2010. The Phosphate as well as the faecal colliform levels which are higher than in 2011 sample may be attributed to runoff associated with the elevated rainfall at the time of the sampling.

4.44. Station 1b is located on the outside the box culvert of Robin's Bay gully. Only one sample was taken here on 14 January 2012 because of the generally low discharge of the gully. All parameters conformed with ambient freshwater quality standard. Faecal coliform which is not included in the ambient freshwater quality standard was however the highest of all samples taken and did barely meet the effluent discharge standard for pre-1997 sewage plants.

4.45. Station 3 is located on the edge of the larger fresh water pond east of the John-to-Whit gully, near the intersection of the coastal road and Tower Road. It was the intention to take the water samples from the smaller pond closer to the John-to-whit Gully. The mudflats surrounding the remaining free water of the small pond, made it impossible to reach the water and take a sample.The fresh water ponds are part of a small subwatershed east of the John-to-Whit gully watershed. This sub-watershed has no obvious drainage system except for the ponds clear river/gully system. During normal rainfall condition the surface runoff collect in the ponds; during heavy rainstorms these pond flow over across the coastal road and discharge in the John-to-Whit gully just below the coastal road.

4.46. Two samples were taken at station 3 on 14 July 2011 and on 14 January 2013. Both samples meet the Draft Jamaica Ambient Water Quality Standards for Freshwater of 2009 for the tested parameters, except for pH and BOD. Since the water in the pond is stagnant, a low pH and elevated BOD was expected. The BOD for the 2011 sample however was inconclusive because the detection limit of theselected test method was too high to get a reading. The BOD of the 2013 sample while being higher than the Ambient Fresh Water standard of 2010, meets and exceed the irrigation water standard.

4.47. Since the fields around the pondsare used as a pasture, the relative high faecal coliform levels of these samples did not come as a surprise. Both samples far exceedthe 12 MPN/100 ml upper limit for effluent that is used for irrigation purposes. Thefaecal coliform level of 2013 sample was more than double the NEPA's current sewage effluent standard but stayed well below the upper limit set by the pre-1997 effluent standard and can there for be considered as fair.

Natural Hazards

4.48. All of Jamaica, particularly eastern Jamaica, is prone to earthquakes. Figure 26 is a map generated from a search at the USGS NEIC database. The tectonic positioning of the eastern Jamaica relative to the Cayman Trough (just south of Cuba) causes a number of relatively shallow earthquakes north of Jamaica as the Caribbean Plate slides eastwards along this boundary with the North American Plate.

4.49. A second more immediate zone of tectonic activity occurs along the Wagwater Fault. In recent times two moderate earthquakes have occurred along this fault: the January 1993 earthquake (M 5.5), which occurred ~45 km southeast of the site,

and the November 1988 earthquake (M 5.4), which occurred ~33 km southeast of the site. The nearest recorded earthquake epicentre is the April 21, 1992 event (M 2.7). Based on the existing data, it is estimated that there is a 5% of a M5.4 occurring (Wiggins-Grandison, 2005[7]).

4.50. There is the potential for offshore earthquakes in the site region to generate tsunamis on the north shore of Jamaica. A minor tsunami was reported on the north coast at the time of the 1907 earthquake. The following account is given in Lander et al. (2002).

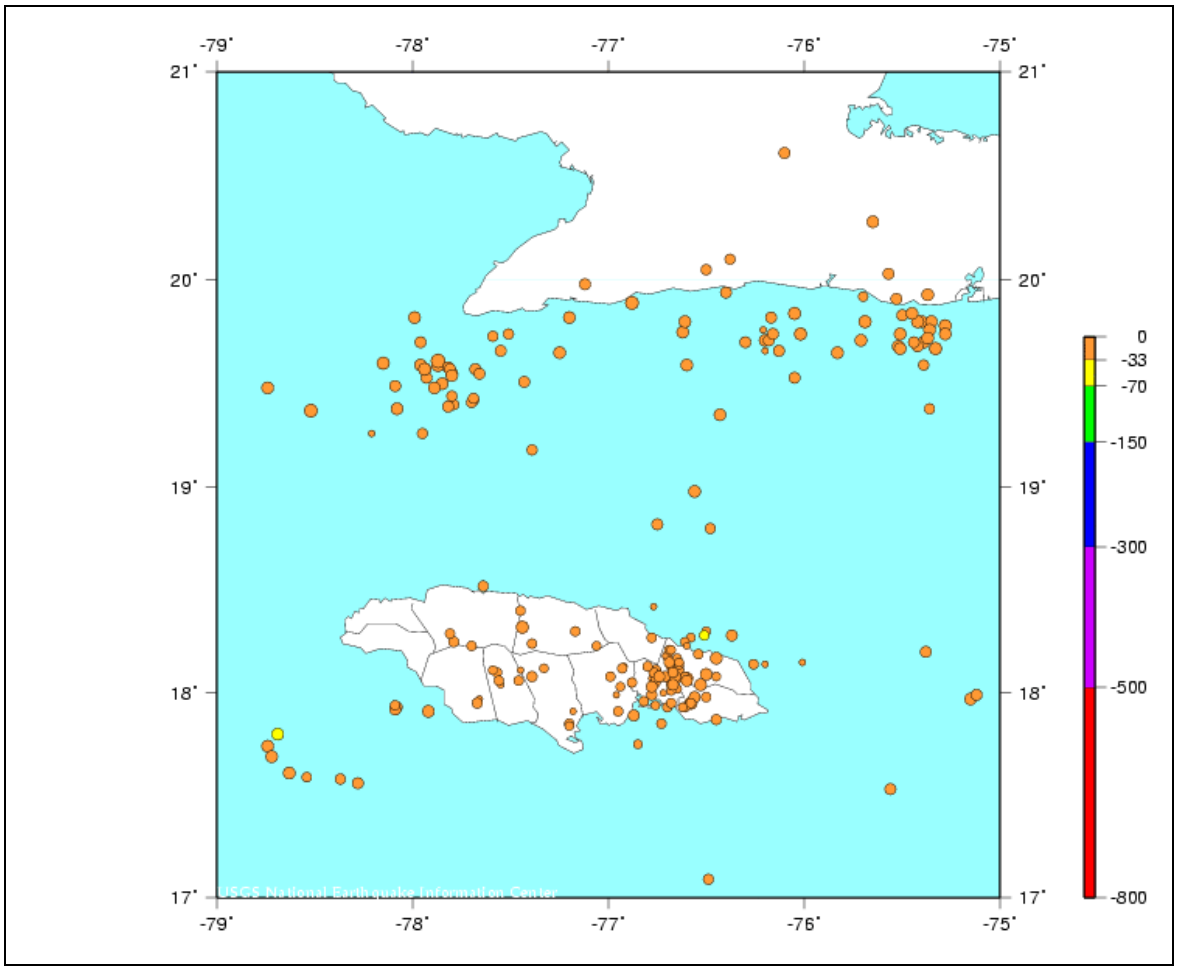

Figure 26 Earthquake Hazard Affecting Jamaica

Source: NEIC.USGS.GOV

[7]http://www.mona.uwi.edu/earthquake/files/JcanSeisPres04122005.pdf

1907, January 14: An earthquake (MMI=IX) ruined most of Kingston, Jamaica, and damaged much of the surrounding area, including a suspension bridge at Port Maria. Buff Bay was destroyed. About 1,000 people perished. A large tsunami pounded the northern coast with waves of 2.5 m, at Hope Bay, Orange Bay, Sheerness Bay, and St. Ann's Bay, Jamaica, where the sea receded and dropped 3.7-6.2 m. At Annotto Bay, the sea receded 73-93 m, dropping 3-3.7 m below mean sea level three minutes after the shock. The returning wave raised the water level 1.8-2.4 m above normal, sweeping into the lower parts of town and destroying dwellings. On higher land it came up 7.6-9.1 m. At Port Maria, the sea receded 25.6 m 3-4 minutes after the shock and returned 1.8-2.4 m above sea level. At Ocho Rios the sea withdrew 69 m and also receded at Bluff Bay. At Port Antonio, the wave moved a small building near the beach. Waves of lesser significance were reported along the southern coast of Jamaica. Seiches of 2.5 m were set up in Kingston Harbor. The short time period after the earthquake and recession of the water suggest a local submarine landslide source. Berninghausen, 1968, Hall, 1907; Heck, 1947; Lynch and Shepherd, 1995; Murty, 1977; Rubio, 1982, Taber, 1920. **V4**

4.51. There are five categories of hurricanes according to the Saffir-Simpson Hurricane scale, with a Category One having the lowest wind speeds, and the Category Five with the highest. Although the category of the hurricane indicates its intensity and its damage potential, the impact of the hurricane depends on the location of the eye of the storm relative to the site. The intensity and frequency of storms vary with various global meteorological conditions from year to year, and it is suggested that it may be influenced by phenomena such as El Nino/La Nina and mid-Atlantic sea surface temperatures.

4.52. Statistically the National Hurricane Centre[8] estimates that the peak of the hurricane season occurs between mid-August to late October in the Atlantic Basin. During the hurricane season (June to November) low-pressure cyclonic systems form off the African coast between latitudes 5 to 25 N, and travel northwesterly towards the Caribbean Basin gradually increasing in intensity if metocean conditions are conducive. Based on the historic tracks of hurricanes affecting the Caribbean, the track most likely to affect the north coast are those occuring later in the season (Figure 27).

4.53. The tracks of 21 hurricanes passed the site within a radius of 120 km or 65 nautical miles between 1865 and 2010 (including tropical storms a total of 48 storms). This is an average of one hurricane every 7 years. Only 5 of the 21 were formed outside the peak seasonal period.

[8] http://www.nhc.noaa.gov/climo/

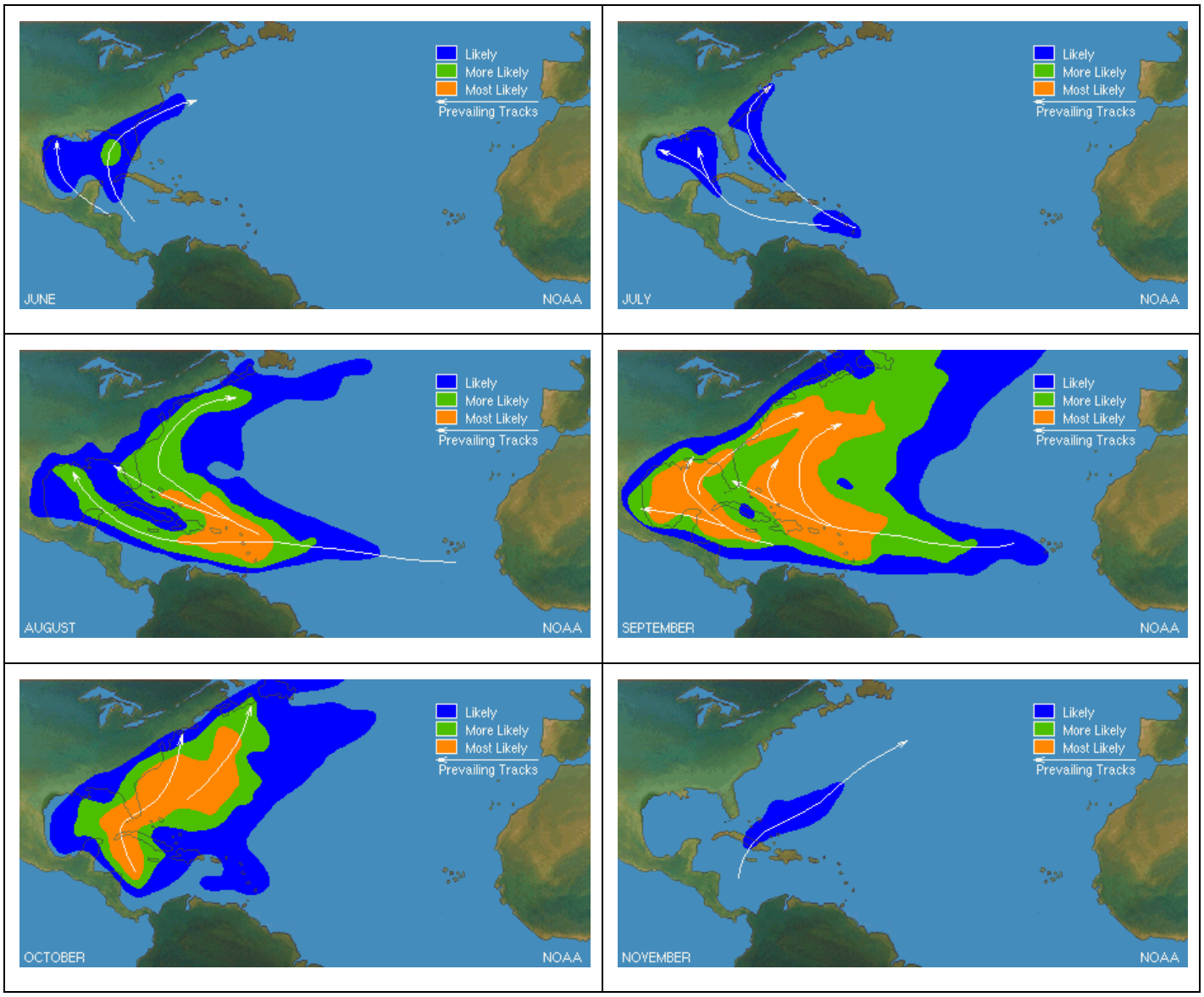

Figure 27 Likelihood of Hurricane Tracks by Months (NHC)

(reproduced from: http://www.nhc.noaa.gov/climo/)

4.54. Early in the last century three hurricanes came very close in this area within a 7 year period. The 1917 hurricane actually made landfall in Robins Bay. At that point the estimated maximum sustained wind speed of this hurricane was 167 km/h. The centre of 1910 and 1915 hurricanes passed within a distance of 15 km. These hurricanes had maximum sustained speeds of respectively 130 and 176 km/h when they were passing through the area.

4.55. The threats from hurricanes include:

- Gale force winds, can result in structural breaches (particularly from roofs being lifted and from airborne debris, or missiles), impacting glass panes. If either a roof or window is damaged, it allows greater potential for rain damage to property contained within a house.
- Flooding from increased rainfall associated with the system at elevations below 25 feet amsl. Flooding from storm events will not only be associated with gully systems, as there may be sheet floods across roads etc.
- Erosion or scouring of gully banks and adjacent areas.
- Mudflows associated with hyper-turbid sheet flows moving across gently sloping lands. This may result in blockage of roads and deposition of bed-loads in areas outside channels.
- Disruption of lifeline services such as power, potable water, telephones, and access roadways.

4.56. Due to the high level of vertical incision in the valleys which concentrate and transmit storm flows effectively off-site and the generally sloping nature of the land, flooding is not considered an issue at this site at elevations above 25 feet above mean sea level.

4.57. In general the Coastal Limestone (coralline limestones) tend to be relatively stable as the material tends to re-cement itself. Deep rotational slides can occur in softer marly units, particularly if slopes are disturbed or waterlogged. Landslides in the area generally tend to be associated with the Richmond Limestone which outcrops outside of the site. There is a horseshoe-shaped slope break in the Hummingbird segment of the Hummingbird/Sandpiper Gully. This feature may be indicative of large historical landslide in the Hummingbird/Sandpiper Gully which could explain why there no obvious connection between the Hummingbird and Sandpiper segments of the gully. Although there are no signs that this is an active landslide, the connection between the Hummingbird and Sandpiper gully are features that warrant further analysis.

Ecological Environment

4.58. The broad vegetation mapping shown in Figure 28 was based on the colour and morphological differences in the vegetation as seen on the July 2009 satellite image of the site. Based on the 2009 satellite imagery, the site vegetation can be characterized into three broad categories: (1) the upland areas which comprise slope and plateau, with a maximum elevation with the study area of ~280 feet (85 m) above mean sea level; (2) riparian areas that slope between the uplands and the lowlands, where moisture is more abundant, and (3) flatter lowlands which generally lie below the 125 foot (38 m) contour.

4.59. Based on the vegetation map, two upland areas were selected for quantitative surveys using the "line intercept" transect method. The first line transect was located at 18.298249°N, -76.806618°W to 18.298644°N, -76.807604°W. A 100 metre line transect was laid using a tape measure. All plant species with a diameter at breast height (DBH) of 18 cm and over intersecting the line were recorded and data on them gathered. Information gathered included distance from start point (datum point), approximate height, canopy width along transect, Diameter at Breast Height (DBH) and DAFOR (Dominant, Abundant, Frequent, Occasional, Rare) rating. Where trees had more than one limb at breast height, the diameter of all were recorded. Where species were unknown to the ecologists, representative parts of the plants were collected, tagged and taken for subsequent identification. This methodology was repeated for the second line transect located at 18.302719°N, -76.809859°W to 18.303404°N, -76.810365°W. Line transects were conducted between the hours of 10:00 a.m. and 4:00 p.m. For Transect 1 (T1), the slope was facing the ocean to the east and was at an elevation of approximately 85 m. The slope of the second transect (T2) led to a small stream that ran from west to east. This transect was at an elevation of approximately 72 m.

4.60. A two-man walk through of the area of the sub-division was then conducted and species lists created from random, geo-referenced photo surveys. Plant species were later identified from the photo surveys done. The geo-referenced points of the photo surveys are shown on Figure 28 (P1 through P13). These were all taken between 40 m to 50 m above mean sea level.

4.61. Faunal observations (species seen) were also made during the line transect observations. Birds were surveyed separately because of their high mobility. The Fixed Radius Point Count Method was used to count birds at a defined point or

spot and determining the distance of each bird censured. A point was selected and then all bird contacts (seen and heard) were recorded, with a determination of distance given (< 25m or >25m) for each contact. This was done for 10 minutes before moving to another point at a specified distance away (Bibby et al. 1998). Points for this survey were at least 40 m apart. This method reduces the chance of overestimating the abundance of birds in open habitats (Douglas, 2001). Further bird observations were made during walkthrough surveys in order to support the methodology above. Wetland birds were also observed, particularly around mangrove stands and ponds closer to the coast. These birds were observed using binoculars and a camera to assist in identification.

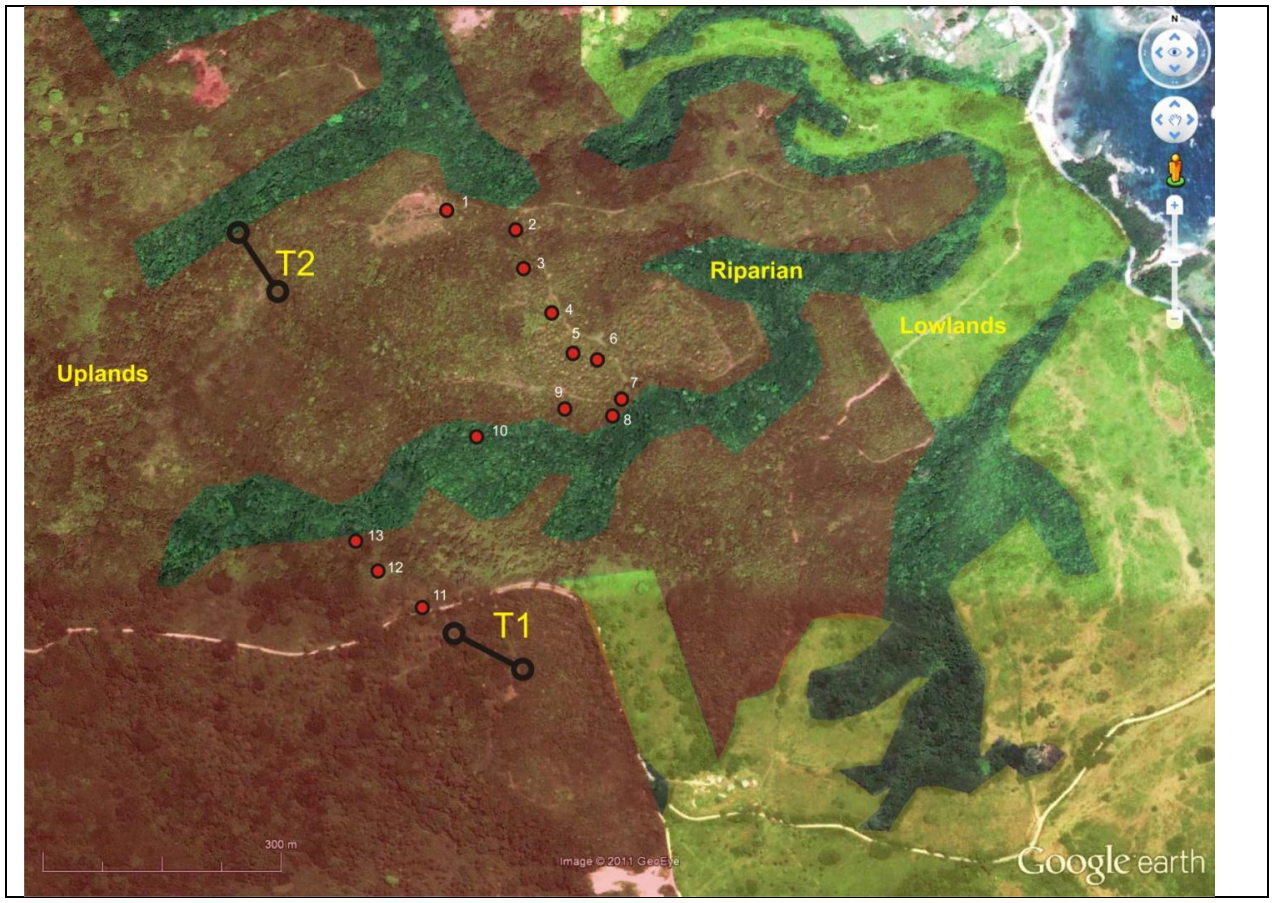

Figure 28 Vegetation Map showing Transects and Photo points

Areas tinted brown are in the uplands, areas with no tinting (appearing green) are the riparian zones, and the areas with the yellow tint are the lowlands.

