ENVIRONMENTAL IMPACT ASSESSMENT

For the Proposed Villages of Colbeck Castle Development, St. Catherine, Jamaica

Draft Report

Prepared on behalf of BCR Industries Ltd
for submission to the National Environment & Planning Agency

October 22, 2007

emc²
Environmental Management
Consultants (Caribbean) Ltd
61 Mansfield Meadows,
Ocho Rios St. Ann, Jamaica
876-974-7423
rburrowes@eiacaribbean.com

DRAFT ENVIRONMENTAL IMPACT ASSESSMENT FOR PROPOSED VILLAGES OF COLBECK CASTLE DEVELOPMENT, COLBECK CASTLE, ST CATHERINE.

October 22, 2007

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Acknowledgements

This Environmental Impact Assessment (EIA) was prepared by emc^2. The principal author was Dr. Ravidya Burrowes, with assistance from Mr. Osbourne Chin and Ms. Kamille Dwyer. Mr. Chin also prepared the socio-economic baseline report. Ms. Sheilah Forward assisted with the copy-editing and report collation

Mr. Steve Lalbeharry and Mr. Osbourne Chin conducted the field sampling of sediment and water, and the analytical testing for water and sediments. Scientific Research Council analysed water samples for faecal coliforms, Total Suspended Solids, and Nutrients. Mines and Geology analysed sediments for heavy metal contaminant levels.

Reports for the environmental baseline for the study previously contracted by BCR Industries were undertaken by Mr. Damian White (birds and vegetation), Dr. Catherine Murphy and Dr. Tannice Hall (entomology), Dr. Eric Hyslop (freshwater ecology), Ms. Natalie Blake (malacologist), and Mr. Marvel Gray (soil specialist).

The authors also wish to acknowledge contributions from BCR Ltd. to the project description, and stakeholders who took the time to comment on the proposal.

EXECUTIVE SUMMARY

BCR Industries Ltd. is seeking environmental permission for the implementation of a mixed-use development called *Villages of Colbeck Castle* on a 159 ha (394 acres) parcel of land at Colbeck Pen, which straddles the boundary of St. Catherine and Clarendon. Pursuant with the NRCA Schedule Natural Resources Conservation Act (1990), permits are indicated for the proposed residential sub-division and housing development, construction of a sewage treatment plant, development of a commercial complex, and agricultural subdivision. An environmental license is being sought for the discharge of sewage effluent (tertiary) from the proposed the sewage treatment plant. This Environmental Impact Assessment (EIA) is submitted in support of the applications, in accordance with the directive of the National Environment and Planning Agency (NEPA) further to a review of the application.

The *Villages of Colbeck Castle* represents an investment of US $300 Million in the housing sector, with a planned 2671 dwelling units and 32 saleable agricultural lots at full-build-out, plus a major 30-acre Central Business District (CBD) and the creation of the water company. The residential component is divided into five "*villages*", intended to foster a stronger sense of community within each village than would a large-scale development spread over 394 acres.

Site planning and architectural design on the project have been substantively completed at this time. Sales are scheduled to commence as soon as the relevant permits, approvals and licenses are obtained, which are anticipated before the end of the first Quarter of 2008. Sales are therefore expected to commence during this period. Construction is expected to begin shortly after sales have commenced. Full-build-out is expected to be completed within 5 years of permitting (2012). It is expected that major infrastructure, the agricultural sub-division, and the construction of 416 units will be completed in the first year.

As part of the EIA process, 100 householders in the surrounding areas were surveyed to determine their position in respect of the development proposal. When asked if they were aware of the proposed development, 67% indicated that they first heard of it during the interview. The vast majority (95%) of respondents had no objection to the project. Most people regarded the project as being extremely important to the community. When asked to rank out of ten the importance of the project to the community, half ranked it over 9, with 42% ranking it a perfect ten. Another 40% ranked its importance between 6 and 8 (15% ranked it eight, 16% ranked it seven, 9% ranked it six). More than half (58%) of the individuals were of the view that there would not be any negative social effects arising from the project. When asked if they believed the project will cause problems for those living in the area, 78% responded no.

Further to an in depth evaluation of possible impacts, it was found that minor or negligible negative impacts included infestation of vectors, effects on groundwater and potential ecological barriers and possible crime effects arising from the project implementation. Ten negative impacts were classified as moderate. Most of them were long term transitional or cumulative effects on the biophysical environment:

- Heat island effect.
- Vehicular emissions (air quality).
- Flood potential in the Bowers River System (from built surfaces).
- Flood potential in the Bowers Gully System (from curve flattening).
- Changes to surface water quality.
- Reduction in biomass.

Of those related to the human environment, one out of the four was considered short to medium term (construction nuisance), and the others were regarded as long term effects that were cumulative with other similar schemes in the area:

- Increased risk (hazard vulnerability)
- Demands on municipal services.
- Potential negative effects on traffic.

Six positive effects were assessed. These were compounded by many indirect effects, and mainly impacted on the human environment. Three of these were determined to be significant by the criteria established in this EIA: change of land use, ease of congestion in Old Harbour, and the long term demographic changes in the region. Development of heritage tourism opportunity at Colbeck Castle was determined to have moderate benefits, and the introduction of continuous effluent outfall into the ephemeral stream downstream of the property was determined to have a negligible positive effect on the eco-system there. Visual improvement to the quarry area was considered to be a