4.62. As with all survey techniques, there are constraints, which influence overall results, against which the resulting data must be assessed. Below are given factors which affect the aforementioned bird census technique.

4.63. **Time of Day** – the best time for conducting a census is in the morning from sunrise until about 10am in the lowlands. It is recognized that as the day continues it gets hotter and the ability to detect birds decreases due to lack of movement. (Wunderle 1994). Bird observations using the Fixed Radius Point Count Method were made during the morning between 5.30 am and 11.00 am. All other bird observations were made between 6.00 am and 6.00 pm.

4.64. **Breading Seasons (Time of Year)** – the change in behaviour of birds during the breeding and non-breeding seasons affect detection by census. However for this report, the assessment was done in the breeding season, when birds are more vocal. (Wunderle 1994).

4.65. **Weather** – wind, rain, fog or particularly hot days, affect conducting a census (Wunderle 1994).

4.66. **Summer Counts versus Winter Counts** – dependent upon the time of year counts will incorporate not only resident species but also migrant species also. During summer counts summer migrants (breeding or non-breeding) will be included, whereas winter counts will incorporate winter migrant species. This survey was conducted in late June 2011 (summer) and therefore is unlikely to record any winter migrants.

4.67. The remaining fauna, including herpetofauna (reptiles, amphibians), gastropods and insects were assessed by using three methods: walk-throughs; pitfall traps (for fauna crawling on the ground) and light traps. Pitfall traps consist of open jars, cans and even buckets that are buried such that its rim is at the same level (or just below) the surface of the earth and can trap crawling organisms. The trap was baited using fruits, meat, or vegetation. Organisms trapped may also serve to lure other organisms. In this case, open jars and fruit were used as the traps (Figure 29). The setup for this exercise begun at approximately 4.30 p.m. and occurred in tandem with the setup for the light trap. Ten pitfall traps were buried along and around line transect 1 and left for a 24 hour period to capture organisms that crawl at night and day. After the 24 hour period, the traps were retrieved and the organisms collected for identification. This procedure was done simultaneously at line Transect 2. Faunal sampling using pitfall traps was conducted at both day and night, light traps were used at night only and walkthrough surveys were conducted during the day only. Night time data was collected between 7.30 pm and 1.30 am in the vicinity of line transects 1 and 2.

4.68. Light traps attract insects that fly at night. The ideal type of light for such traps is the black light because of their emission in the ultra-violet (UV) range that attracts insects best. In cases, such as this, where weight, size and power source are issues, fluorescent tubes are a perfect alternative (Eymann, J. et. al., 2010). Rope was tied between two trees located along line transect 1. A white sheet was spread and hung over this rope and under this sheet two light sources were tied to the road (one as backup for the other). The fluorescent tube was turned on at 7.30 p.m. and insects attracted to the apparatus were collected every half hour until 1.30 a.m. the following day. This procedure was also carried out at line transect 2.

Figure 29 Baited Pitfall Trap (left) and Light Trap (right)

4.69. A thorough two-man walkthrough of the site was done in order to identify flora and fauna such as reptiles, arachnids, birds, arthropods and mammals. Species seen along and around vegetation line transects were also recorded.

Vegetation Surveys

Upland Areas

4.70. Line transect 1 was located on a north-facing slope. Vegetation was fairly dense and one of the main characteristics was the abundance of climbing vines. A total of 13 individual plants with DBH (diameter at breast height) 18 cm and over were found along this 100m transect. Only 5 species were represented in these 13 individuals. These were Logwood, Pimento, Guango, Red Birch and Coconut (Table 14). Line transect 2 was also on a north-facing slope. Vegetation was not as dense as with Transect 1 and climbing vines were not as abundant. Again, 13 individual plants with DBH 18 cm and over were found along the 100 m transect. A

total of 7 species were represented in the 13 individuals (of DBH 18cm and over) recorded along the transect. These species included Logwood, Portia, Pimento, Legume, Cedar, Coconut and Woman's Tongue.

Common Name	Scientific name	Location		
	Psychotria nervosa Sw.			*P*
Bamboo	*Bambusa vulgaris* Shrad. ex Wendl			*P*
Cedar	*Guazuma ulmifolia* Lam.		*T2*	
Coconut	*Cocus nucifera*	*T1*	*T2*	*P*
Guaco	*Mikania micrantha* Kunth			*P*
Guango	*Samanea saman*	*T1*		
Guava	*Psidium guajava* L.			*P*
Jumbay	*Leucaena leucocephala*		*T2*	
Lantana	*Lantana* sp.			*P*
Legume	*Gliricidia sepium*		*T2*	
Logwood	*Haemotoxylon campechianum* L.	*T1*	*T2*	*P*
Maiden Plum	*Comocladia pinnatifolia* L.			*P*
Pepper	*Pipera malago* L. var*a malago*			*P*
Pimento	*Pimenta jamaicensis*	*T1*	*T2*	
Red birch	*Betula occidentalis*	*T1*		
Trumpet tree	*Cecropia peltata* L.			*P*
Thatch	*Thrinax/Coccothrinax sp.*			*P*
Wild Star apple	*Chrysophyllum oliviforme* L.			*P*
Woman's tongue	*Albizia lebbeck*		*T2*	

Table 14 List of Species found on transects

4.71. The lower-lying photo-point counts showed a wider variety of species (12 different species over the 13 points). This included introduced species that were not found in the transects (e.g. bamboo, guava, pepper) as well as species that were typical of the riparian zone (e.g. thatch and trumpet tree)

Riparian Vegetation

4.72. The species that characterize the riparian areas are listed in Table 15 below.

Common Name	Scientific name
	Fagara spp
Thatch Palm	*Cocothrinax* spp.
Trumpet Tree	*Cecropia peltata*
Rubber tree	*Castilla elastica*
Logwood	*Haemotoxylum campechianum*

Table 15 List of species found in valleys and along gully banks

4.73. Vegetation in this area (Figure 30) tends to be denser for a number of reasons including deeper soils, greater moisture availability, and the fact that historically these areas were not cultivated. The high density of saplings and trees in this area decreases the availability of light at lower levels in the forest, making the trees in this zone very tall as they struggle to emerge from the canopy to better compete for light.

Figure 30 Riparian Vegetation

Lowlands

4.74. In the lowland areas there is substantial evidence that the area has been used extensively for farming as verified by the type flora found and the numerous trails that remain cleared and in use. Much of the low-lying areas are still being used for cattle grazing. These low-lying areas consist mainly of grassland, shrubs, coastal vegetation and the occasional tree. The area sampled revealed a high quantity of vegetation associated with agriculture. Low-lying areas were generally pasture land mixed with coastal vegetation, grazed by cows and horses. Elevation increased gradually with distance from the coastline.

4.75. The shoreline of the bay was dominated by 7 species of plants as detailed in Table 16. The vegetation is dominated by typical coastal species such as sea-grape, Thespesia sp., among others. There was some amount of debris in this area in the form of logs, tree branches and sea-grass blades, washed up from the sea.

Common Name	Scientific Name
Beach morning glory	*Ipomoeapes-carpe* ssp. *brasiliensis* (L.) R. Br.
Seaside purslane	*Sesuvium portulacastrum* (L.) L.
Marigold	*Sphagneticola (Wedelia) trilobata* (L.) Hitchc.
Hog Apple, Noni	*Morinda citrifolia* L.
Creeping Oxeye	*Wedelia trilobata*(L.) Hitchc.
Sea Grape	*Coccoloba uvifera* (L.) L.
Thespesia spp.	*Thespesia sp.*

Table 16 *Coastal vegetation spotted along shoreline of the Bay*

Bats

4.76. No chiropterans (bats) or evidence of them was found during the assessment. Chiropterans in Jamaica may be cave-dwelling or tree-dwelling. No caves were seen in the inland or coastal areas on the site. Historically, chiropteran species found in the area include the Big-Eared Bat, *Macrotus waterhousii*, which is a cave-dwelling species; and the Fruit Bat, *Artibeus jamaicensis*, which is tree dwelling (National Zoology Collections, Natural History Division of The Institute of Jamaica, November 2011).

Birds

4.77. A total of 27 bird species were found in the area (Table 17). This is quite good bird diversity considering the size of the area (*personal communication with local birder*, 2011). Neither nocturnal species nor winter migrants have been included in the data. Nocturnal birds were not seen during night time data collection and the study was not conducted at the time that winter migrants would be in the area. Nonetheless, nocturnal and winter migratory species may use this area. Nocturnal species that are reported in this area include the Jamaican Barn Owl (*Tyto alba*) and the Antillean Nighthawk (*Chordieles gundlachii*). Possible winter migrants include American Redstart (*Setophaga ruticilla*); the Black-Throated Blue Warbler (*Dendroica caerulescens*) and the Prairie Warbler (*Dendroica discolor*). No birds were seen during the night though ecologists were on the lookout for them during night time data collection.

4.78. Wetland species that were noted included Yellow-crowned night heron (*Nyctanass aviolacea),* Ruddy Duck (*Oxyura jamaicensis*), Least Grebe (*Tachybaptus dominicus*) and the Northern Chicana/Checana.

Common Name	Scientific Name	Status	Red List Category*
Stolid Flycatcher	*Myiarchus stolidus*	E	LC
Jamaican Tody	*Todus todus*	E	LC
White-Chinned Thrush	*Turdus aurantius*	E	LC
Sad Flycatcher	*Myiarchus barbirostris*	E	LC
Red-Billed Streamertail	*Trochilus polytmus*	E	LC
Jamaican Pewee	*Contopus pallidus*	E	LC
Jamaican Woodpecker	*Melanerpes radiolatus*	E	LC
Jamaican Euphonia	*Euphonia jamaica*	E	LC
Jamaican Becard	*Pachyramphus niger*	E	LC
Orangequit	*Eunoernis campestris*	E	LC
Jamaican Stripe Headed Tanager	*Spindalis negricephalis*	E	LC
Jamaican Lizard Cuckoo	*Saurothera vetula*	E	LC
Vervain Hummingbird	*Mellisuga minima*	ES	LC
Jamaican Oriole	*Icterus leucopteryx*	ES	LC
Common Ground-Dove	*Columbina passerina*	ES	LC
Bananaquit	*Coereba flaveola*	ES	LC
Loggerhead Kingbird	*Tyrannus caudifasciatus*	ES	LC
Greater Antillean Bullfinch	*Loxigilla violacea*	ES	LC
White Crowned Pigeon, Bald Pate	*Pategonas leucocephala*	ES	NT
Mangrove Cuckoo	*Coccyzu minors*	R	LC
Red tailed Hawk	*Buteo jamaicensis*	R	LC
Smoothed-Billed Ani	*Croto phagaani*	R	LC
Johncrow	*Buteo sp.*	R	LC
White Winged Dove	*Zenaida asiatica*	R	LC
Zenaida Dove	*Zenaida aurita*	R	LC
Caribbean Dove	*Leptotila jamaicensis*	R	LC
Black Whiskered Vireo	*Vireo altiloquus*	SM	LC

Table 17 Surveyed Bird Species

E	Endemic	A species native to or confined to a certain region.
ES	Endemic sub-species	A species which is a native taxonomic subdivision of a species consisting of an interbreeding, usually geographically isolated population of organisms.
R	Resident	A bird that does not make seasonal migrations.
SM	Summer migrant	A species which spends its breeding season in Jamaica between March – September of each year.
SR	Summer resident	
I	Introduced	Species placed in a new environment with the intention of producing a resident breeding population.
LC	Least Concern	A species is Least Concern when it has been evaluated against the criteria and does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened. Widespread and abundant species are included in this category.
NT	Near Threatened	A species is Near Threatened when it has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future.

Insects & Other Fauna

4.79. Table 18 lists the insects captured in the light and pitfalls traps and those spotted during walkthrough surveys. A total of 22 different insect species were identified using the various survey and trap methods. No rare or endangered species were observed.

Common Name	Family Name	Light Traps		Pitfall Traps		Walkthrough
Ant	*Formicidae*	**X**	**X**	**X**	**X**	
Bee	*Apoidea**					**X**
Beetle	*Scarabaeidae*	**X**	**X**			
Beetle	*Nitidulidae*	**X**	**X**			
Beetle	*Rhysodidae*		**X**			
Beetle	*Cerambycidae*		**X**			
Beetle	*Curculionidae*			**X**	**X**	
Cicada	*Cicadoidea* *					**X**
Cricket	*Gryllidae*	**X**	**X**			**X**
Fly	*Diptera*			**X**	**X**	
Horsefly	*Tabanidae*					**X**
Leafhopper	*Cicadellidae*		**X**			
Love bug	*Rhopalidae*	**X**	**X**			
Millipede	*Myriapoda (Class)*					**X**
Mosquito	*Culicidae*		**X**			
Moth	*Geometridae*	**X**	**X**			
Moth	*Pyralidae*	**X**	**X**			
Peenie Wally	*Lampyridae*					**X**
Termite	*Termitoidae*					**X**
Wasp	*Ichneumonidae*	**X**	**X**			
Wasp	*Ichneumonidae*		**X**			
Wasp	*Vespidae*					**X**

Table 18 *Insect Species Identified at Site (excluding butterflies)*

*superfamily

4.80. Twelve (12) species of butterflies were observed during the walkthroughs (Table 19). Other species that were noted in the walkthrough included snails (*Gastropoda*), and various anoles (*Polychrotidae*) including the common Green Lizard *Anolis Garmani, Anolis lineatopus,* and *Anolis graham.* These are all common species in this area.

Common Name	**Scientific Name**
Buckeye	*Junonia genoveva*
Cadmus	*Historisacheronta Cadmus*
Cloudless Sulphur	*Phoebis sennae*
Common Tailed Skipper	*Urbanus proteus*
Cuban Swallowtail	*Papilio andraemon*
Dirce	*Coloburadircea vinoffi*
Jamaican Albatross	*Appias drusillacastalia*
Jamaican Polydamus	*Battus polydamus jamaicensis*
Julia	*Dryasiulia delila*
Thersites	*Papilio thersites*
White Peacock	*Anartia jatrophae*
Zebra	*Heliconius charitonius simulator*

Table 19 *Butterflies observed during walkthrough sampling*

Marine Benthic Ecology

4.81. As the major gully draining the sub-division site drains into Robins Bay, a rapid benthic assessment was undertaken. The site was accessed from the shore using snorkeling gear and kayaks. Depth of the water did not warrant the use of SCUBA gear. The two-man team snorkeled along the reef and in Robins Bay (Figure 31) observing the health of the reef, seagrass species present, presence of macro-algae, and presence of organisms, particularly fish and herbivores. The seagrass areas were observed on the way to shore. Types of seagrass present, health of the ecosystem and fauna present were noted. Observations of seagrass species washed up on the shoreline were also made to support the findings in the water.

4.82. The survey was made at 5.30 a.m. in late June 2011. Though conditions allowed for the survey to be conducted, the bay was still choppy. Wave flow patterns suggested the presence of rip currents in certain areas of the bay. A fisher in the

area confirmed that the conditions described are common to the area. Visibility was moderate (approximately 4-5 m) throughout the bay. The maximum depth observed was approximately 4 m).

4.83. The bay observed was protected by a fringing reef consisting of live coral and dead coral covered with macro-algae. To the north was a small, rocky island, approximately 100 m in length and ~ 25 m wide rising to approximately 3 m above sea level; the core of the island (the innermost 43 m of length) is vegetated. This island is oriented along its long axis roughly WNW. A relatively large wave cut platform can be observed on the perimeter the island; this platform is well developed on the northern and eastern sides of the island. This is likely to provide Rocky Shore habitat.

Figure 31 Benthic Survey Points

4.84. The bay itself is approximately 135 m long between the rocky promontories on either end, and ~200 m wide between the high water mark and the edge of the coral reef. This area behind the coral reef forms a back-reef lagoon. The two species of seagrass found here were *Thalassia testudinium* and *Syringodium*

filliforme. These species were found in the shallows near the shore and extended out to the maximum depth observed, 4 m. At approximately 120 m from the shore, patches of coral and algae began to appear, interspersed with the seagrass.

4.85. A barrier reef occurred between approximately 200 and 250 m offshore. There was a relative very high percentage of macroalgae on the reef, particularly in the shallower areas of the reef where wave action was most concentrated. Live coral was found on the reef in the more sheltered areas and at depths of approximately 1 m below the surface and deeper. Types of coral included *Monatastrea annularis, Siderastrea radians*, *Siderastrea siderans*, *Colpophyllia natans*, *Diplora strigosa*and *Millepora campeniatum*.

4.86. Fish included snappers, jacks, parrotfish, sergeant majors and surgeon fish. Green and black urchins were also found in seagrass beds and on the coral reef respectively. The invasive species lionfish have been reported[9] from this bay as early as August 2010.

4.87. The benthic environment of Robins Bay is impacted by a number of factors including very high wave action and freshwater and sediment outfalls from three gullies. There is also a fair amount of human garbage and debris on the shoreline. Two fishing boats were noted on the beach, and the beach is used as a fish landing site.

Human & Built Environment

4.88. Human census data from the relevant Enumeration Districts (EDs) for the parish of St Mary as a whole as well as for the Robins Bay and Greencastle area were reviewed in the following section. Additionally, as a means of gathering more site specific information on key stakeholders questionnaires were administered in the community of Robins Bay, which is the only community located within a 2 km radius of the project site. There are no existing households in the community of Greencastle. Thirty (30) questionnaires were administered within EDs 032 and 033 which have a combined total of 394 households. This represents 8% of the total number of households of these two EDs, and is considered representative.

[9]http://www.jamaicaobserver.com/columns/Lionfish-in-Jamaican-waters_7897083

Demographics

4.89. The Statistical Institute of Jamaica (STATIN) 2010 end of year population data, estimated the overall population size of the parish of St. Mary to be 114,889. This is an increase of 0.5% over 2008 levels when the parish had an estimated population size of 114,300. The growth of the parish's population has been slight, increasing by only 3% over the ten (10) year period between 2001 and 2010. The parish has therefore continued to grow at an annual rate of 0.3%, a third (1/3) the national growth rate of over the same period (0.9%) and almost half (1/2) the present national growth rate of 0.5%. Robins Bay was estimated to have a population of 1,376 in 2001. Based on the 0.03% annual rate of growth for the parish of St. Mary between 2001 and 2010, at the end of 2010, the population of Robins Bay is expected to be approximately 1,800.

4.90. In 2008, females accounted for 50.1% of the total population of the parish, with males representing the balance. This percentage breakdown in the population by gender has remained consistent since the 2001 Census.

4.91. The population of St. Mary is predominantly rural, with only 22% living in urban areas in 2008.

4.92. Children accounted for approximately thirty-four percent (34%) of the population of St. Mary in 2008, while the working age group accounts for fifty-six percent (56%). The proportion of children living in the parish was five (5%) higher than the national average, while the working group size was lower than the national figures.

Housing and Land Tenure

4.93. The Jamaica Survey of Living Conditions (PIOJ, 2011) estimated in 2008 that 71% of the population of St. Mary owned the dwelling they occupied, which was a decline from previous estimates. The decline has seen a commensurate increase in the number of rental dwelling units in the parish. This has been a consistent pattern with the housing tenure status of the population in St. Mary. The housing tenure data for the periods 1992, 1998, 2001, 2002 and 2008 shows that with an increase in housing ownership there is corresponding decline in housing rental and vice versa (Table 20). There is a similar pattern between home ownership and squatting; where there is a decline in ownership there is a commensurate rise in the percentage of the population squatting and vice versa.

Year	Own	Rent Free	Rent/Lease	Squatting	Other
1992	65.9	10.8	15.1	3.9	4.3
1998	64.3	12.2	17.7	1.7	4.1
2001	62.4	17.6	1.8	0.5	0.3
2002	75.5	8.3	11.9	0.0	4.3
2008	70.8	17.5	9.8	1.7	0.2

Table 20 Housing Tenure (%) for the Parish of St. Mary

Source: PIOJ, 2011

4.94. In the 2001 Census, Statin found that 40% of the population of these EDs owned their land. Our survey (emc2 2011), which was concentrated within the village of Robins Bay, found less than a third reported owning their land. This is in contrast to more than double that number who report that own their house; making it likely that many had built their houses on long term leased lands. According to the 2001 census report, 60% of the population in the Robins' Bay/Green Castle community owned the dwelling they occupied (Table 21), which is consistent with the parish level data (62%) and the survey data (63%).

	Own	Rent Free or "Other"	Rent/Lease	Total
Statin Housing 2001	60.5%	21.5%	18%	100%
Emc2 survey 2011	63.4%	-	56.6%	100%
Statin Land 2001	40%	36%	24%	100%
Emc2 survey 2011	30%	3.3.%	66.7	100%

Table 21 Tenure Status, Robins Bay

Source: Statistical Institute of Jamaica, 2005

Utilities & Municipal Services

4.95. Based on the 2008 census data, more than 75% of all households in St. Mary had access to water piped and treated by the NWC from either its White River or Grants Level Treatment Plants. This was supplied via indoor (50%) or outdoor (21%) taps and public stand pipes (5%). This actually represented a 16% decline from 2002 levels. The remaining 25% reportedly relied on natural surface sources (rivers or springs), rainwater. Approximately 1% reported using well water.

4.96. Despite the reduction in access to piped water, there have been vast improvements in access to proper sanitary conveniences, with the total percentage of persons having access to water closets in the parish in 2008 almost doubling 2002 baseline levels. It was estimated that 61% of the total population had access to water closet toilet facilities in 2008, compared to 34% in 2002. The sharp decline in the percentage of the population using pit latrines is a welcomed and major change.

4.97. While all respondents in our 2011 survey had access to safe, potable water supply sources, a third did not consider their supply reliable, citing frequent lock-offs and low water pressure as being their main problems with the existing water supply distribution system. It was therefore not surprising that 60% of the respondents used a private tank to supply water to their household. Public standpipes were not used by any of the respondents; 7% relied on the community tank and or sourced their water from the parish council's water truck, while another 20% had water piped into their dwelling 13% had a pipe in their yard.

4.98. The latest census data (2008) for the parish shows that approximately 92% of all households now use electricity as their main lighting source. Our 2011 survey indicated that most households (27 out of 30 or 90%) used electricity as their main source of lighting. Kerosene lamps were the other major source of lighting used in the parish; this was also the case in our survey for the remaining 10% who did not use electricity.

4.99. LIME (Cable and Wireless) and Digicel provide telecommunication services in the project area. Residents living in the vicinity of the project area have access to cellular and internet services provided by both companies. LIME is however the sole provider of landline service in the area.

4.100. The Robins Bay Postal Agency provides postal services to the Robins Bay and Green Castle property.

4.101. The Islington Police Station, located 8.5 km from the Green Castle and Robins Bay, is the major public security service facility serving the population within the communities.

4.102. The Annotto Bay fire station, located 5.5 km away, is the provider of emergency fire services to the communities. The police and fire services are well over their maximum carrying capacities, as the numbers of security and emergency personnel and additional resources (equipment etc) are not enough to serve

efficiently the growing population of the parish. The relocation of police personnel to other stations is the main challenge facing the security services within the parish. Emergency services are hampered by limited equipment.

4.103. The parish of St. Mary is served by 32 health facilities. These include two small (Type C) hospitals in St Mary: Port Maria (89 beds) and Annotto Bay (122 beds). In addition, there are thirty (30) health centres found in the regional areas of Annotto Bay, Highgate, Gayle and port Maria. Robins Bay is served by the Robins Bay and Islington Health care centres, which provides primary health care services to its residents. Robins Bay health centre is a Type 1 facility (smallest primary health care units) and caters to a maximum of 4,000 persons. Secondary health care services are sought from the Annotto Bay hospital.

4.104. All our 2011 survey respondents had access to security, fire and health care services. These services were located between 1 and 10 km from the community of Robins Bay. The Robins Bay health care centre has an overall maximum carrying capacity of 4,000 persons and is sufficient to deal with the 1,800 persons residing within the community. The only challenge facing the health centre is limited medical supplies and other critical resources required to treat patients. The vast majority of persons opt to use public health facilities as private health services are considered expensive. Only 17% of respondents surveyed had health insurance, and this is likely one of the central reasons why private health care is not sought out by residents unless it is "absolutely necessary."

4.105. The parish of St. Mary has approximately seventy (70) public and five (5) independent educational institutions, providing primary, secondary and tertiary level education to the population. There is one public educational institution in Robins Bay (Robins Bay Primary School). That school was established on its present site in 1951. It is a small school with approximately 83 students, and has a capacity of 150. With five teachers, the student teacher ratio is 21:1. The average daily attendance is 81%. Many students at the primary level are from low socio-economic backgrounds. Secondary and early childhood education is accessed in Islington and Annotto Bay.

4.106. North Eastern Parks and Markets Limited (NEPM) is responsible for the collection and disposal of solid waste in the parish of St. Mary. The north-eastern "Wasteshed", the division managed by NEPM, also comprises the parishes of St. Ann and Portland. It is estimated that 120,825 tonnes of waste annually is collected

and disposed of in this region. The Strategic Development Plan for St Mary (2007) indicated that in 2001 the dominant means of waste disposal in the parish was burning trash (64%).

4.107. St Mary does not presently have a landfill located within the parish. Solid waste has to be taken either to Portland or St Ann. According to the Strategic Development Plan for the parish, a site has been earmarked at Nonsuch to construct a sanitary landfill but studies were still being conducted. North Eastern Parks and Markets Limited (NEPM) provided collection services to most (90%) of respondents surveyed at Robins Bay. Three percent (3%) reported disposal of garbage by burning, while approximately 6.7% reportedly utilized private collection services.

4.108. All respondents indicated they had access to at least one type of recreational facility and resource in the community. The beach was the recreational resource of choice for seventy percent (70%) of respondents. The Punching Beach area was the preferred choice for fifty-two percent (52%) of respondents, followed by Long Bay Beach (35%) and Jacks Bay Beach (13%). Twenty-three percent (23%) of interviewees preferred parties and dances as their recreational activity of choice. Church and Youth groups were chosen by only three percent (3%) of respondents, while the remaining three percent (3%) did not utilize any of the recreational resources or facilities available to them in their community.

4.109. Sports clubs or organizations were also not found to be popular in the community, even though these have largely become the norm in most communities across the island. From the survey data, it was shown that only an estimated seventeen percent (17%) of respondents were part of a sporting organization or knew of such an organization within the community. Football was said to be the sporting activity of choice for community members and there were several small football sporting groups in the community. A search through the Jamaica Football Federations' list of football clubs in Jamaica revealed that no formal football organization existed in Robins Bay.

4.110. Approximately eighty-seven percent (87%) of respondents indicated that either a school or church served as the main disaster shelter areas for the community. Most householders surveyed preferred to remain in their homes.

Economy

4.111. Manufacturing and agriculture (and agro-processing) are St. Mary's major economic activities. The principal products are bananas, sugar, citrus, pimento, cocoa, coconuts, coffee, vegetables and breadfruit. Recently there has been a decline in the agricultural sector due in large part to the decline in the sugar, coconut and banana industries. Export earnings from traditional crops (banana, citrus, coffee, cocoa, pimento) decreased from US$57 million in 2001 to US$46 million in 2006. Agriculture is still considered the 'backbone' of St. Mary, with 61% of agricultural production being export crops. One of the major agricultural estates in the parish is the St. Mary Banana Estates Limited (SMBE). The SMBE is a wholly owned subsidiary of the Jamaica Producers Group Limited and is a 1,600 acre estate and is the second largest banana farm in Jamaica, with an estimated 1,340 acres of the estate under banana production.

4.112. Robins Bay is one of the ten fishing ports named in the Second Schedule of the Fishing Industry Act (1976). Also included in that list are Mahoe Bay, Carlton Bay and Annotto Bay. It is uncertain exactly how many vessels use this landing site. Not more than three motorized canoes have been noted at any one time on the eastern end of the beach.

4.113. In recent times, the increase in foreign direct investments into tourism developments has seen the growth of the construction and tourism sector in the parish. The growth of the tourism sector has been driven largely by heritage and eco-tourism, which has seen three key establishments driving the growth of the sector in the parish. The White River and Green Castle eco-tourism attractions and the Robins Bay and Strawberry Fields beaches and bays have all helped in boosting the tourism sector. Other key investments in the tourism sector, such as the Golden Eye Resort, the newly established Ian Fleming Airport, and the refurbishing of the Boscobel Aerodrome, have all contributed to the growing importance of tourism to the parish.

4.114. The Robins Bay economy is supported largely by the agricultural and tourism sector. There are small commercial establishments e.g. retail stores, within the community, however fishing and crop cultivation are the two other primary economic activities undertaken in the community. Greencastle Estate provides employment to farmers living within the community of Robins Bay.

Land Use

4.115. Land uses at the Estate have been expanded in recent times to include commercial, recreational, educational, and tourism land uses. Following the acquisition of the Estate by current land owner, Richard Padgett, parcels of lands were leased and several establishments were brought into operation. There include: JamOrganix (JOX), GC Orchids, Eastern Livestock Development Company, and Jack's Bay Beach. Under the lease arrangement non-lodging operations were developed by persons within the Robins Bay community.

4.116. In 2005, the Greencastle Tropical Study Centre (GCTC), a non-profit organization, was formed to manage the Green Castle property. The main purposes of the centre are to support a sustainable development of the Green Castle Estate, to advance the role of the organization in promoting research and development in agriculture, and to support the growth of sustainable eco-tourism initiatives and advancing community development. One of the main roles of the GCTC was to manage and conserve large areas of open and green spaces on the property, along with protection of the biological environment.

4.117. Through environmental education, the GCTC promoted and raised awareness about the environmental and cultural assets of the Green Castle Estate, as well those within the community of Robins Bay. As of 2009, the Greencastle Tropical Study Centre seized operations and is no longer affiliated with the Greencastle Estate. Although, throughout the year students from local and foreign Universities visit the Green Castle estate to conduct research on archaeological artifacts history of the estate, birds and agricultural practices and methods used on the Estate. The Estate also host students from primary and high schools, where tours are conducted and students are given an opportunity to learn more about the history and culture of Green Castle and Robins Bay.

4.118. Current tourism land uses at Green Castle includes tours (bird and wildlife watching, hiking, tours of the coconut oil and orchid operations, and heritage sites, rental of the Green Castle Estate House, and swimming and lunch at Jack's Bay Beach. Jack's Bay is a small bay inside of Robins Bay located on Greencastle property. The Bay was used in early colonial times as a pier to ship commodity crops to England and the United States, and to receive slaves from Africa.

4.119. The beach at Jack's Bay is a private day beach that is located along the Robins Bay main road. The beach has several facilities including a bar, restroom and changing area. A small fee is charged for entry to the Jack's Bay beach. The development plan does not propose to undertaken any modification of the beach or facilities, aside from general clean-up.

4.120. JamOrganix is an organic food operation that grows organic fruits, vegetables and root crop. The operations are located near the Calabash Bottom River at Greencastle Estate. The company was registered in 2007, but began operations in 2005. In addition to its operation near the Lower Calabash, JOX possesses harvesting rights to reap the various organic tree crops on Greencastle including cocoa, pimento, and coconuts for two years. JOX may not improve, plant, or manage the tree crops at this time, but they may harvest them. JOX currently has eight employees that are all dedicated to producing JOX's organic cold pressed coconut oil.

4.121. G.C. Orchids is one the largest orchid operations in Jamaica. They provide both cut flowers and potted plants to Jamaican flower shops, florists, and hotels. GC Orchids is Jamaica's biggest supplier of cut orchids and potted orchid plants. Their primary product is cut flowers from Hawaiian-type dendrobiums produced from approximately 60,000 plants with a smaller number of Thai orchids. In addition to cut flowers, the operation includes approximately 30,000 potted orchids in varying stages of growth which are sold on the local market. A smaller numbers of cattaleya, phalaenopsis, vanda and the lovely local orchid, broughtonia, are also sold. The greenhouses are part of the Estate tour.

4.122. Eastern Livestock Development Association Limited (ELDA): ELDA was incorporated as a Limited Company on October 8th 2007 with the aim of encouraging farmers in the parishes of St. Mary, Portland and St. Thomas, who in times past raised cattle as an integral part of their farming operation, to be a part of the re-building process of the National Herd. The raising of livestock by farmers with both large and small holdings was one of the main stays of their livelihoods prior to 2002. The importance of having an animal to sell to assist with "back to school" expenses cannot be underestimated. Neither can the importance of having a milk cow as part of balanced nutrition for the family. Livestock in general and cattle especially, should be part of the rotation within the farming system. ELDA is in the process of acquiring the beef cattle herd at Green Castle Estate. This herd

consists of pedigreed animals of the Jamaican Red Poll, Jamaican Black Poll and Jamaican Brahman breeds with the aim of providing quality animals available for purchase by its members. Once acquisition has been completed the Association intends to examine the feasibility of being able to offer sheep and goats in addition to cattle to its members.10

4.123. Land use within the boundaries of the subdivision is characterized by the distribution of vegetation as shown in Figure 32, which shows the transition between mixed forest with the remnants of cultivation in the upland areas, valley/riparian vegetation along the river courses which has been historically undisturbed, and pasture lands in the lower course. Some ruins and old buildings (described below) are located near to the main road to the Great House). Review of these photos illustrates the extent of change from farming between 2002 and 2009, with an apparent decline in tree crop cultivation.

4.124. Robins Bay comprises approximately 20,000 acres of land and extends 15 miles along an undeveloped coastline; it is one of the last remaining villages with an undeveloped coastline and expansive forested and mangrove covered areas in Jamaica. Robins Bay has three beaches (Jacks Bay, Punching Beach and Long Bay) and two waterfalls (Tacky and Kwamen Falls). Tacky falls is named after the Coromantee slave Tacky, who lead the slave rebellion in 1760. Both falls are located deep in the forests within the community. Residential, agricultural and tourism are the main land uses in Robins Bay.

4.125. Residential land use in Robins Bay is comprised mainly single storey buildings, constructed from wood and concrete materials. This land use type accounts for approximately 5% of all land uses within the area. Commercial land uses account for less than 1% of the land uses in Robins Bay. Commercial establishments found in the community are mostly small bars and restaurants. These are scattered across the community and generally found on lands that have residential dwellings.

[10]The information provided on the commercial and land uses were provided http://www.greencastletropicalstudycenter.org

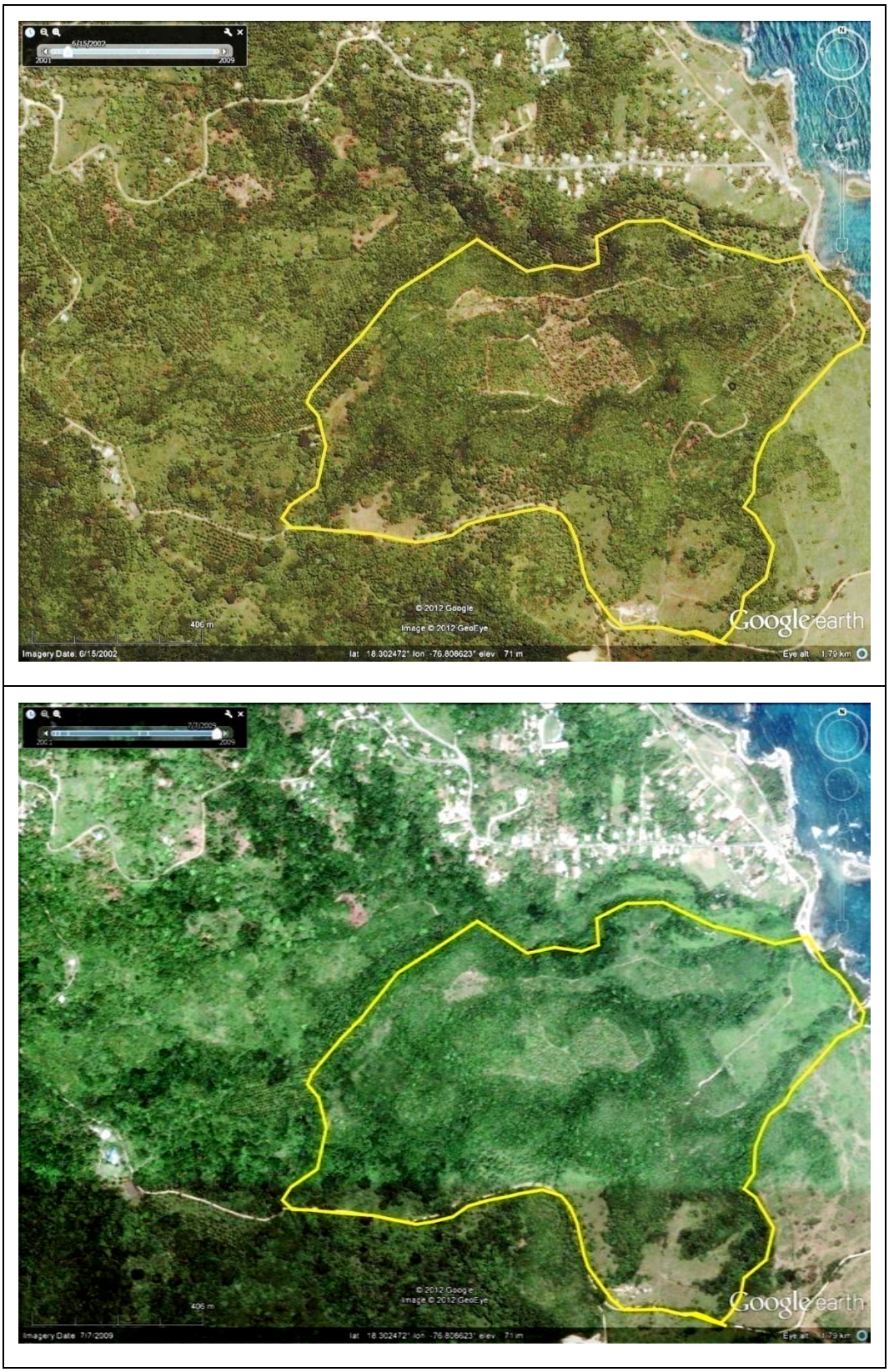

Figure 32 Land Use Change between 2002 (top) and 2009 (bottom)

4.126. Additionally, Robins Bay is a small farming and fishing community and as such agricultural land uses are widespread in the community, accounting for approximately 10-15% of total land use in the area. Farming is done on a small scale, with a few large scale farmers, and crops and animals reared are for both commercial and subsistence purposes. The landing site for fishermen is at the Fisherman's Beach, located at the entrance to the community. Artisanal and subsistence fishing activities are also undertaken along the bay at Don Christopher Point and at Long Beach.

4.127. Tourism accounts for less than 5% of the land use in Robins Bay. Tourist facilities are low impact and low density type developments, catering to small groups. Strawberry Fields Together, the Robins Bay Hotel and River Lodge are the three main tourism land uses within the community. The Strawberry Fields Together site comprises wooden cottages and has a private beach. River Lodge is a 17th Century Spanish Fort that was converted into an eco-tourism site, comprising small cottages and dining facilities for visitors.

Traffic Conditions

4.128. The Robin's Bay community is connected to the North Coast Highway by two main roads, Robin's Bay main road to the west and the Nutfield road to the East. The Robin's Bay main road intersects with the North Coast Highway near Orange Hill (Figure 33). The Nutfield road continues to Rosend and intersects with the Highway near Water Valley. As an alternative to coming out on the North Coast Highway at Water Valley, the option exist to continue further to the east over Islington, and to come out either on the North Coast Highway at Martins or east of Port Maria, near Frontier.

4.129. Both the Robin's Bay main road and the Nutfield road are typical country roads with road widths varying from single to dual lane. The condition of the road surface varies just as widely from good to very poor. The Robins Bay main road is a single lane road where it approaches the village of Robin's bay. The dilapidated box culvert which serves as a bridge over the gullies west of the fishing beach is also a single lane structure. Works to replace this structure are scheduled to start at the end of March 2013. During heavy storms sections of the Robin's Bay main road near the sea get often blocked with material deposited on the road by storm surges.

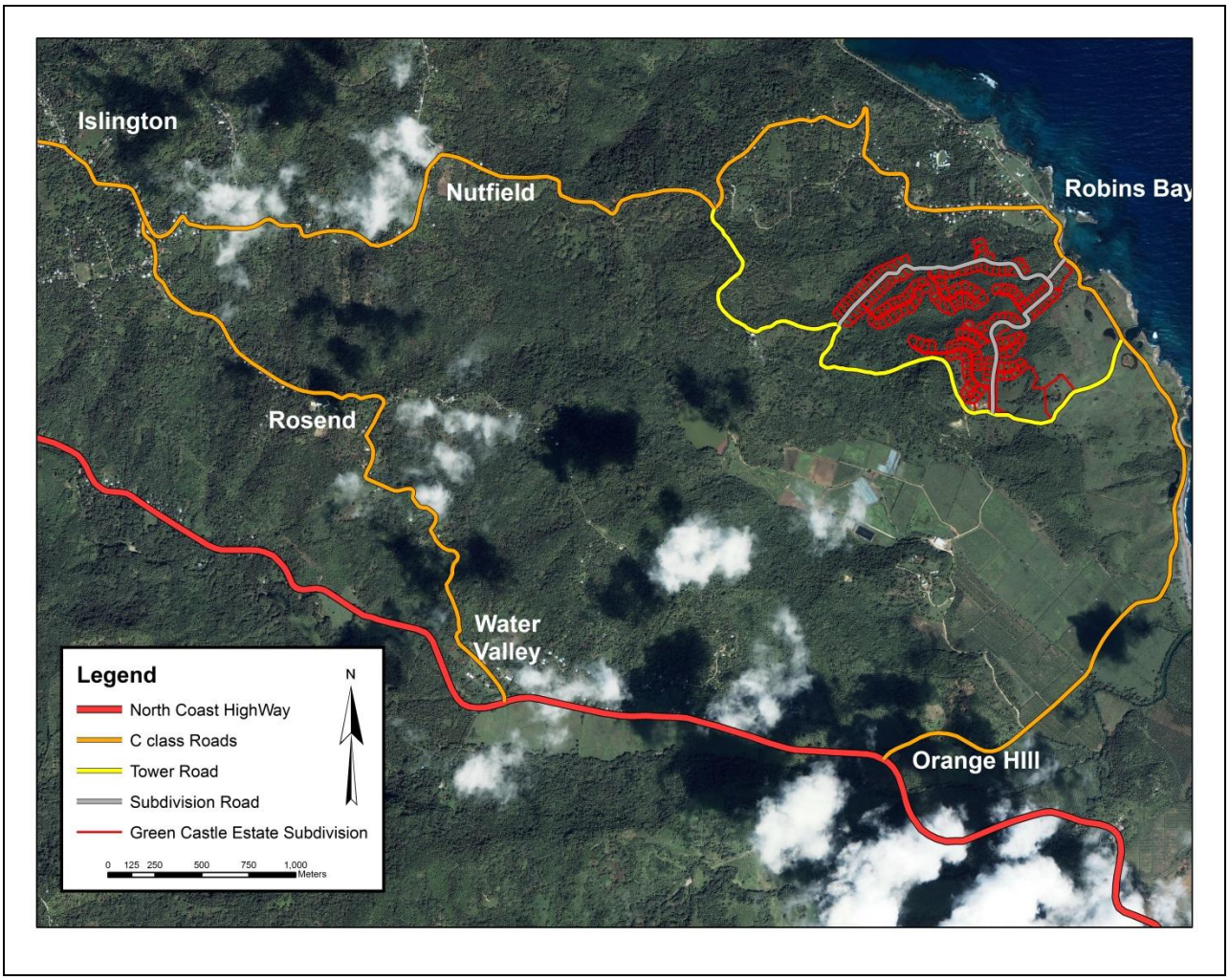

Figure 33 Main roads and intersection near the proposed subdivision

4.130. The Robin's Bay main road and the Nutfield road are also connected by the Tower Road. The Tower road is not surfaced and serves currently as the main access road to the Green Castle Great House. It has gates on both ends and is not open for public through traffic. The Tower road begins near the coast at the Robin's Bay road, passes the martello tower and the Great house and ends on the road to Nutfield above the Mount Pleasant community.

4.131. The subdivision plan proposes to construct two roads which will connect the Tower road with the Robin's Bay main road. Both roads follow the alignment of existing farm roads. One intersects the Tower road near the Martello tower while the other one begins near the Green Castle Great House. These two roads will come together and intersect the Robin's Bay main road as one road just east of the Robin's Bay fishing beach.

4.132. The North Coast Highway is a two lane single-carriageway that connects Negril with Port Antonio and is intended to provide fast and comfortable access to the main urban centres on the north coast. The highway was designed to allow a safe traveling speed at 80 km/h in open areas and at 50 km/h in build-up areas.

4.133. Near the intersection of Robins Bay Road, the highway has the standard dimensions and configurations, a carriageway of approximately 7.3 meters with shoulders of 2.4 meter wide and drainage on both sides of the road. The access to the highway from the Robin's Bay main road is controlled by a stop sign. Coming from the west, the intersection is located at the end of long straight segment, in the beginning of a wide S-bend, which forms the embankment of the small concrete bridge over the Water River. That section of the road is governed by a 50km/h speed limit.

4.134. A Traffic survey was conducted on June 28 and July 1, 2011 at (a) the intersection of the North Coast Highway and Robin's Bay Road near Orange Hill, and (b) the Entrance point to Green castle Estate from the Robins Bay main road. Two vehicles classes were identified in the survey: (1) Cars which included cars, SUVs, pick-ups, and light commercial vehicles and vans (2) Trucks which included heavy commercial vehicles, bus, trucks and trucks with trailers. The survey included traffic volume counts and turning counts for two hours during the established peak hours of Morning (7:00-9:00 am), Afternoon (11:00 am-1:00 pm) and Evening (4:00 pm-6:00 pm). Traffic count data is given as Appendix 5 and has been summarized in the Figure 34.

4.135. The traffic survey at the Orange Hill intersection of the North Coast Highway and Robin's Bay main road show that during peak hours in the week on average a total of 250 vehicles are passing through the intersection per hour. Seven percent of that traffic is generated by the Robin's Bay community. The remaining traffic moves on the highway between Port Maria and Annotto Bay. The traffic towards Port Maria and Annotto Bay is balanced and does not show a statistical significant preference for either direction.

4.136. During weekends and public holidays is can be surmised there is a significant increase in traffic to and from Robin's bay when tourist facilities such as the Robins Bay Hotel, Strawberry Fields Together and River Lodge are utilized during these particular time periods.

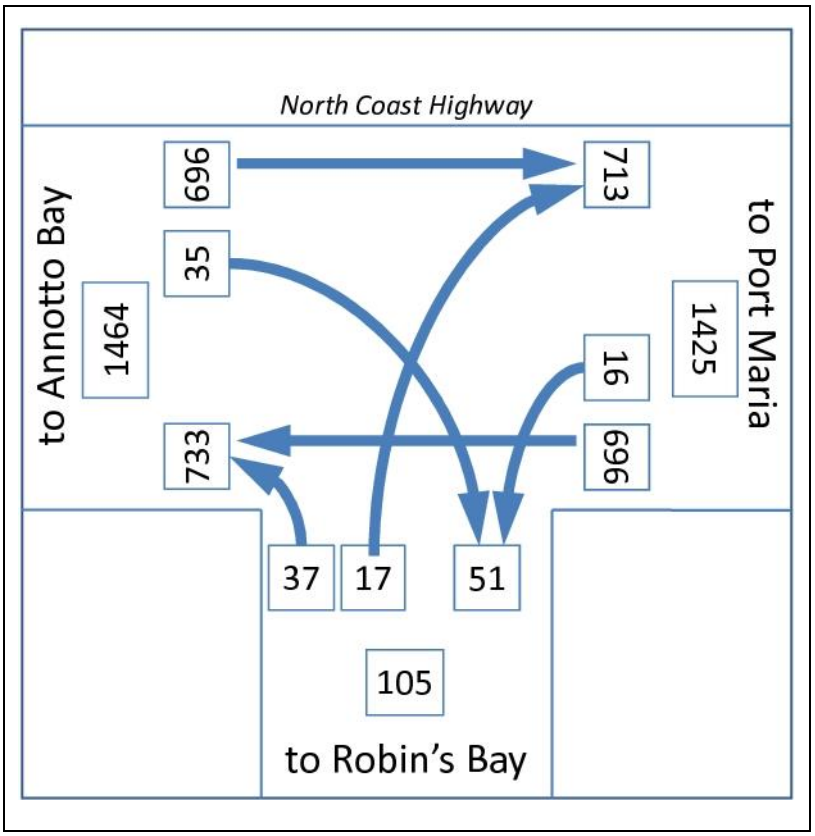

Figure 34 Total Average traffic count for the 3 daily peak hours combined at the Orange Hill intersection

4.137. The vehicles through the Orange Hill intersection are dominated by cars. Only 11% of the vehicles are trucks. This bias is even stronger for the traffic on the Robin's bay road; 94% of the vehicular traffic can be classified as a car.

(a) Entrance to Robins Bay Road off the North Coast Highway, view looking to the N

(b) Section of Tower Road leading to Green Castle Estate, view looking S

(c) View from entrance to Robin's Bay Community looking to the west

(d) View from the entrance of the Robin's Bay looking to the east.

Figure 35 Views of the Robins Bay Road (including Traffic Survey Point)

Heritage and Archaeological Resources

4.138. This part of St Mary has a rich history as it was known to be occupied since before Columbus discovered the island. Taino middens[11] located at the top of Davey Hill are estimated to date back to 1200's. A Pre-Columbian burial site located on Davey Hill was excavated in 1999-2001 by the University of the West Indies (Philip Allworth-Jones[12]), confirming occupation of the property as far back as AD 1075. There were no signs of Spanish presence at the site. Pottery shards have also been found at Davey Hill[13]. Taino sites also reportedly occur at Newry.

4.139. There is also a tower (Figure 36) which may be the remains of a windmill or a Martello (defense structure); the presence of ports in the structure suggests that it was a defensive structure

Figure 36 Tower (Greencastle on right; River Fort in Barbuda)

[11] http://www.greencastletropicalstudycenter.org/Jamaican_Taino_project.pdf

[12] http://infosys.murraystate.edu/KWesler/Kit%20Weslers%20papers/SAA%202001%20Excavations%20at%20Green%20Castle%20Jamaica.pdf
And
http://books.google.com.jm/books?id=M33aOoslSTMC&pg=PA69&lpg=PA69&dq=archaeology+%22green+castle%22+jamaica&source=bl&ots=1PIs-StMaT&sig=DaukYSa9W1dztL9W6aRMsRRNu_s&hl=en&sa=X&ei=EQFTUYrgO0668wTo50HgDA&ved=0CE8Q6AEwBQ#v=onepage&q=archaeology%20%22green%20castle%22%20jamaica&f=false

[13] http://blog.gcjamaica.com/category/uncategorized/

4.140. The remnants of British army barracks are located near to Jack Bay Beach. Estate buildings from later periods can also be seen around the estate, including the old Green Castle Great House

4.141. Over the years, the owners and managers of Green Castle Estate have been very supportive of archaeological investigation on the 1600 acre property. This site was selected for development particularly as there is no record of archaeological discovery during the course of its cultivation. The area where the archaeological sites occur elsewhere and the tower will not be included in the sub-division, and will be appropriately protected.

SECTION 5 STAKEHOLDER CONSULTATION PROCESS

The EIA shall contain section titled "Summary of the Stakeholder Consultation Process, which should summarize the key environmental concerns arising during the stakeholder consultations done prior to submission of the EIA. At a minimum, this section should:

- ***a) Document the public participation programme for the project.***
- ***b) Describe the public participation methods, timing, type of information to be provided to the public, and stakeholder target groups. Append survey instruments used to collect information.***
- ***c) Summarize the issues identified during the public participation process.***
- ***d) Discuss public input that has been incorporated into the proposed project design, the EIA; and environmental management systems. Concerns that were raised by the public but not considered in the EIA must be justified.***

The degree of public concern with specific issues (and general acceptability of the impact given proposed mitigation) is a key criterion used in determining of the relative significance of environmental impacts. The EIA process will only be considered valid if there are meaningful and valid opportunities for public scrutiny of the environmental effects of the project as proposed, including:

- ***a) During the course of preparation of the EIA Report, direct written communication from the EIA preparer to relevant public agencies, NGOs and adjacent land owners/occupiers advising them of the project, and seeking their concerns about it as they relate to potential environmental impacts.***
- ***b) Survey of the communities (Perception Survey) within proximity to the site to determine community organization, values and environmental awareness, and attitudes to a housing sub-division in this area.***
- ***c) Public Meeting held three weeks after the EIA is made available for review in accordance with the Guidelines for Public Presentation at a time and location signed off by the National Environment and Planning Agency (NEPA). This meeting should include presentations outlining the development proposal, environmental impacts, and proposed mitigations.***
- ***d) Availability of all EIA documents for public review, inclusive of: (1) these Terms of Reference (2) the EIA inclusive of all supporting technical appendices (3) the Public Meeting Report (containing presentations, summary, verbatim report of question and answer session and the register of attendance) and (4) Addendum Report (i.e. written response to EIA review comments).***

5.1. The standardized open-ended questionnaires (Appendix 6) consisted of forty-seven (47) questions covering key areas to determine the overall perspective of stakeholders on the level and types of impact the proposed eco-tourism development project will have on their community and Jamaica (see also paragraph 3.71). The survey had an overall response rate of one hundred percent (100%). The results of the survey are presented below.

Respondent Profile

5.2. The modal age group category (30%) of respondents was the 18-29 year group. Twenty-three percent were from the 30-39 age group, 20% the 40-49 age group, 10% the 50-59 age group 17% from the 60 and over age group category.

5.3. Although fifty-three percent (53%) of total respondents were female, 73.3% of all respondents indicated that a male is the head of their household. According to respondents, the family structure within the community of Robins Bay has remained largely traditional with males heading the households. Females who head their households are largely single parents or their spouses reside/work overseas.

5.4. All respondents had received formal education, with fifty percent (50%) receiving such training beyond the primary level. For respondents who were educated beyond the primary level, thirty percent (30%) of the total number of persons surveyed had received secondary level education, approximately seventeen percent (16.7%) skills training and three percent (3.3%) tertiary level training. only six percent (6.7%) of respondents indicated they were currently enrolled in an educational institution.

5.5. The employment rate amongst the individuals surveyed revealed that 7 out of every 10 persons were employed, with an overwhelming majority, 62%, being self-employed. Only nine percent (9%) of all persons who indicated that they were employed, were employed on a full-time basis, while an estimated twenty-nine (29%) percent were employed part-time. Twenty eight percent (26.7%) of all respondents selected the 'Other' options and 3% indicated being unemployed. Those choosing the option of 'Other' were retirees, students or housewives.

5.6. The income earning status for persons indicating they were employed, showed that approximately seventy six percent (76%) earned less than $10,000 JMD (117 USD) a month, compared to an estimated 9% who earned above $60,000 JMD (705 USD) a month. The remaining 14.5% earned between $10,001 JMD and $30,000 JMD (353 USD) per month.

5.7. The vast majority of respondents were employed in the Agricultural, Retail and Hospitality/Service industries. Occupational types that appeared frequently in the survey included: farming, bartending/shop keeping, merchant trading and housekeeping/domestic engineering. Ninety percent (90%) of the total number of persons surveyed acknowledged having an additional source of income or were the recipient of family support and remittances. This included retirees who had pensions and persons who were students and not earning a formal income. Sixty-three percent (63%) of all persons surveyed indicated that they received additional income or revenues from their spouse or family, while 10% received remittances and another 13% relied on savings from investments made.

5.8. This was not entirely surprising, as based on socio-economic information gathered on the community, it is ranked as low-income community, where many of the households depend on the PATH programme to support their children and the elderly. The Ministry of Education Annual Report (2010) noted that more than half of the students attending the Robins Bay primary school were from low income households and were all part of the PATH programme in the Ministry of Labour and Social Security. Additionally, with the community being a predominantly farming and fishing community, it means many of the individuals within the working group population are predominantly self-employed in seasonal job activities and are therefore more opened to risks and thereby more reliant on additional income sources during 'low peak' work periods.

Community Organization

5.9. This aspect of the survey is important to facilitate meaningful future dialogue with the community as a group as it identifies the organization structure within the community, leadership roles and social capital. Only a third (33.3%) of the persons surveyed was aware that their community had a Citizens Association and Neighborhood Watch Group. All respondents did however acknowledge the presence of a community centre, but noted that it was not in used as it was in need of urgent repairs. Prior to the deterioration of the centre, members of the

community said the centre was used by various groups within the community, including the Citizens Association and Neighborhood Watch Group as their meeting base. The church was also recognized as an important organization within the community, particularly the work the institution undertook in caring for the elderly and children.

5.10. Both males and females participated in the organizations within the community. However females were said to take the lead roles in organizing most community projects and events. Householders that were surveyed were asked about the key decision makers in the community and if there was an established democratic process that supported decisions made about community development. The following were identified as the main decision makers for the community (ranked in order of frequency named by respondents):

i. Community members themselves (30%)
ii. Area Councilor (20%)
iii. Member of Parliament (MP)
iv. Citizens Association.

Whilst a third of the respondents identified the community as the decision-makers, another third said they could not identify who were the leaders in the community.

5.11. Based on the responses provided by community members, the Citizens Association and Church Groups undertake many of the outreach programmes in the community. Outreach programmes involved feeding the elderly, education and community clean-up or beautification. Labour Day (May 24) projects are held yearly in the community and almost half (47%) of householders interviewed were aware of such projects. The citizens association and church groups were said to be the main organizers and financial backers of such projects. School groups and individual community members have also organized Labour Day projects. Most Labour Day projects are beach clean-up exercises and community beautification projects.

5.12. US Peace Corps volunteers have had a long relationship with the community of Robins Bay. Volunteers have undertaken several projects within the community over the years. These have included environmental awareness projects; migratory bird conservation projects, restoration of the health facilities, social intervention

programmes targeting the elderly and children and community beautification projects. It was surprising therefore that only an estimated seven percent (7%) of total respondents were aware of outreach programmes that were being implemented in their community by the Peace Corp Volunteers.

Values & Environmental Awareness

5.13. Surveyed respondents, though generally satisfied with their community, believed numerous improvements were needed to make their community a more sustainable and livable one. Half of respondents indicated that they valued their community mostly for its tranquility and its natural resources, though many did not utilize these resources. A third identified the lack of crime, friendliness of the people and the landscape as what they valued most about their community. There were however, 20% of respondents who said they valued nothing about their community, as it offered limited opportunities for economic advancement.

5.14. It was therefore not surprising that 63% respondents identified the need for job and employment opportunities as the single most important improvement that was required in their community. The introduction and expansion of additional business initiatives to drive growth and create employment opportunities for residents was identified as the key requirement for 'jump starting' improvements in their community. The need for community and recreational facilities and training and educational facilities/programmes were desired by close to twenty-seven percent (27%) of respondents, while the remaining respondents felt their community could benefit with improvements in road and utility infrastructure.

5.15. Fifty percent (50%) of respondents said they exploited natural resources in the area, with the vast majority using water and trees. Resources were utilized for recreation, business purposes or food. An overwhelming majority of interviewees (97%), did not find any of the resources within their community to be exposed to pollution threats or any other stress factors. Only one respondent found that the resources within the community were being threatened by air pollution, caused by recent increases in quarrying activities in surrounding communities.

5.16. All persons surveyed acknowledged that several species of birds could be found within their community, with 64% of respondents noting the presence of migratory birds during various seasons of the year. From the nineteen respondents who indicated that they had seen migratory birds, most (84%) said these birds

were seen during the summer period, while only 11% of respondents said migratory birds were likely to be seen in the community during the winter season. The remaining respondents could not say definitively during what time of the year these birds were in the community, but were certain that particularly species of bird moved in and out of the community throughout the year.

5.17. All respondents noted that they have seen turtles at one point or another in their community, some away from their natural habitat. However 70% of respondents noted the presence of turtle nesting sites on the beaches found within their community.

5.18. Approximately fifty-three percent (53%) of all respondents indicated they had seen the lion fish on the beaches and within the bays within Robins Bay. All respondents did however acknowledge that they had heard or have been told about the lion fish. For those respondents who had seen the fish within their community, more than half said they had caught the fish for consumption by them or sale to consumers.

Attitudes to a Housing Sub-Division at Greencastle

5.19. Given the nature of the proposed project, it was important to get a better understanding of the views of respondents on the housing and land markets in their parish and community, and how they believed the current status of the housing and market affected or is likely to affect their overall tenancy status. Most (87%) felt that housing solutions and land being offered for sale in their parish and community were unaffordable and were not priced with locals in mind. The overwhelming majority (93.3%) of respondents felt there was not enough low- and middle-income housing solutions on the market in the area.

5.20. Interviewees generally felt both land and housing costs were very expensive, and that the practice of players in the market to quote the price of their properties in United States Dollars (US$) was making housing and land even more expensive with the constant changes in the exchange rate. Persons surveyed in the Robins Bay community also noted the practice of lands being offered to expatriates, rather than locals who had resided in the communities for years. This practice they said generally brought the landowners more revenues, but often left residents displaced after many years of living and raising their families within the community. Lease and rental of land were also identified as other ways in which to access land and

housing at an affordable cost for persons who could not at the moment purchase the properties.

5.21. Persons interviewed in the community noted that developers were not interested in providing housing in the community of Robins Bay to low income groups, but more interested in high end developments on the beaches and cliffs overlooking the bays. Respondents generally felt that housing solutions that were developed, targeting low and middle income groups, were far outside the financial reach of persons who fell within these income groups, and in the end, these individuals are faced with the options of 'capturing' land and/or relying on the support of family to purchase these dwellings.

5.22. Based on information provided by respondents, informal developments are widespread in the community of Robins Bay, and have been taking place for generations. This has been supported by the housing and land tenure data for the community, which shows that many of the lands occupied by residents are not owned by the occupiers. One of the primary reasons for this has been the reluctance of landowners to sell the lands to low and middle income groups, as there is more to be gained financially from selling the lands to foreign developers.

5.23. A wide variety of measures were proposed by respondents on how the housing and land market crisis in their parish and community could be solved. Respondents were largely concerned about the price tag that was placed on new housing developments and land subdivisions. It was therefore not surprising that sixty percent (60%) of persons surveyed indicated that a reduction in housing and land prices would be the most practical measure for solving the current crisis.

5.24. The subdivision of lands into smaller parcels was also put forward by residents as a feasible option, and was the preferred measure for fifteen percent (15%) of respondents. Other suggestions put forward included:

i. Improving the job market and salary packages.
ii. Making more lands available for lease.

5.25. A third of all persons surveyed were aware of proposed plans to subdivide lands at the Green Castle Estate for housing development. Respondents had been made aware of the project by workers from the property and other residents within their community. They could not say however when they were made aware of these proposed project plans.

5.26. The use of former plantation lands for housing was supported by all respondents. Sixty percent (60%) of persons surveyed said they supported the conversion of sections of the lands at Green castle Estate for housing as it would likely lead to the introduction of new business developments in the community.

5.27. Approximately twenty seven percent (26.6%) of respondents supported the conversion as they felt with the introduction of high-end housing, there would be more opportunities for employment, as home owners would likely need construction laborers, domestic workers and other skilled laborers e.g. gardeners, helpers, plumbers, electricians, masons, carpenters etc. Community members felt that this would assist the small farming and fishing community, as in addition to providing direct employment, farmers and fishermen would get access to a new consumer market. The remaining, 13.4% of respondents believed the subdivision would improve current utility infrastructure and service in their community. It was noted that Green Castle Estate already provides employment for workers from the Robins Bay, and it is anticipated that many will benefit from the proposed development changes earmarked for the estate.

5.28. Persons surveyed hoped the introduction of middle and high income housing in the community would lead to upgrades being undertaken on existing utility and road infrastructure in their community. A third of respondents expressed their dissatisfaction with the water supply service, while others noted that the upgrading and improving in utilities and road infrastructure was what their community needed to support its growth and development.

5.29. An increase in the housing stock within the community can increase collective bargaining power for demanding improvement in local services, such as security, lighting, garbage collection services etc.

5.30. There were no objections to the proposed project by community members surveyed. Respondents did not even identify any expected negative impacts. There was some skepticism about the potential impacts this project would have on the housing and land market within their community. Close to sixty-seven percent (67%) of all respondents said they expected no changes or impact to the housing and land market when the proposed project has been implemented.

SECTION 6 ASSESSMENT OF ADVERSE ENVIRONMENTAL IMPACTS

The impact of the development on the specific sensitivities of the area should be comprehensively evaluated. The purpose of this is
(1) to identify the major environmental and public health issues of concern and
(2) to indicate their relative importance to the design of the project and the intended activities, taking full consideration of the effectiveness and acceptability of any proposed mitigation measures in the protected area context.

Methodologies

6.1. Negative project impacts were identified using the following methods:

a) Stakeholder consultation.
b) Technical inputs from environmental specialists on the EIA team.
c) Review of the possible impact-causing aspects of the project.
d) Review of impact assessments done for similar projects.
e) Regulatory criteria governing aspects of the environment likely to be impacted.
f) The sensitivity of valued environmental components (VECs) likely to be impacted.
g) Review of the risks arising from the project and the range of environmental consequences that could arise under upset conditions.

Impact Evaluation and Classification

6.2. Each identified adverse impact is classified according to the assessed Effect Level (no impact, minor, moderate or major). Each identified impact is analyzed using a standard set of impact evaluation criteria. These criteria fall into three broad groups of environmental metrics, which together give a more comprehensive picture of the character of the impact.

6.3. Magnitude Indicators:

a) Secondary (Indirect) Effects: The number of likely adverse secondary (indirect/ triggered) effects occurring elsewhere or at a later time.
b) Scale Spatial extent of influence arising from frequency and magnitude of the causative action: isolated within the boundaries of the property, near dispersion pathways, or off-site effects (downstream etc).
c) Environmental Persistence: This refers to the duration/frequency of the causative activity, and the time after cessation for the environment, and the extent of residual adverse effects that occur despite mitigation.
d) Affected Numbers The proportion of a population or habitat that will be adversely impacted by the project.
e) Baseline change: the estimated change on an adversely impacted receptor that can be measured and attributed to the project. This allows for: (1) comparison of normal seasonal change with change arising from the project, and (2) inclusion of cumulative effects (from unrelated activities) through the concept of a dynamic or moving baseline.

6.4. Vulnerability:

a) Resilience: the ability of a receptor to cope with the effect at the particular time/season when it will occur. For socio-economic parameters, this is best indicated as a measure of nuisances/loss of amenity or revenue. For ecological parameters this is indicated as a potential health or mortality concern. For physical parameters, this is indicated as the possible demand on the assimilative carrying capacity and effect on system stability.
b) Reversibility: the extent to which the site (or affected area) can be returned to a pre-project state

6.5. Manageability and Validation:

a) Mitigation Potential: the feasibility, effectiveness and timeliness of management responses to reduce or avoid environmental costs.
b) Uncertainty: disclosure of the level of scientific and statistical confidence in the predicted outcomes, and the general reliability of the data and models used to predict impacts and an understanding of any scientific uncertainties that could diminish the effectiveness of management responses.
c) Acceptability to stakeholders: The acceptability of the impact can be measured by the likelihood of compliance with (1) environmental quality standards; (2) legal requirements; (3) physical plans and land use policy; (4) societal norms for trading off the impact against project benefits; (4) public opinion/interest/values; level of controversy and (5) opportunities for positive environmental effects and mitigating circumstances.

Impact Significance

6.6. Using the evaluations on the magnitude of the impacts, the vulnerability of the receptors and the general manageability of the impact, impacts shall be classified as either having no impact, or being minor, medium-scale or major.

6.7. Impacts shall be classified as minor or negligible if the change to baseline is not measureable or is less than normal fluctuations within the system. In many cases, where the change to baseline is very small, the effects are likely to be cumulative, and should be identified as such where relevant.

6.8. If the change to baseline is measureable, the impact shall be classified as medium or major depending on the following parameters, whereby a major adverse impact is one that:

a) Where the geographic extent and persistence:
   - Is widespread (offsite regional effects) and persistent after 2 years and impacts on a biological population continue to occur over a number of recruitment cycles after the cause has ceased.
   - Associated with numerous indirect negative affects, with more than one generation and several trophic levels involved.
   - Affects a large number of individuals or large proportion of the exposed community.

b) Where receptors are vulnerable and the impact:
   - Occurs within designated protected area or the habitat of protected species, and these receptors are unable to cope with the change resulting in mortality.
   - Permanently damages habitat quality or creates ecological barriers.
   - Contributes to the endangerment of threatened or protected species or reduces the stock of commercially important species.
   - Occurs at the peak time when receptor is vulnerable.
   - Results in a loss of revenue or amenity which is sustained after remedial action is taken or threatens cultural or heritage resources.
   - Alters community lifestyles or requires long-term adjustments of local people in respect of traditional values and resource use.
   - Represents a long-term nuisance or significant safety or health risk to other users.

c) Where management of the impact is characterized by:
   - Not being easily or cost-effectively returned to previous state or be re-used for any other productive purpose.
   - Not being cost effectively mitigated or requiring major design change to causative activities or no mitigation possible.
   - Little or no opportunity for environmental enhancement or no perceptible environmental benefit of the project.
   - Public outcry against the impact or cause. Prohibitive legislation, plans or policies or the impact or cause exceeds legal thresholds, limits or criteria or maximum allowable levels.

6.9. Wherever relevant, a lack of scientific certainty or confidence in the data or findings shall be disclosed, and taken into account in assessing the impact. In the absence of scientific certainty, the precautionary principle shall be adopted, such that worst case scenarios shall be assumed, and appropriate mitigation measures recommended.

6.10. Cumulative adverse are defined as adverse environmental impacts that arise from several activities impacting the same environmental receptor. The causes of these impacts may be from various project activities or partly from project-related activities (internal aggregations) and pre-existing conditions (external factors). External activities form part of the baseline condition, and are taken into account in the examination of the baseline, as well as divergence from the baseline that might be expected to arise from project implementation. In this way the impact of the project on the surrounding area especially as it relates to the cumulative impacts of this project with any existing developments will be included.

Environmental Sensitivities (Adverse Impacts)

Construction Phase

6.11. Section 1 (paragraphs 1.86 to 191) summarized activities related to the development of the sub-division, inclusive of infrastructure development and construction of individual homes. The environmental impacts of these activities are related to the consumption of resources and associated waste streams.

Visual Intrusion

6.12. Due to the phased nature of lot sales and site development, it is expected that there will be protracted periods of construction at the site over the next five years. Visual intrusion is very difficult to quantify or assess as an impact as it is a normally accepted part of construction, but can become a nuisance to residents. This is also only expected to have the potential to become a nuisance if there are persons who have completed their own construction projects on their lots and are living at the site. This can be mitigated to some extent by the proposed phasing of the development and by the installation of construction screening around lots that are under construction. It is classified as minor.

Increases in Ambient Noise Levels

6.13. Noise associated with site development is likely to be associated with vehicular engines associated with the haulage of construction materials along transportation routes and construction equipment on site (along sites for roads, drainage works etc). Based on available ratings of construction equipment[14] it is unlikely that the noise emissions at source would exceed 96 dBA.

6.14. Using the standard noise distance decay rate of 6dBA for every double of distance from the source, it can be estimated that this peak estimated noise of 96 dBA will reduce to 60 dBA within a distance of 64 m. Peak single site noise of 96 dBA will reduce to the World Bank Standard 45 dBA within a distance of 300 m, not taking into account dampening effects of topography, wind direction and vegetation.

6.15. There are no primary noise sensitive receptors (schools, churches, hospitals) within 300 m of the boundary of the property; the nearest dwelling units are more than 250 m away from the northern boundary of the site. Any birds or other wildlife that might be disturbed by the noise can be expected to temporarily retreat to the wooded valleys within the site, which will be left undisturbed. The main receptors of the noise will be construction workers, who will be equipped with suitable gear to protect them from any harmful noise levels. No persistent environmental effects are predicted to occur as a result.

6.16. All construction activities (including haulage) will be limited to normal working hours. Noise can also be reduced through the use of noise abatement technologies that might be available for specific equipment.

6.17. Mitigation measures that are recommended include:

- Limit construction activities (including haulage) to normal working hours (7 am to 7 pm Mondays to Saturdays. There should be no construction activities at night or on Sunday.
- Use of noise abatement technologies that might be available for specific equipment (e.g. silencers or mufflers; vibration damped blades)
- To the extent practicable, use equipment with low noise ratings (e.g. compressors with acoustic grade casings).

[14]E.g. http://www.cpwr.com/hazpdfs/kfnoise.PDF

- Provide personal protection gear for workers operating equipment that generates noise. Workers operating equipment generating noise of ≥ 80 dBA (decibels) continuously for 8 hours or more should use ear muffs. Workers experiencing prolonged noise levels 70 - 80 dBA should wear earplugs.
- Maintain equipment for optimum performance: e.g. keep power saw blades sharp.
- Clamp materials to be cut.
- Use partial acoustic enclosures (noise buffers), which can easily be moved around the site.
- Keep enclosure panels on compressors closed.

6.18. Due to normal acceptability of this impact given its manageability potential, the residual effect of this impact is considered to be minor.

Reduction in Air Quality Due to Construction Site Emissions

6.19. The sub-division development itself is only expected to require major clearance along roadways (totalling 4.3 ha), much of which is already aligned along existing roads. It is expected that the construction projects on individual lots (27.4 ha divided into 171 lots) would generate the wider impact. In general, air quality at construction sites and along haulage routes tend to be impacted adversely by the generation of fugitive dust (e.g. cement or soil stockpiling and cleared areas) and combustion emissions (from excavators, trucks etc).

6.20. The geographic extent of these effects tends to vary with local meteorological conditions as well as the effectiveness of material management and maintenance.

6.21. High levels of dust in the atmosphere can create the following secondary environmental effects:

- Aesthetics/poor visibility (haziness), which can impact road safety.
- A poor visual aesthetic with dust clouds, dust build-ups on vegetation, roofs, soiling of walls etc.
- The effects on agriculture include decreased photo-synthesis in plants, which can impact fruit sizes and sugar levels in crops like bananas. It can also include reduced effectiveness of pesticide sprays as a result of reduced penetration.

- Respiratory problems like asthma and irritation to eyes and nostrils. Health problems arise when airborne particles of 10 microns (PM_{10}) or less are inhaled. Dust containing high levels of silica can cause lung disease.
- Deposition on clothes drying on outdoor lines.
- Deposition in buildings, resulting in poor indoor air-quality, dust build-up in electronics and indoor surfaces and increased need for cleaning systems (like vacuums). This could also lead decreased efficiency in air-conditioning systems as filters become clogged with dust particles. A major effect of this is an increased need for cleaning and washing down, which involves the increased demand for water and use of cleaning products. This can therefore become financially and environmentally costly.
- Impurities in rain, which can impact rain water harvesting systems.
- Discouragement of outdoor recreational activities such as sports and picnics.

6.22. The following standard mitigation measures can be implemented at the construction sites to reduce the air emissions:

(a) Unpaved Surfaces (e.g. site access roads)

- Wet cleared areas and earth material stockpiles as well as earthen roadways within construction sites. This should be done on a schedule (every 4 to 6 hours), particularly during the dry months when there is no rain (when bare areas should be dampened more frequently). It is recommended that connection of the site office to a the water main grid be done prior to the commencement of construction to ensure there is adequate water at the site for construction purposes as well as controlling of fugitive dust.
- Pave site access roads as early as possible.
- As soon as construction at any one site is completed remaining unpaved or bare areas should be re-planted with grass.
- Limit site clearance to the areas needed most immediately for construction. For example, do not clear all road alignments at the same time.

(b) Construction Site and Stockpile Management

- Cover and secure stores of cement.
- Prohibit burning of vegetation debris on site.
- Where unavoidable, construction workers working in dusty areas should be provided with N95 respirators.
- Restrict and control cement mixing on site: use ready-mixed poured concrete as much as possible.
- Place mesh screening, zinc or plywood fencing around individual lots under construction.
- Limit the height and slope of stockpiles (of fine aggregate, top soil, excavated earth materials etc).
- Limit drop heights from haulage vehicles.

(c) Vehicle Management and Paved Surfaces

- Limit load size to avoid spillages.
- Ensure that haulage trucks are covered.
- Set up a wheel wash and truck wash down facilities at site exits.
- Traffic calming (speed control) devices should be used to the extent practicable for large heavy equipment and haulage vehicles.
- Use construction stabilized construction exits (SCEs) at the exits to remove excess muds from the wheels of haulage vehicles before the enter paved roads

6.23. This impact on air quality is considered relatively minor as the construction sites are isolated within the property over an extended period of two to ten years, and extent of change to baseline is expected to be marginal if the mitigation measures are properly implemented. At this location, this impact is classified as minor.

Contamination of Surface Water by Construction Site Effluents

6.24. Construction site run-offs are mobilized by construction water piped to the site, or by rainfall. They may contain suspended solids as well as hydrocarbons. There is also potential for accidental spills of fluids such as paints, lubricants, fuels etc, which can contaminate soils and potential migrate to gullies, and ultimately to Robin's Bay.

6.25. These effluents can be managed using the following mitigation measures:

- Many of the same mitigation measures for management of fugitive dust apply, for example, limiting or phasing land clearance.
- Construct the detention basins before the start of roadway and other earthworks.
- To the extent practicable, fuels and lubricants should be stored and dispensed within covered, bermed hardstands located away from drainage areas. These areas should not contain storm drains or sumps. The bermed area should be able to contain at least 110% the volume of the stored material, and should not be higher than the level of an average water boot.
- Based on the bill of quantities, develop an effective materials management plan for the main construction site (Lot B1). This should include provisions for storing earth material stock piles away from storm run-off pathways. Stockpiles should be covered and bermed.
- If there is any washing of equipment or vehicles on site, it should be done at a designated wash-down area, where the run-off is routed to a settling pond or tank. Sludge contaminated with oil and grease should be disposed of at a landfill by an approved contractor.
- Stabilized construction exits should be used.

6.26. Due to the absence of running streams on property, it is unlikely that normal site run-offs (construction water) will exit the boundaries of the site to the detention ponds unless mobilized by major storm flows. This impact is classified as minor because with proper management, the impact is unlikely to occur or be residual or show any measureable change to baseline water quality in the nearest receiving body (Robin's Bay).

Contamination of Groundwater with Construction Site Sewage & Grey Water

6.27. Generally at small construction sites in Jamaica construction workers are provided with a temporary pit latrine (soak-away) and shower. One commode serves approximately 25 workers. For the individual lot developments, this method of sewage disposal during house construction would be acceptable. The latrines should be located away from major water courses, and should be properly screened with zinc or plywood. The pit should be covered with a toilet, inclusive of a seat and cover. The toilet should be sanitized daily.

6.28. A hand washing basin should be provided immediately outside the facility.

6.29. When abandoned, the pit should be filled with marl and compacted over. Approximately 30 cm of marl should be mounded over the top of the pit after compaction. Grey water from the shower and sink should be routed to a temporary soakaway pit on property.

6.30. During the pre-sale site development period, it is recommended that portable lavatories be utilized, in addition to the installation of more permanent restroom facilities at the site office at Lot B1. It is likely that in this area the most acceptable sewage disposal solution would be a septic tank and constructed wetland.

6.31. This impact is considered minor as there are no water wells or springs in vicinity of the site. With the installation of site-appropriate temporary sewage disposal during construction it is unlikely that this will cause a change in the baseline water quality of the groundwater system or coastal water quality in this area.

Loss of Vegetation Cover

6.32. After full build-out, it is expected that ~51% of the natural vegetation on the 77.5 ha site will replaced with pavement or landscaped areas, comprising "disturbed areas" (see Table 2). The remaining 49% consists of open space including drainage easements.

6.33. During the initial development of the sub-division infrastructure (pre- lot sales), very little impact on vegetation is expected. The main impact will be associated with clearance of less than 5 ha for sub-division roads. Upon completion of the roads, verges will be landscaped with species that are common in this region, that do not require fertilizers, pesticides or irrigation.

6.34. Much of the change is likely to occur as the lots are sold and developed by the individual owners. More than two thirds of the "disturbed areas" is attributable of lot development. It is important to remember, that not all of the 27.4 ha that are allocated for lot development will be paved over by impervious surface (see paragraph 1.32). Less than 10 ha of this number will actually be built up. The remainder will be likely be replaced by gardens.

6.35. Figure 37 shows the overlay of the sub-division over the 2009 satellite image (Google Earth). All of the riparian zones that were historically undisturbed by

agriculture will remain undisturbed by the proposed development. The areas that will be disturbed are those that have been historically impacted by cultivation and pasture.

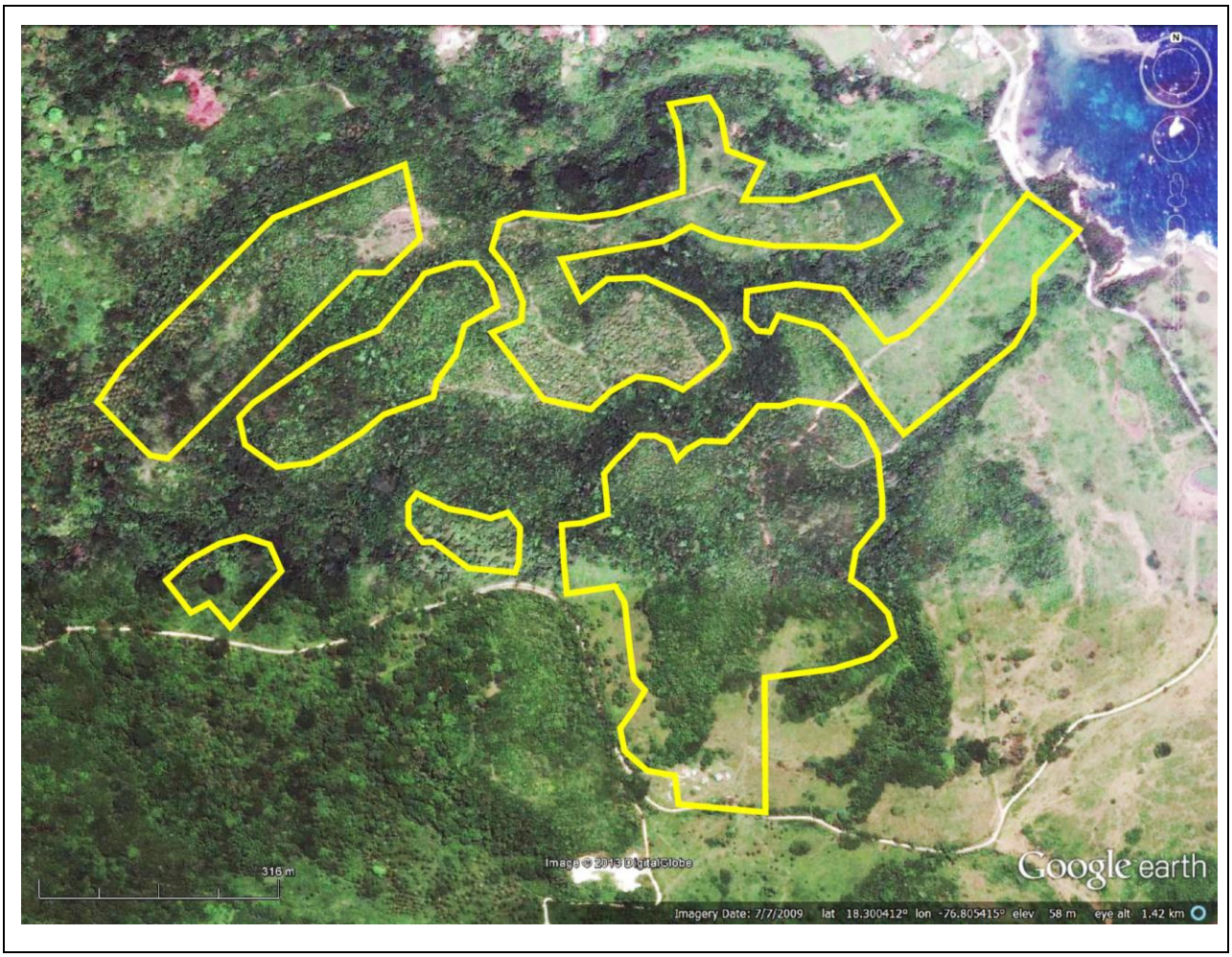

Figure 37 Sub-Division Footprint (Overlay)

6.36. The main environmental impacts of land clearance include potential soil erosion and loss of biomass and habitats.

6.37. Although a significant portion of the development site will be disturbed (39.4 ha), only about 15 ha will actually no longer be under vegetation cover. Much of this area has been already impacted by the presence of existing farm roads and historic cultivation.

6.38. It is estimated that close to 44% of this 39.4 ha will actually be converted to gardens, which off-set the total loss of biomass (15 ha). Another major mitigating factor is the preservation of the undisturbed areas, which account for ~49% of the

total development. In addition, the applicant is exploring the feasibility of setting up a Forestry Reserve within the bounds of the wider Green Castle Estate, which would be the equivalent of the cleared area at a minimum.

6.39. Soil erosion is not likely to be a major factor, as these soils are not highly erosive, and land clearance will proceed on a phased basis, with completed areas being quickly replanted. Natural vegetation re-growth is also expected to be relatively rapid because of the high precipitation levels in this area.

6.40. Based on the relatively low habitat value of the lands being disturbed by the sub-division, and other mitigating factors, it is expected that this impact is relatively minor.

Demand for Landfill Space due to Construction Waste

6.41. During the pre-sale development period it is likely that solid waste will be mainly associated with the construction camp workers and earthworks. In respect of worker related waste, it is recommended that a Construction Phase Solid Waste Management Plan be developed, providing specific guidelines to contractors in respect of restricting eating and waste disposal to the main site office lot. Waste receptacles should be provided, as well as arrangements made for storage and routine collection of construction camp waste. Once a bill of quantities becomes available, it is recommended that a plan be prepared to ensure that excavated materials are beneficially reused on site as top soil, engineering fill or compacted road or foundations base as appropriate.

6.42. During the lot construction period solid waste is expected to occur as a result of:

- Clearance of tracts of land (vegetative debris)
- Domestic waste associated with site workers. This can include food package (polystyrene containers, plastic wrapping, paper, boxes, bottles, tins, organic material from leftover food).
- Construction materials packaging. This will include cardboard, gypsum (drywall cuttings), plastic sheeting, fencing materials, wooden pallets, roofing shingles, asphalt felt cuttings, containers etc. This also includes construction fencing and used scaffolding materials, as well as solid waste accumulating in any waste water treatment system on the construction site.

- It is estimated that construction could potentially generate solid waste 28 kg per m^2 (6.14 lbs per square foot[15]). Assuming that the average size of each building is of the order of 3000 square feet, the total estimated solid waste that could be generated by the construction would be ~7 metric tons per lot. This would cumulatively (over the extended build-out period) amount to ~1200 metric tons of solid waste being generated to be disposed at a municipal landfill.

6.43. The secondary effects of solid waste generation during the construction period include potential impact on visual aesthetic if improperly collected and stored on site, potential for pest infestation (especially if there is waste food that are being disposed on site), demand for routine collection from the site and disposal of solid waste at the landfill.

6.44. In general, generation of solid waste is an accepted and unavoidable effect of all development projects.

6.45. The following recommendations are made for environmentally sound management of solid waste generated at the construction sites.

- Designate waste collection/storage area with skips or large bins.
- Employ a licensed waste haulage contractor to collect waste on a weekly basis from the sites.
- For the infrastructure construction phase (pre-sale) develop and implement a Construction Phase Solid Waste Management Plan, which sets objectives and strategies for reducing, re-using and repurposing waste at source. The Plan should also identify collection points, and final disposal of waste that cannot be reused or recycled.

6.46. This waste generation will be barely measureable against the general consumption of landfill space in the parish. However, it is considered a cumulative effect, which can be minimized through efforts to reduce, re-use and re-purpose waste at source. Given that this is generally acceptable and small scale, it is classified as minor.

[15] http://peakstoprairies.org/p2bande/construction/c&dwaste/whatsC&D.cfm - this site estimates construction wastes to range between 2.41 and 11.3 lbs per square foot, with an average of 6.14 per square foot, although home size is just a rough guide as choice of construction materials, contractors and other factors may control solid waste generation.

Adverse Effects along Haulage Routes

6.47. As in the case of solid waste impacts, these effects cannot be quantitatively assessed as there is considerable uncertainty about the specific routes of haulage vehicles and the periods during which these will be operational. It is likely that most of the haulage vehicles will use the North Coast Highway to the entrance to Green Castle at Orange Hill, and continue to the site via Newry and the coast road.

6.48. Construction traffic (trips generated) cannot be properly quantified for the purposes of this EIA due to the high level of uncertainties in terms of actual quantities and timeframes for build-out (of individual lots in particular). The following is a qualitative or semi-quantitative assessment of likely trip generators in each phase of construction.

6.49. **Set up of the laydown site.** This will involve establishment of the management office, stockpile and storage areas, re-fuelling and equipment maintenance areas (including wash down) during the infrastructure construction phase. This will mainly involve transportation of vehicles for clearing and preparing the site, as well as transportation of materials required for the site office. It is uncertain whether a temporary or more permanent structure will be constructed as the site office. It is likely that a concrete pouring mixer truck will be required on at least one day for foundations. It is uncertain what other hard stands would be needed at the site office (potentially for driveway, parking, and fuel storage/dispensing).

6.50. **Construction of the detention basins and stabilized construction exits (SCEs).** This will involve the transportation to the site of heavy earth moving equipment such as bull-dozers and excavators. These will be brought to the site during off-peak hours (mid-night to 5 am). Earth materials excavated from the detention basins (~16,115 m3) will be reused on site as either fill or top-soil so there would be no off-site haulage traffic generated.

6.51. **Site preparation along proposed roadway alignments on a phased basis, involving limited vegetation clearance**. No major transportation is expected during this period, aside from commuter traffic (manager, project engineers, survey teams and bush-clearing workmen). Any vegetation debris generated by the clearance activities will be disposed onsite.

6.52. **Construction of the subdivision access roads (laying and compaction of sub-grade, and other layers and pavement).** During this period it is expected that suitably sized aggregate will have to be brought to the site from a quarry. Aggregate, marly limestone and rip rap will have to be transported to the site for the road and drainage works. No accurate bills of quantities have yet been generated, but it is likely that this phase of construction will generate the most construction traffic.

6.53. **Installation of power and water mains and completion of verges**. This will require the transportation of pipelines (pvc) and trenching equipment to the site, as well as the electrical cables. It can be assumed that water and sewage pipes of equal length of the roads (4,512 m) will have to be transported to the site. Eight (8) to 10 times the length of electrical, cable and telephone lines would have to be brought in (most likely on rolls).

6.54. **Construction of concrete kerb and channel, concrete u-drains concrete pipes (600 mm) and culverts**. Detailed estimates of quantities of in-situ concrete requirements and pre-fabricated concrete are not yet available. There will likely be considerable transportation of mixed concrete, cement and pre-fabricated concrete associated with the drainage installations.

6.55. **Survey and field marking of sub-division lots for sale**. This is not expected to generate more than commuter traffic for the workers involved in clearing, and the survey teams.

6.56. **Sale and construction of individual lots by lot owners in accordance with the Purchasers' Agreement**. This will require transportation to the site of mixed concrete, concrete blocks, steel rebar, roofing and flooring materials, pipes and cables and a ranging of finishing materials (paints, plumbing fixtures, doors, windows, woodwork, etc). It is not possible to estimate how many lots will be under construction at any given time on the sub-division. In addition to transportation of materials, there would be commuter transportation associated with supervisors, skilled workers (electricians, plumbers, masons, carpenters, roofers, tillers etc) and labourers. This phase is also likely to generate a significant amount of construction traffic depending on how many lots are under construction at any given time.

6.57. The main environmental effects associated with construction transportation include:

- Congestion delays due to slow moving laden vehicles (Level of Service)
- Road safety
- Wear and tear on roads
- Noise, dust and combustion emissions along transportation corridors.

6.58. Due to the uncertainties in quantifying the scale of these impacts, a precautionary approach must be adopted. It should be noted that the traffic impacts specifically associated with the sub-division infrastructure development are likely to be spread over five to eight years, and that daily traffic is not likely to be more than 10 to 15 construction-related trips per day at peak construction periods, including both trucks and commuter traffic.

6.59. Congestion delays at the intersection (off the North Coast Highway at Orange Hill) can be mitigated during the construction phase with the implementation of the following measures:

a. Clearance of vegetation at the intersection to ensure visibility of traffic turning onto or off the Green Castle Estate road.

b. Construction traffic and deliveries entering or leaving the site shall be scheduled for off peak hours (10 am – 1pm and 6pm -7am) to minimize additional congestion at the intersection and or disruptions in the regular traffic flow.

c. Heavy equipment should be transported to the site in the early morning (12 am to 5 am with proper pilotage.

6.60. Safety of motorist is of great concern and the following steps should be taken to mitigate or reduce accidents on the roads leading to the site:

a. Secure and cover loads (steel rebar, concrete blocks, steel turbine components, aggregate, cement etc) to avoid presenting a hazard to other road users.
b. Place appropriate traffic warning signs, advising road users of a construction site entrance ahead and instructing them to reduce speed, should be placed along the highway near to the turn off to Green Castle Estate at Orange Hill.

c. Flagmen should be employed to control traffic and assist construction vehicles as they enter and exit the project site as well as the intersection.

6.61. In respect of emissions, the following mitigation measures are recommended:

a. Maintain vehicles to avoid excessive noise and emissions.
b. Wash vehicles to avoid excessive generation of fugitive dust from surfaces.
c. Establish stabilized construction exits (SCEs) to prevent tracking of dust onto public roadways.

6.62. The impact of increased construction traffic and associated indirect impacts described above are restricted to occurring during the construction period of the project. Emissions and delays are not environmentally persistent after the causative activity has ceased. The effects of wear and tear on the surface, as well as poor road safety can be more long term if mitigation measures are not implemented. Based on the fact there are appropriate and cost-effective mitigation measures that can be implemented to minimize these impacts, the residual effect after mitigation is determined to be medium-level.

Vending and Food Hygiene

6.63. The establishment of a construction campsite near Robins Bay and increased numbers of casual workers coming to the site to work is likely to result in a proliferation of "cook shops" (food vendors) to provide the construction workers with meals.

6.64. Improper food preparation and the failure to practice proper hygiene can result in certain pathogens entering the food supply and cause food borne illness. Food-borne illness often presents itself as flu likes symptoms such as nausea, vomiting, diarrhoea or fever. This is particularly of concern due to the proximity of the site to the municipal landfill, where there might be rodents and roaches.

6.65. With proper mitigation, the impact of poor street food hygiene can be minimized, while optimizing the benefits of having food available to workers (and minimizing travel time to seek food) and possibly allowing vendors to have the economic opportunity to supply the food. There is therefore generally a high level of acceptability of the risk, and a general "willingness-to-trade" the impact of hygiene risk for the convenience of the food supply.

6.66. The main way to mitigate this impact is to ensure that the contractors, particularly during the infrastructure development phase ensure that the food vending proceeds in an orderly manner, and that all vendors have the necessary food handlers permits, and pay attention to sanitary waste disposal.

6.67. Given that this benefits of having food available to workers outweigh the possible risk of poor hygiene, and the range of appropriate mitigation measures that can be cost-effectively implemented, as well as the fact low potential for environmental persistence or residual impact, this impact is classified as minor.

Slope instability

6.68. Slope instability can occur if steep and unstable rocks are cut into for the purpose of laying roads or foundations. This can result in landslides or rock falls which can cause:

a. Potential damage and blockage to sub-division roadways.
b. Potential damage to above ground utility poles.
c. Clogging of culverts and drainage channels with landslide debris, and potential for flooding.
d. Potential for accidents if falling rocks disorient drivers.
e. Potential damage to vehicles if a landslide or rock fall occurs while cars are passing.

6.69. Nearly 50% of the proposed roads will be intentionally utilize the alignments of existing farm/property road that have been used for hundreds of years. In general these run parallel to contours or along ridges. This approach has been maintained in the placement of new alignments. This was very intentional, and will serve to minimize disturbing new areas in terms of slopes (cut and fill, and general stability) as well as vegetation.

	Roads using old Alignments				Completely New Roads	
Proposed Road	**Length in m**	**Existing length in m**	**Existing %**		**Proposed Road**	**Length in m**
John-to-Whit Avenue	930	791	85%		Jetty Road	120
Sandpiper Drive	693	658	95%		Grassquit Terrace	254
Hummingbird Drive	584	409	70%		Becard Terrace	576
Mockingbird Close	393	236	60%		Becard Close	76
Hummingbird Close	442	177	40%		Parula Close	191
	3042	2270	75%		Flycatcher Close	134
					King Bird Close	141
					Patoo Close	83
						1575

Table 22 Comparison of Proposed Roads and Existing Roads

6.70. Because the vast majority of the propose roads are on slopes that are classified flat to moderately sloping, very little cutting and filling is needed to keep the road roughness within the standard set the NWA. All cut and fill are considerably less than 1 m except at 3 locations. On Sandpiper Drive and Mockingbird Close, a 2 m fill is proposed to level out a culvert across a drainage channel. On Hummingbird Close 2 m cut is proposed. The rocks in are partially recrystallized marly rubbly limestones and will not require any support.

6.71. Near the intersection between Hummingbird drive and Mockingbird Close special attention must be given to ensure free drainage of the lands above the intersection east of Hummingbird drive. In that area the channel of the Hummingbird/Sandpiper Gully disappears and there is no clear connection between the sections of the gully further down. A culvert has been proposed and the construction must be monitored to ensure that this is not omitted.

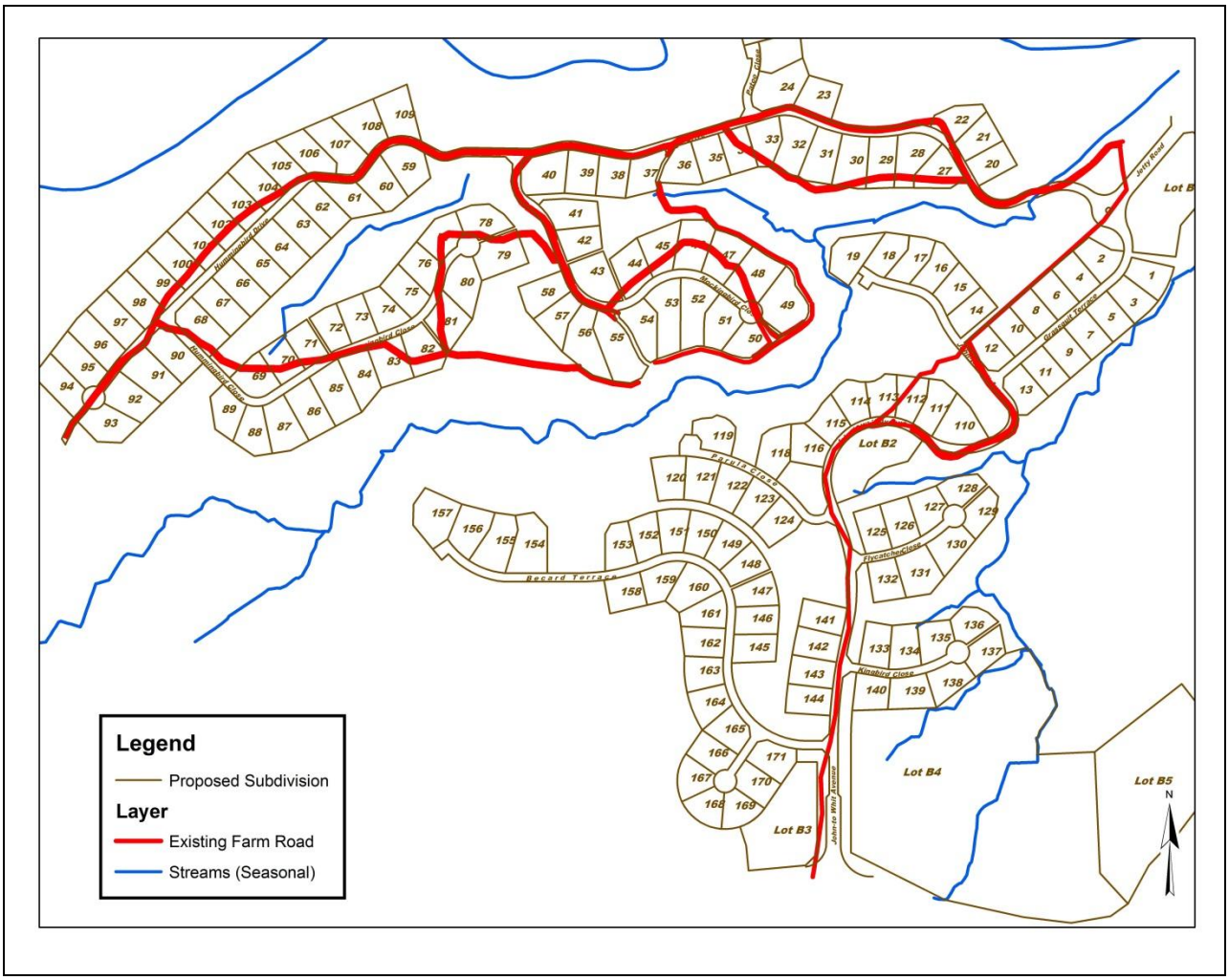

Figure 38 Alignment of Sub-Division Roads with Existing Farm Roads

6.72. In the design of this subdivision special consideration was given to locate residential lots on the flat sections of the property and to ensure that each lot has sufficient flat or reasonable sloping land to be able to build safely on every lot without needing extensive geotechnical studies and /or special building solutions. No major grading is expected to be required on any of the lots.

6.73. Some parts of lots closest to gully can be steep. Construction on these steeper sections is discouraged although it may be attractive to build there because of the view. A good example of that are lot 97 to 109 on the western side the Hummingbird Drive where about half of the lot is flat and the western side of the lot is moderately sloping.

6.74. Lithology in the subdivision is dominated by marly limestone deposits which can be classified to be loose to medium dense rock. Localized the marly limestone maybe recrystallized near the surface as this seems to be consistently the case for the lots on Terrace Level 2 between 35 m and 50 m amsl. Although these rocks tend to re-cement themselves through re-crystallization, on steeper slopes the stability of these deposits with additional load need to be verified.

6.75. In the gully between Hummingbird Close and drive there is a scarp slope behind lots 64 to 62 on the Northern side of the gully and behind lot 72 to 74. The scarp slope does not appear to be active feature and may be caused by headward erosion. It is recommended that the stability of the scarp slope is assessed before any construction under taken near the edge of these lots.

6.76. Based on the preliminary geological investigations, the impact of the proposed roads and lot development is expected to be very minor.

Accidental Damage to Buried Artifacts

6.77. Based on the fact that this area has been historically cultivated and no artefacts have ever been found, it is very unlikely that there are important archaeological resources at this sub-division site. However, in the event that artefacts are unearthed during any excavations, it is recommended that work is temporarily halted, and the JNHT be notified for them to arrange inspection and procurement of the find as necessary. The based on the low level for potential discovery, this impact is classified as minor.

Carbon Footprint (Construction)

6.78. During the pre-sale sub-division development phase the carbon footprint of the project is expected to be relatively low. The main contributors will be:

a. Consumption of cement (concrete) and steel, both of which require high inputs of fossil fuels during manufacture. These inputs are mainly required for the drainage infrastructure and the pavement of the driving surface.
b. Direct consumption of fossil fuels (transportation of construction materials and fuels for equipment on site). This would mainly include heavy earth

moving equipment (like excavator etc) as well as the transportation of construction materials like aggregate.

6.79. During the construction phase, this impact would include the same contributors, but is likely to require considerably more cement based products. It is also likely that the transportation costs associated with house construction inputs would be higher as many fixtures are not manufactured in Jamaica.

6.80. The environmental effects of a high carbon footprint include cumulative contributions to climate change (through CO_2 emissions), which have indirect impacts on sea level rise, global warming and the frequency of high magnitude storms.

6.81. The overall carbon footprint of the project can be further off-set by the following measures:

a. Ensure maximum operation efficiency in all equipment being used at the site during construction. This would involve routine maintenance.
b. Minimize wastage of concrete or cement products.
c. Design site buildings to maximize the use of natural light, and install energy efficient lights (florescent and LEDs as opposed to incandescent).
d. Restore vegetation cover and plant trees as far as reasonably practicable.
e. Install energy efficient office appliances such as inverter air conditioners.
f. In sourcing subsidiary inputs, select suppliers that are located closer to the source. Transportation increases the carbon footprint through consumption of fossil fuels.

6.82. At this time there is too much uncertainty about the quantities of subsidiary inputs and sources (transportation distance) to quantify or estimate the carbon footprint of the installation. Based on the high level of uncertainty, this impact is classified as a medium-scale (cumulative) impact.

Operational Phase

6.83. The operational phase of this development proposal is assessed herein as the when lots have been sold and homes built, and possibly occupied. Assuming 3 bedrooms per lot, it can very conservatively be estimated that there would be 1026 residents in 171 households on the property at full build-out. This does not include day workers or persons employed on the commercial areas. It also very conservatively assumes that all households will comprise persons living full time at the sub-division, when it is expected that most purchases will be as vacation homes or for villa rentals.

6.84. Occupancy is expected to generally follow lot development and sales phasing, with full occupancy not occurring until all lot sales and construction projects are completed. It is not possible to determine with any certainty how long it will be before all lots are sold. Assuming that all lot purchasers build on their lots within 8 years of purchasing the lot, the development could potential reach full build out in 10 years.

Change in Land Use

6.85. Vegetation clearance was discussed above, and it was noted that approximately 15 ha will likely be permanently converted to built space (roads, houses, parking lots etc) within the total sub-division area of 77.5 ha. This represents a persistent change in land use from vegetation cover (remnants of cultivated crops and opportunistic species) to residential land use.

6.86. The loss of habitat and green space has been addressed in paragraphs 6.30 to 6.38 above. The main effects of increased built up area are possible changes to micro-climates, visual aesthetic and hydrological effects. The latter (hydrological changes) are respectively addressed in paragraphs 6.82 and 6.131 below. The loss of agricultural land is not considered a real impact as it has not been economically feasible to cultivate these lands in recent times.

6.87. This section primarily deals with possible changes to micro-climates arising from the change in land use.

6.88. Changes in micro-climates arise from:

a. The trapping of heat by paved surfaces, buildings and fugitive dust (heat island effect).
b. Increased humidity arising from increased water availability at the site, which can enter the atmosphere from clothes drying, evaporation from pools etc.
c. The presence of large physical obstacles (such as buildings) which can block light (create shaded areas) and low level winds.

6.89. The expected level of change in micro-climate arising from this kind of low density development with a slant towards green design is not expected to create a level of micro-climate change that would be detrimental to the health or well-being of humans or eco-systems in the area. Much of the effect is likely to be felt at a very localized level, e.g. the side of a housing unit. The main secondary or indirect effect is the possible increase in energy consumption (which affects the overall carbon footprint) for cooling.

6.90. This impact (and the associated indirect effect) can be effectively mitigated by the following measures:

a. In the Lot Purchasers' Agreements, restricting the built footprint on any given lot to maintain built density ratios.
b. Planting of vegetation (gardens) around dwelling units.
c. Preservation of large trees to the extent reasonably practicable.
d. Designing buildings to be naturally cool:
    - Encourage natural ventilation with windows oriented to permit a good cross breeze with the prevailing winds.
    - Prevent direct heating of walls by the sun (particularly the afternoon sun); this can be achieved by using verandas.
    - Avoid the use of slab roofs and extensive use of concrete (e.g. large paved driveways; concrete decks or patios; concrete outdoor structures like gazebos).

6.91. At a very localized level there is likely to be discernable changes to the baseline micro-climatic conditions, which could potentially be within the range of change that could occur if the land remained under natural vegetation cover. The expected residual impact is therefore classified as a minor level impact.

Visual Aesthetic

6.92. The introduction of 171 homes plus an unknown quantity of support buildings (in the site office and farm stores), along with the wide paved roads and drainage infrastructure will likely change the visual appearance of the area from rural to basically a more urban "built-up" environment.

6.93. From a viewscape perspective, the residential units will mainly be visible from the lower elevations (east side, which includes the main road and the coastal lands of Green Castle Estate and the sea) and possibly from the higher elevations to the west (part of the wider Green Castle Estate). The ridge forming the northern boundary will effectively serve to block views of the development (and vice versa) from the community of Robins Bay. The ridge to the south (including the Davey Hills) will block views of the development from the south.

6.94. Even when within a direct line of sight, the following factors are expected to mitigate the level of visual intrusion:

a. The use of colours and construction materials will also be restricted by the LPA, with a preference for natural or earth tones and materials.
b. The housing density (a function of lot size) is too low to create a sense of being crowded.
c. A significant portion of the lands within the sub-division parcel will remain under the natural vegetation (49%), and the wider environmental setting of the estate is heavily vegetated.
d. Under the LPA, lot owners will be required to maintain large trees to the extent practicable. The development of gardens and small scale landscaping on lots will also be encouraged.
e. Fences and boundary walls will be discouraged.
f. Unused or unsold lots will be kept under the existing vegetative cover.
g. Public areas will be maintained so as not to have an appearance of being unmanaged (including drains, road verges, community lots).

6.95. In general, buildings will be "hidden" from sight, or will blend in to the extent possible. The main visual intrusion is expected to the roads and associated rights of way. Wider arterial roads will be tree-lined, with earthen median strips near the entry ways.

6.96. Consequently, the level of visual intrusion will be minimized to the extent possible. Due to the fact that there are very few receptors in this area, the extent of mitigation possible, and the fact the few receptors may not find the change in visual aesthetic objectionable, this impact is classified as minor.

Change in Air Quality

6.97. During the operational phase it is expected that there would be more cars at the sub-division site, including vehicles owned by residents and commuters (visitors, day workers etc). A maximum of 200 cars may be expected (1 car per lot, plus a factor to account for visitors and workers) at any given time under normal circumstances. If there is a wedding, party or other similar function, there may be an additional number of cars depending on the size of the function.

6.98. Secondary effects of vehicular emissions on the property include:

a. Very tiny contributions to global warming (CO_2, methane, and NOx emissions). According to the USEPA[16], 1 US gallon of gasoline produces ~9 kg of CO_2 (compared to 10 kg CO_2 per gallon of diesel). The fuel economy of engines that burn diesel is off-set by this slightly higher CO_2 emission. The USEPA has determined that the average passenger vehicle emits ~423 grams of CO_2 per mile (or 264 g per km). Given the scale of the property, no vehicle can travel more than 2 km within its bounds from any given point to another point.
b. There could also be hydro fluorocarbon (HFC) emissions associated with leaking air conditioners, which is a green house gas (GHG). Although likely to be present in a very small quantity, the global warming potential (GWP) of this gas is 1,430 times that of CO_2.
c. Nitrous oxide (N_2O) has almost 300 times the GWP of CO_2.
d. Methane (CH_4) has 25 times the GWP of CO_2.
e. Heat island effect (from particulates).
f. Black build-ups on vegetation (particularly those adjacent to major high-use arterial roadways.
g. Minor contributions to atmospheric acidity (acid rain) from SO_2 emissions.
h. Fugitive dust from vehicles can also build-up on vegetation and decrease visibility in the atmosphere.

[16] http://www.epa.gov/oms/climate/documents/420f11041.pdf

6.99. The USEPA has not issued estimates of the likely emissions of HFC, N_2O or CH_4 per mile as these are dependent on many factors including the age and condition of the car as well as maintenance and the amount of use. In general CO_2 accounts for an estimated 95% to 99% of the total greenhouse emissions.

6.100. Assuming two trips of 2 km each way per car and 200 cars on property, the maximum daily emission scenario for carbon emissions at the sub-division can be of the order of 105 kg, which would be relatively small when compared to emissions that might be associated with Robins Bay, which has ~400 household.

6.101. Although there are presently very few sources of GHG emissions on property, the very small contribution that is expected is not expected to be measureable against baseline levels. It is also expected to be cumulative with contributions from Robins Bay, and other regional sources (e.g. the North Coast Highway). This impact is classified as minor.

Increased in Ambient Noise

6.102. Present ambient noise levels in this area are expected to be below 30 dBA due to the general absence of noise generating sources (see paragraph 4.7), and relative low level of use of the roadways that run in proximity to the property.

6.103. Residential noise generators include the following sources: lawn mowers, vehicle engines, generators (back-up), air conditioners, entertainment (televisions, radios etc) and general conversational noise. Much will depend on the nature of the residents themselves. Generally, this kind of development is expected to attract persons seeking solitude who value “peace and quiet” and are seeking to get away from urban noise levels. Therefore, it is not likely it would be a noisy crowd.

6.104. It is difficult to predict how the ambient noise level will change with any certainty. However, it will be, at times (either day or night), above ambient levels at very localized places on property. Residential peak noise levels are not expected to increase ambient levels beyond the boundaries of the property.

6.105. Day time noise levels shall be mitigated by:

a. Restricting the use of lawn mowers should be restricted to week-days, during the hours of 9 am and 4 pm.
b. Requiring that back-up generators be properly housed and noise muffled.

c. Restricting land use very strictly to residential use only (i.e. no machine shops, schools etc).
d. Topographic highs and vegetation cover.
e. The low-density of the development, with only two to three houses per acre on average, and the distance from nearby settlements.
f. Encouraging the use of shuttle service to large private functions, with a large parking area designated on the outskirts of the development (possibly near the site office lot).
g. Encouraging and facilitating large private functions to be held at the Estate Country Club.

6.106. Additionally, night time noise levels can be further mitigated by:

a. Prohibiting commercial parties ("sessions") from being held on property.
b. Ensuring that the residents are aware and observe the stipulations of the Noise Abatement Act (paragraph 3.17).
c. Night-time off-shore breezes.

6.107. As this impact can be mitigated, and will not be persistently above ambient levels, it is classified as minor.

Night-time lighting

6.108. The project is expected to increase night time light pollution above present ambient levels. Sources of light will include outdoor security lights, street lights, vehicular lights, and in-door lights (on average up to about 11 pm). The development is situated more than 100 m from the shoreline (at Robins Bay) and is not expected to have any direct impacts on the light levels at the beach itself (which may impact turtle hatchlings). Most of the light will be generated between 100 and 1200 m from the shore and will be occluded by vegetation and terrain.

6.109. Secondary effects are likely to be very localized, including attracting insects to the lights, which may attract predators such as lizards. It is noteworthy that mosquitoes, which could represent a health hazard, are also attracted to bright lights. Localized light can also make some prey more visible to nocturnal predators like owls. These secondary impacts are not expected to disrupt the eco-system or impact sensitive populations adversely.

6.110. Another secondary effect is the consumption of power (electricity) and the contribution to the overall carbon footprint of the development.

6.111. This impact can be mitigated by the following measures:

a. Use fluorescent or LED lights to the extent practicable (added benefit of reducing power consumption).
b. Use motion activated bulbs for security.
c. Use light sensitive or programmable lights that will shut off automatically when there is enough ambient light.
d. Angle lights downwards or use lamp shades to control emissions above the bulb.

6.112. This impact is classified as a minor level impact.

Possible Degradation of Nature Preserves

6.113. There will be a number of relatively pristine wooded areas (mainly along gully courses) that will be maintained as nature preserves. These areas are expected to serve as places of refuge for wild life that is disturbed by the development footprint. These nature preserves can potentially be impacted by a number of activities related to the development. Noise and light are discussed above.

6.114. Other possible impacts are related to residents using these areas recreationally, or through the introduction of pet species (birds, cats, dogs), which can be potentially deleterious to these areas. Recreational uses include hiking/birding, picnicking, and collection of wild plants. Walking traffic through these areas can result in trampling of vegetation, degradation of forest structure, disturbance of nesting/roosting, accidental fires. Pets that are allowed out of their residential lots can kill birds and other fauna, take eggs, destroy nests etc.

6.115. The following mitigation measures are recommended:

a. Designate and mark nature trails.
b. Place signs asking users not to deviate from the trail or collect vegetation.
c. Place signs restricting walking dogs or smoking on nature trails.
d. Prohibit racing (running or biking) or playing of music along nature trails.
e. Under no circumstances should bird shooting be allowed.

f. Encourage owners with pets to neuter pets to prevent the growth of a wild feral population.
g. Designate a controlled picnic area where the risk of fire is low.
h. Ensure that residents are aware of the presence of a near-threatened species of bird (White Crowned Pigeon, Bald Pate), which is endemic to this region.

6.116. The residual impact of this (after mitigation) is classified as minor.

Introduction of Invasive Pest Species

6.117. Development of an area can often bring with it an invasion of pest species that may also be disease vectors. These are attracted to solid waste or standing water bodies (like ponds and pools). Disease vectors include: rodents (rats and mice), insects (cockroaches and mosquitoes). Other pests that could be attracted to home (particularly openings in roof tops as roosts) include bats (none found in this area), owls and pigeons (noted in field survey).

6.118. The environmental effects of pests include

a. Illness or mortality in human populations.
b. Decline in visual aesthetics.
c. Demands on public health inspectors and health care providers.

6.119. Mitigation measures include:

a. Ensure that there are strict rules for putting out trash: it must be bagged and placed in a receptacle that can be covered, which does not hold water and is not easily accessible to cats or dogs.
b. Ensure that there is routine collection of garbage from residential lots.
c. Standing water bodies should have fish (such as guppies) in it to control mosquito larva populations.
d. Roof openings must be grated to prevent infestation by pests.

6.120. The causes of this impact can be easily and cost effectively mitigated, so that the residual impact is expected to be minor.

Increased Demand for Waste Disposal

6.121. The proposed development will likely produce 220 metric tonnes of solid waste (domestic) per year. This will have to be collected (which adds to the traffic impact) and disposed of at an approved dump site. It is likely that solid waste from this site may have to be taken as far as the Doctors Wood Disposal site at Buff Bay in Portland until a dump site is developed in St Mary.

6.122. The environmental effects of solid waste production at the site include consumption of scarce land fill space, traffic impacts, contribution to off-site cumulative environmental effects at landfill (pests, vectors, leachate, odors, air quality, visual intrusion, methane production etc). The Portland disposal site is particularly sensitive as it is located near to a coastal wetland[17].

6.123. This impact and related secondary impacts can be mitigated by encouraging domestic waste reduction, which would include strategies such buying in bulk to minimize retail packaging, and recycling or repurposing.

6.124. Due to the strain this is likely to put on municipal resources, this impact is classified as medium scale effect.

Demand for Municipal Services

6.125. Residential developments require the support of municipal services such as health care, education, emergency services (police and fire), solid waste collection (addressed above), and even burial capacity. At full-build out, assuming a population of ~1026 persons, the development will represent just under 1% of the total population of St Mary (see paragraph 4.74), and be a 60% increase to total population within the Robins Bay EDs.

6.126. Based on existing levels of supply and planned improvements, it is not expected that the development will place undue strain on either water or power supplies.

6.127. Demands on education facilities are expected to be very low because of the nature of the expected demographic of lot purchasers: vacation home owners and investors in rental villas. Very few actual permanent residents with school age

[17] http://pioj.gov.jm/Portals/0/Sustainable_Development/Management_of_Wastes.pdf

children are expected to occupy the units. The Green Castle Estate will continue to support the basic school located on its property in Robins Bay.

6.128. Demands on emergency services are expected to be relatively low based on in-house provisions of fire-water and security services.

6.129. Medical services may be required from time to time. The residents will likely rely on private medical facilities rather public facilities for all medical services except in the case of emergencies that require them to be taken to the nearest hospital equipped to deal with their matter. An emergency response plan will include and evacuation plan and a list of private medical practitioners in proximity to the development. This impact is classified as minor.

Traffic Impact

6.130. This discussion pertains to the effect of vehicles entering and exiting the property (which cause traffic delays at the intersections). Emissions are addressed above, and no significant wear and tear are expected to arise from the average class of vehicle that would be used during the operational phase.

6.131. Measured baseline levels of traffic passing the Orange Hill intersection is 250 vehicles per hour. The hourly increase in traffic flow of generated by the subdivision is difficult to predict. The market that is targeted is the upmarket tourist market and most of the traffic generated is therefore expected to be concentrate around the typical holiday season and should not significantly affect the normal working day peak hours. In the event that people live there, peak flows would also be expected if there are functions or parties. With occupancy rate of 50% at full development we estimate that could generate an additional traffic of 15 vehicles per hour at the Orange Hill intersection during peak season or AADT increase of 55.

6.132. Due to the relatively low flows along the Robins Bay main road, no mitigation measures are proposed for this area, particularly as residents are expected to turn eastwards towards Newry using the estate road to exit via the Orange Hill intersection when leaving Green Castle Estate.

6.133. The project engineers and project managers continue to have dialogue with the NWA to ensure that the best practices are implemented to minimize traffic impacts.

6.134. Based on the expected level of change to the baseline levels, and the ease of mitigation, this impact is classified as a minor level residual impact.

Decline in Water Quality in Receiving Water Bodies

6.135. The development is drained by three ephemeral gully systems that empty into Robins Bay (see paragraph 4.19 and Figure 19). The most important system is the relatively small central basin (Parula Gully catchment), 80% of which is contained within the development footprint (Table 23). Less than a third of the southern (John to Whit) system is within the development footprint. A relatively small proportion of the northern system (Robins Bay Gully) overlaps with the project footprint.

Basin	**Total Basin Area (ha)**	**% catchment within the development**	**No. Lots**	**Lots within the catchment**
Robins Bay Gully (northern)	115.4	11%	27 lots	22, 23 to 26, 28 to 33, 94 to 109,
Parula Gully (central)	57.8	80%	80 lots	14 to 21, 27, 34 to 93, 149 to 159
John To Whit (southern)	41.2	27%	54 lots	1 to 13, 110-112, 117, 124, 125 to 148, 160 to 171

Table 23 Division of Lots across Drainage Basins

6.136. The sub-division footprint is greatest in the central basin, with 80% of the catchment being contained within the development footprint, and 80 of the 171 (48%) lots located within its boundaries. The relative importance of the development as a source of pollution is also comparatively lower in the southern basin with less than a third of the basin being within the footprint (and less than a third of the total number of lots). The potential relative contribution of the development to pollution in the northern basin compared to other sources elsewhere in the catchment is the lowest of the three, with 11% of the total

catchment area lying within the footprint of the development, accounting for only 27 lots (16% of all lots).

6.137. Residential development can influence water quality in a number of ways, including:

6.138. Bacterial loading (Enterococcus and Fecal Coliforms, mainly E Coli). This would be associated with sewage effluent percolating into the groundwater. The effect of this would be off-set by the distance from the water table. In addition, high levels of faecal coliform were measured (Table 12) in this area, and are attributed to animal grazing, which would be largely removed from within the project footprint.

6.139. Nutrient loading (nitrates and phosphates) and pesticides. This would be impacted by sewage effluent, as well as potential landscaping activities. The developers do not plan to use plants that require fertilizers in any public areas and will recommend the same to the lot owners. This parameter can impact the growth of algae, which in turn adversely impacts the health of coral reefs. Pesticides are toxic to most marine vegetation as well.

6.140. Sediment loading (total suspended solids). Poor management of soils and bank erosion can potentially increase the TSS level in the coastal waters. This can smother nearshore benthic communities.

6.141. Fats oil and grease (FOG). In a residential this can be impacted mainly by road surfaces, if there are leaks in transmission oils or fuels. There are no plans for a restaurant at the present time, but improper disposal of cooking oils can also increase the FOG levels. Similarly, there are no plans for any kind of machine shop or maintenance of equipment, but spills from domestic equipment like lawnmowers, or weed whackers can also contribute to the load of FOG. High levels of FOG can be toxic to fish and other forms of marine life.

6.142. Biological Oxygen Demand (BOD) concentration is an indication of how much decaying material/ pollution there is the water. It normally is higher if there is a lot of plant debris or sewage coming into the system.

6.143. Salinity can also be impacted if there are higher freshwater influxes coming into the bay. With a 20% increase in impermeable surfaces in the three catchments it can be expected that without mitigation there would be a higher level of freshwater influx. This can deleteriously impact marine communities.

6.144. Heavy metal loads in the coastal water can be impacted if there is improper disposal of solid waste containing heavy metals, like car batteries, cell phone batteries and refrigerants. This can result in fish kill incidents or poor health of marine ecosystems.

6.145. Floatables. This includes plastic (bags, bottles, Styrofoam), aluminum (cans) and vegetation debris. Floatable levels in coastal water increase with poor management and disposal of solid waste. It affects the visual aesthetic of the water, but can also cause injury and mortality to marine life if ingested.

6.146. A number of preventive and mitigation measures will be implemented by the development. These include:

6.147. Construction of the detention/settlement ponds to collect water from the central and southern basins. This will receive and settle out the first flush for the 25-year storm event, which normally contains most of the pollutants. This will very effectively settle out floatables and suspended solids, and will in most cases trap water containing high nutrient loads, which can then be removed by plants like vetiver (khus khus grass). This would also trap vegetative debris. The detention basin will also serve to reduce fresh water influxes to the sea.

6.148. Bacterial loading will be controlled by ensuring that the lot owners implement the most appropriate on lot sewage solutions for the sub-surface conditions (percolation and depth to groundwater) present on their lot. The engineering team will provide guidelines on the type of system to use given various percolation rates that are likely to occur on the property. At optimal rates, most bacteria will be expected to die before reaching the sea.

6.149. There is enough of a buffer between the coast and most lots for nutrient loads in the percolating effluent to be assimilated by vegetation. The maintenance of riparian vegetation as well as vegetation buffer near the coast would also serve to remove nutrients. Seagrass and coastal vegetation will further remove nutrients before they impact open marine systems. In addition, the use of fertilizers and pesticides will be discouraged by using adapted or indigenous species.

6.150. Sediment load will be effectively controlled by the presence of the detention ponds. In addition, it will be controlled on the property by reducing the potential for bank erosion as a result of high levels of storm water discharges. This will be effected by retention of as much storm water as possible on each individual lot,

through grassy verges and other strategies to promote on-lot infiltration. Maintenance of riparian vegetation will also serve to prevent bank erosion. Leaving gullies in a natural condition is expected to promote natural sediment deposition within the system before reaching the detention ponds.

6.151. FOG will also be trapped in the detention ponds, and will be broken down with exposure to sunlight.

6.152. Floatables and vegetation debris will be removed by the detention pond. Proper solid waste management and maintenance of storm water drains should be prevent build-up of this kind of debris, as well as heavy metal contaminants.

6.153. Efforts to keep storm water run-offs on lots will also serve to minimize the amount of contaminants that eventually make their way to the sea via the engineered stormwater drains, natural gully systems, engineered detention basin and overflow.

6.154. The residual impact on coastal quality after mitigation is expected to be very minor, and may even be positive.

Flood Risk Impact

6.155. Paragraph 4.41 indicates the finding of the geologist that flooding is not considered an issue at this site at elevations above 25 feet amsl. The lower elevations (i.e. below 25 feet amsl) are prone to flooding in some areas but are ameliorated by coastal wetlands, and direct discharges to the sea. It is noted that there was major flash flooding in St Mary in November 2012[18]. However, the hydrogeological conditions are very variable along the coast of St Mary, and this particular area is less prone to flash flooding because of the highly permeable and extensive nature of the underlying lithology (Coastal Group). The coastal area at Robins Bay may actually be more prone to coastal flooding as a result of storm surges, the risk of which would not be impacted by the development. The area has been impacted by storm surges historically.

6.156. There are no communities down-stream of the proposed development. The immediate receptors (shown in Figure 39) for storm flows from the property are:

[18] http://jamaica-gleaner.com/gleaner/20121118/lead/lead5.html

a. Existing culverts which are being replaced by NWA due to their present condition.
b. The coastal road which is still used to some extent by the public.
c. Coastal lands which are owned by Green Castle Estate. The actual beach is used as a fish landing site.

Figure 39 Main Stormwater Outfall at Robins Bay

6.157. It is expected that not more than 15 ha will be converted to impervious surface in the development, which would increase the stormwater run-offs. Appendix 3 is the Stormwater Management System Engineering Design Report (EDR) that was prepared by N.O. Whyte and Associates in March 2012. Storm water flows from the drainage areas for the pre- and post-development scenarios were computed using the Jamaica 2 Method and 24-hour rainfall data from the Annotto Bay Rain gauge for the central and southern basins (Table 24) for the 25-year storm event.

Drainage Area		Pre-Development	Post-Development
Parula Gully (central)	Area R	1.59 m3/s	1.96 m3/s
John To Whit (southern)	Area U	2.90 m3/s	5.33 m3/s

Table 24 Estimated Flows (m3/s) for the 25 year storm event

6.158. Storm water from lots falling with the northern basin (Area W) will be drained using on-lot soak away pits, and therefore the flows changes were not estimated for this basin (only 11% of which overlaps with the development).

6.159. The capacity of the existing culverts to handle the increased flows will not matter as the development will install two detention ponds to accommodate the excess flows that would be generated.

Drainage Area		Detention Pond Size
Parula Gully (central)	Area R	1,382 m3
John To Whit (southern)	Area U	9,361 m3

Table 25 Detention Basin Capacity

6.160. The engineered stormwater drainage system is further detailed in Appendix 3, and has been designed to accommodate estimated changes in peak run-offs. The proposed stormwater management system inclusive of the internal civil structures, on-lot soak-aways and detention ponds will prevent worst case (unmitigated) impacts of the development on the area. Consequently, there is no risk of flooding on the main road or damage to the existing infrastructure on the main road (Robins Bay coastal road) or beach front as a result of the project. Based on the low likelihood of impact to receptors as a result of the proposed detention basins in particular, the residual impact is classified as minor.

Conclusion

6.161. This assessment examined a number of environmental impacts that were identified during the course of site investigations and stakeholder consultations. Most of the impacts (21 of 24) were classified as having a minor residual impact. Three of the impacts were classified as having the potential to have a residual effect that was medium-scale: (1) adverse effects of construction traffic; (2) carbon footprint and (3) demand for solid waste disposal during the operational phase.

6.162. Of the 24 potential adverse impacts that were evaluated, there were no impacts that qualified to be classified as major, as defined in paragraph 6.8. This study therefore concludes a finding of no significant impacts and recommends that the project be granted an environmental permit subject to the conditions listed in the following section.

SECTION 7 ENVIRONMENTAL MANAGEMENT PLAN

The Environmental Management Plan (EMP) outlines the following:

- ***a) Environmental performance/quality objectives based on the specific impacts.***
- ***b) Summary of proposed mitigation measures, identifying the best timing for implementation, responsibilities and any required commitments of resources.***
- ***c) General guidelines to improve the project's overall environmental performance (e.g., in respect of waste management, water and energy conservation, soil conservation, community development, etc.) and to enhance any opportunities for environmental conservation.***
- ***d) General guidelines for dealing with the effects of climate change shall also be included, in connection to the following main areas: sea level rise, increased temperatures and humidity, increased occurrence of cyclones and increased potential for drought.***
- ***e) An evacuation plan shall also be included in the EIA.***
- ***f) Requirements for post-permit plans and approvals.***
- ***g) Outline monitoring programme should be included in the EIA, and a detailed version submitted to NEPA for approval after the granting of the permit and prior to the commencement of the development. At the minimum the monitoring programme and report should include:***
    - ***Introduction outlining the need for a monitoring programme and the relevant specific provisions of the permit and/or license(s) granted.***
    - ***The activity being monitored and the parameters chosen to effectively carry out the exercise.***
    - ***The methodology to be employed and the frequency of monitoring.***
    - ***The sites being monitored. These may in instances, be pre-determined by the local authority and should incorporate a control site where no impact from the development is expected.***
    - ***Frequency of reporting to NEPA***

Purpose

7.1. The purpose of this section is to outline the Environmental Management Plan (EMP) for the proposed development in all its phases. It presents the recommended mitigation measures in a more easily managed format than given in the previous section, and gives additional guidance on general environmental performance in accordance with the specific requirements of the TORs.

Environmental Performance

Quality Objectives

7.2. Based on the adverse environmental impacts that are likely to occur, the following environmental performance/quality objectives are recommended for this project:

a. To put measures in place to ensure that phased and on-going construction activities (associated with sub-division infrastructure as well as individual lot construction) are conducted in such a manner as to mitigate any reduction in the environmental quality (visual aesthetics, noise, air quality, surface water) arising from these activities.
b. To ensure that construction related traffic impacts on public roads and on the project's overall carbon footprint are properly planned for, and the implementation of mitigation measures are properly monitored.
c. To build awareness amongst contractors and lot purchasers that environmental sustainable landfill space in the parish is a scarce resource, and to emphasize the importance of responsible solid waste management in all phases of the project.
d. To ensure that all developments within the footprint of the sub-division are strictly controlled by sustainable land use planning principles that are consistent with a low impact residential community that has integrated nature preserves as its principal amenity.

Planning & Design Mitigation Measures

7.3. Explore the feasibility of setting up a Forest Reserve within the wider Green Castle Estate to off-set vegetation losses in the development site (~15 ha).

7.4. Off-set carbon footprint of the project (site office); these recommendations can also be made to the lot purchasers:

a. Ensure maximum operation efficiency in all equipment being used at the site during construction. This would involve routine maintenance.
b. Minimize wastage of concrete or cement products.
c. Design site buildings to maximize the use of natural light, and install energy efficient lights (florescent and LEDs as opposed to incandescent).
d. Restore vegetation cover and plant trees as far as reasonably practicable.
e. Install energy efficient office appliances such as inverter air conditioners.
f. In sourcing subsidiary inputs, select suppliers that are located closer to the source. Transportation increases the carbon footprint through consumption of fossil fuels.

7.5. Have dialogue with NWA to ensure that the best practices are being implemented to minimize traffic impacts.

7.6. Have dialogue with NWC to ensure that water can be provided in the quantities needed on a phased basis.

7.7. A geotechnical investigation should be conducted to inform the final road design. Particular attention should be paid to areas where the fill is expected to be more than 1 m. Upon field survey of the road alignments, it should be ascertained that lands adjacent to filled areas will drain freely, and the all required culverts are installed as planned.

Construction Phase Mitigation Measures

7.8. Implement the construction of the detention basins and stabilized construction exits prior to the commencement of construction works for sub-division infrastructure. Detention pond overflows must have grates to trap floatables. Plant verges with khus khus to assimilate nutrients.

7.9. Contractors should be required to implement the following mitigation measures to minimize environmental impacts during the construction of sub-division infrastructure.

7.10. Manage fugitive dust and air pollution by:

a. Wetting of bare areas and earth material stockpiles as appropriate and on schedule.
b. Paving site access roads as early as possible.
c. Re-planting grass as soon as possible.
d. Limit or phase site clearance to the areas within construction footprint.
e. Cover and secure stores of cement.
f. Prohibit burning of vegetation debris on site.
g. Use ready-mixed poured concrete as much as possible.
h. Use construction stabilized construction exits (SCEs) at the exits.

7.11. Manage nuisance noise by:

a. Limiting construction activities (including haulage) to normal working hours (7 am to 7 pm Mondays to Saturdays.
b. Maintaining equipment for optimum performance: e.g. keep power saw blades sharp.
c. Implementing operational controls: e.g. clamp material to be cut,
d. Using noise buffers: e.g. partial acoustic enclosures (mobile) and ensuring enclosure panels on compressors are closed.

7.12. Manage stockpiles & material stores:

a. Limit the height and slope of stockpiles.
b. Covered, bermed and locate stockpiles away from major storm water run-off pathways.
c. Fuels and lubricants should be stored and dispensed within covered, bermed hardstands located away from drainage areas. These areas should not contain storm drains or sumps. The bermed area should be able to contain at least 110% the volume of the stored material. In addition, oil-water separators can be used to prevent oil from entering river systems. Contractors should be required to have a procedure document on site to guide containment and clean-up of spills.

7.13. Implement controls on vehicle operation and maintenance to prevent pollution:

a. Limit load size to avoid spillages.
b. Haulage vehicles should have proper axel spreads for their loads (consistent with NWA standards).
c. Ensure that haulage trucks are covered and secured.
d. Ensure that all vehicles and equipment engines are properly maintained.
e. Wash vehicles to avoid excessive generation of fugitive dust from surfaces. Set up wheel wash and truck wash-down facilities. Run-off from wash down areas should be routed to a settling pond or tanks. Sludge contaminated with oil and grease should be collected by an approved contractor and disposed of at a landfill.
f. Limit drop heights from haulage vehicles.

7.14. Manage traffic issues (during infrastructure development phase):

a. Review bill of quantities and determine how much of the required fill, top-soil and other earth materials can be sourced on property or within the parish.
b. Dispose vegetation debris onsite.
c. Facilitate worker shuttles if possible.
d. Use traffic calming devices and install traffic warning signs along the main road near to the Orange Hill turn-off: construction site entrance ahead, reduce speed, slow moving vehicles.
e. If necessary, employ flagmen to assist with traffic control traffic and to assist construction vehicles as they enter and exit the project site as well as the intersection.

a. Clear vegetation at the intersection at the Green Castle Estate road intersection with Highway.

f. Schedule construction traffic and deliveries for off peak hours (10 am – 1pm and 6pm -7am). Transport heavy equipment to the site in the early morning.

7.15. Manage solid waste:

a. Designate waste collection/storage area with skips or large bins.
b. Employ a licensed waste haulage contractor to collect waste on a weekly basis from the sites.
c. Ensure that the Construction Phase Solid Waste Management Plan is developed and properly implemented, and that there are provisions for dumpsters and routine collection and transportation to the landfill.
d. Advise all workers that disposal of solid waste must be in provided receptacles. There should be no disposal of solid waste into gullies or open lots or areas around construction sites.

7.16. Provisions for construction workers:

a. Provide personal protection gear for workers operating equipment that generates noise. Workers operating equipment generating noise of ≥ 80 dBA (decibels) continuously for 8 hours or more should use ear muffs. Workers experiencing prolonged noise levels 70 - 80 dBA should wear earplugs.
b. Where unavoidable, construction workers working in dusty areas should be provided with N95 respirators.
c. Provide portable lavatories that are emptied routinely by an equipped and licensed contractor. One lavatory should be provided for every 25 workers.
d. Provide a shower and an area for changing.
e. Where possible, construction workers should be sourced from the surrounding communities.
f. Ensure that the food vending ("cook shops") proceeds in an orderly manner, and that all vendors have the necessary food handlers permits, and pay attention to sanitary waste disposal

7.17. Contractors should implement a standard procedure for the event that artefacts are unearthed during any excavations. Work is temporarily halted, and the JNHT should be notified for them to arrange inspection and procurement of the find as necessary.

7.18. A set of procedures for shutting down the laydown/site office and construction sites within the property in the event of emergency (e.g. hurricane or earthquake) should be developed to minimize any potential losses or environmental damage as a result of material or equipment being on site.

7.19. A set of procedures should be documented in respect of closure or decommissioning of the infrastructure development phase. This would include restoration of storage areas and plans for removal of equipment etc.

Guidelines for the Lot Purchasers' Agreements

7.20. The following recommendations/guidelines can be made in the Sub-Division Standards document, which would form a legally binding part of the Lot Purchasers Agreement (LPA). That document would outline various requirements, guidelines and recommendations.

7.21. Individual lots will need to get approval for building and on-lot sewage disposal solution from the local planning authority. However, the developer can make stipulations or recommendations on the design of dwelling units to ensure consistency and a visual/design aesthetic that is in keeping with the wider sustainable planning approach and integrated vision for the community.

7.22. This should include restrictions on:

a. The extent of the built footprint on any given lot to maintain built density ratios. Buildings should not exceed two storeys.
b. The kind of land use that is allowed, i.e. residential use only (i.e. no machine shops, nursery schools etc).
c. The use of colours and construction materials with a preference for natural or earth tones and materials.
d. Off-site stormwater outflows. To the extent reasonably practicable, storm water should be retained on site by maximizing infiltration. In addition, all buildings should be guttered, with rainwater routed to either a sub-surface storage tank, soakaway or the engineered sub-division drainage system.
e. Building on the steeper sections of any particular lot (e.g. lots 97 to 109) that is close to a valley.

7.23. It can also include "green design guidelines" such as:

a. Site buildings should be designed to maximize the use of natural light.
b. Design buildings to be naturally cool:
    – Encourage natural ventilation with windows oriented to permit a good cross breeze with the prevailing winds.
    – Prevent direct heating of walls by the sun (particularly the afternoon sun); this can be achieved by using verandas.
    – Avoid the use of slab roofs and extensive use of concrete (e.g. large paved driveway.
c. Selection of design and materials that minimize the use of concrete or cement products with a preference for natural materials like stone and wood. Discourage concrete decks or patios; concrete outdoor structures like gazebos).
d. Discourage fences and boundary walls between properties.
e. Grating of roof openings to discourage occupation by birds or bats.
f. Encourage rainwater harvesting systems to be installed.
g. Utilize photo-voltaic cells if possible.
h. Select material suppliers that are located closer to source.
i. The use of plumbing fixtures that allow conservation of water as necessary, e.g. low flow faucets.

7.24. In addition, clear guidelines should be given in respect of:

a. The types of foundations that would be acceptable given geotechnical conditions that are likely to occur across the site.
b. The type of sewage disposal system to be used given various percolation rates that are likely to occur on the property.
c. Methods to retain storm water on each individual lot, through grassy verges and other strategies to promote on-lot infiltration. Encourage interior design plans that utilize energy efficient appliances such as inverter air conditioners, solar water heaters.
d. Compliance with building codes for hurricane and earthquakes in Jamaica.
e. The need to verify the stability of sections of lots on steep slopes before construction is undertaken on the lots. In the gully between Hummingbird Close and Hummingbird Drive there is a scarp slope behind lots 64 to 62 on the northern side of the gully and behind lot 72 to 74. It is recommended

that the stability of the scarp slope is assessed before any construction under taken near the edge of these lots.

7.25. In respect of construction, the LPA should make recommendations in respect of

a. Construction screening around lots that are under construction if they are located in areas where there are occupied dwellings.
b. Prevention of site run-offs during construction. Delivery and storage should not be on the road in front of the lot, or within 6 m of a drain or water way unless bunded.
c. Control of soil erosion on each lot site during construction. This can be done by limiting clearance and grading to the building and staging area footprint (inclusive of space requirements for storage of construction materials).
d. Provision of workers with a temporary pit latrine (soak-away) and shower on site. The latrines should be located away from major water courses, and should be properly screened with zinc or plywood. The pit should be covered with a toilet, inclusive of a seat and cover. The toilet should be sanitized daily. A hand washing basin should be provided immediately outside the facility. When abandoned, the pit should be filled with marl and compacted over. Approximately 30 cm of marl should be mounded over the top of the pit after compaction.
e. Minimization site clearance and preserve large trees to the extent reasonably practicable.

7.26. In respect of possible controls during the post-construction phase (occupancy), the LPA can encourage:

a. Planting of vegetation (gardens) around dwelling units.
b. The use of lawn mowers to week-days, during the hours of 9 am and 4 pm.
c. Properly housed and noise muffling to be installed on all back-up generators.
d. The use of fluorescent or LED lights to the extent practicable.
e. The use of motion activated bulbs for security.
f. The use of light sensitive or programmable lights that will shut off automatically when there is enough ambient light.
g. The angling of external lights downwards or use lamp shades.

h. Populating of garden ponds with fish as means of controlling mosquito larvae.

7.27. Ownership of the green space within the boundaries of the sub-division will be deeded and granted (at no cost) to the Homeowners Association, which is a collective of all lot owners. Maintenance of all public areas, including roads, verges, community lots and drainage infrastructure will be the responsibility of the Homeowners Association once it becomes an operational entity. All lot owners will automatically become members of this association upon signing the LPA.

7.28. It is recommended that the Homeowners Association also:

a. Ensure that there is routine collection of garbage from residential lots.
b. Designate and mark nature trails.
c. Place signs asking users not to deviate from the nature trail or collect vegetation.
d. Place signs restricting walking dogs or smoking on nature trails.
e. Designate a controlled picnic area where the risk of fire is low.
f. Ensure that bank and gully vegetation is not disturbed.
g. Retain a list of private medical practitioners in the area.
h. Prohibit commercial parties ("sessions") from being held on property.
i. Prohibit racing (running or biking) or playing of music along nature trails.
j. Prohibit bird shooting.
k. Encourage the use of shuttle service to large private functions, with a large parking area designated on the outskirts of the development.
l. Encourage and facilitate large private functions to be held at the Estate Country Club.
m. Be responsible for implementation of the Evacuation Plan (which was required in the TORs by NEPA).

7.29. It is recommended that the Homeowners Association make available posters or information (through the Sales Office) to increase environmental awareness concerning:

a. The presence of a near-threatened species of bird (White Crowned Pigeon, Bald Pate), which is endemic to this region.

b. Protected wildlife species[19], whether or not they are found at Green Castle Estate.
c. Strict rules for putting out trash: it must be bagged and placed in a receptacle that can be covered, which does not hold water and is not easily accessible to cats or dogs.
d. The stipulations of the Noise Abatement Act (paragraph 3.17).
e. Pet neutering.
f. Domestic waste reduction.
g. The need for water conservation during periods of drought. This can include strategies such as no washing of vehicles or the use of sprinklers during droughts.
h. Closed season for lobster.
i. Permit requirements for recreational fishing.

Community Development

7.30. The owners of Green Castle Estate have always maintained good relationships with the community of Robins Bay. It is recommended that the members of the new Green Castle sub-division community be encouraged to support the community as the owners of Green Castle Estate have done in the past. This can be done by:

a. Employing workers (during both construction and operational phases) from the community.
b. Patronizing local businesses (e.g. restaurants, fishermen, farm shops and markets).
c. Becoming involved in local organizations such as churches, civic clubs, sporting clubs etc.
d. Maintaining a dialogue in times of disasters.

[19] http://www.nepa.gov.jm/publications/brochures/flyers/protected%20Jamaican%20animals.pdf

Climate Change Adaptation

7.31. It is recognized that climate change is occurring globally. In Jamaica, the effects of climate change include increasing rising sea-levels (and associated coastal erosion), higher temperatures, drier conditions (and increased risk of bush fires) and possibly the incidence of higher magnitude "super storm" events. When these are coupled with general environmental change (such as increased built surfaces, coastal and hillside development, loss of green space or modification of natural drainage systems), there could implications for the vulnerability of a particular site and eco-system services to these climate change effects.

7.32. Sea-levels are expected to rise possible 88 cm (~3 feet) by 2100[20]. No development is proposed for the coastal area, but it is likely that the main road (see Figure 39) and entry point could be impacted. This projected sea level rise must be taken into account in the final design and siting of the detention ponds. At some point in the future, depending on the rate of sea level rise, it may become necessary to install sea defense structures to protect the road. It would also become necessary at a municipal level to decommission the dumpsite now being used in Portland, which is a very low-lying site, and develop an environmental sustainable landfill site within the parish of St Mary.

7.33. Temperatures are projected to rise between 1.4°C and 8°C globally during this same period, with an area-averaged annual mean warming of the Caribbean Sea by ~2°C. This could see summer peaks in Jamaica of close to 40 °C. This could potentially have implications for consumption of energy for cooling in particular (air conditioning). Designing buildings to not trap heat and optimize natural ventilation is important. Smaller rooms and lower ceilings would also allow for greater efficiency in air-conditioning. Placement of bedrooms on the east side of buildings for example can allow them to be cooler in the evenings.

7.34. Drier conditions would arise from fewer rain days, with a projected increase in the intensity of storms. This would likely mean greater risk of drought, bush fires and flash flooding. It would be important to maintain clear drains, and to ensure that the detention ponds operate at design capacity (i.e. do not become silted up or

[20] http://www.nepa.gov.jm/neec/front_page/CCF/presentations/Dr.%20Dale%20Webber%20-%20Climate%20Change%20Impacts%20on%20Jamaica's%20Biodiversity.pdf

have choke points). It would also be necessary to take precautions during time of drought against bush fires impacting homes.

7.35. A range of other more general mitigation measures are presented in UNECLAC (2011), amongst these are strategies for reducing GHG emissions and energy conservation.

Evacuation Plan

7.36. NEPA, in the TORs has stipulated that an evacuation plan be included in the EIA. The site is also not flood prone (either from interior flooding or storm surge), so there would be no need for evacuation as a result of flooding.

7.37. Homes will be built to earthquake and hurricane standards, so it would be generally unlikely that there would be need to evacuate the community during or after these events, which would place undue strain on municipal resources. However, in the event of a major hurricane event directly making landfall in this area (also very unlikely) or a devastating earthquake, it may become necessary to evacuate the sub-division. This might also arise in the event of a very large scale bush fire.

7.38. In the case of a hurricane there would be a 24-hour warning issued by the National Meteorological Service. In the event that a direct hit is predicted in eastern parishes, it may become necessary to evacuate the area. In the case of an earthquake, it may be necessary to evacuate after a devastating event.

7.39. The following is recommended:

a. Ensure that there is at least 5 gallons of gas on hand that can be used to fill cars in case gas stations are closed. There should also be an emergency kit containing medications that are routinely taken, flash-light, blankets, and canned food.

b. All electrical appliances and equipment should be disconnected from the mains. Doors and windows should be secured.

c. Follow the recommended evacuation route. It is suggested that this route be out the main entrance of the sub-division, following the coast road to Newry, then the estate road to Orange Hill, turning west towards Port Maria on the North Coast Highway. Flooding and more severe weather

could be impacted roads to the east. Under no circumstances should the Junction Road to Kingston (via Annotto Bay and Agualta Vale) be used.

d. If the owner does not have a car, they should have a plan for how they will get out of the parish. Neighbours should have a plan to help each, and should be aware of any shut-ins on their street that may need assistance.

e. Pets should be taken with the owner if possible, but public shelters may not allow them there. If owner is going to a private shelter, this may be an option.

f. The Office of Disaster Preparedness and Emergency Management (ODPEM) maintains a current list of emergency shelters for each parish at its website[21]. These shelters serve specially designated areas. Various schools in Robins Bay are designated shelters (with the Islington planning Zone). This includes the primary and basic schools. Food, water, emergency medical care and basic supplies may be provided at these facilities.

g. ODPEM will issue Evacuation Order as necessary. Evacuation should not proceed unless an Evacuation Order is given for the area.

Outline monitoring programme

7.40. It is recommended that during the construction of the sub-division infrastructure that there should be monitoring of the implementation of the mitigation measures to ensure that they are being effective, and that the construction works are being done in accordance with the requirements and conditions that are given in the environmental permit.

7.41. Construction monitoring should be undertaken by a qualified third party (environmental engineer or impact assessment specialist), reporting quarterly during the construction period to NEPA. These quarterly reports should be based on at least three site visits (conducted monthly).

7.42. Inspections should include specifically:

a. All areas where site preparation (land clearance) or construction are occurring. The inspection should field marking of road and drainage

[21] http://www.odpem.org.jm/Portals/0/Shelter_List/National%20Shelter%20Listing%202009-St%20Mary.pdf

alignments. It should be verified that there is no encroachment into buffer areas or areas earmarked to remain undisturbed. Large trees that can be retained by minor adjustment of alignments should be flagged for preservation.

b. Storage and maintenance areas, including the main laydown site /site office. Inspections should be made of the condition of stockpiles, fuel/lubricant storage/dispensing areas, solid waste disposal areas, wash-down areas, and any temporary settling ponds.
c. Vehicular access points (entrances and exits), including stabilized construction exits.
d. The condition of the detention ponds, and overflow culverts to Robins Bay.
e. The food vending situation, including provisions for hygiene.
f. The adequacy of provisions for workers including personal gear, lavatories and showers etc.
g. Construction documents, procedures and plans (e.g. solid waste) are available onsite for review. This should include copies of permits from haulage contractors, suppliers of quarry materials, waste contractors etc.
h. The reports should also indicate the state of completed works.

7.43. The monitoring report should include specific observations and recommendations in respect of:

a. Compliance with the conditions of the Environmental Permit and national quality standards. No specific monitoring of these parameters is considered necessary, provided the mitigation measures are implemented in a timely manner. No impact on the coastal water or benthic ecosystems is expected once the detention basins are implemented.
b. Discovery of any artefacts or protected species on property.
c. Occurrence of any workplace accidents or environmental incidents.
d. The occurrence of any impacts not anticipated by the EIA or environmental permit.
e. The nature of any complaints made by users of the beach, Robins Bay road or community.
f. Disposal or beneficial re-use of excavated materials.

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APPENDICES

Appendix 1 Terms of Reference for the EIA

Appendix 2 Letter of No Objection for Proposed Land Use from RPPD

Appendix 3 Stormwater Management System Engineering Design Report

Appendix 4 Letter from JPS

Appendix 5 Traffic Data: Total Vehicle Count (2 day survey)

Appendix 6 Household Survey Questionnaire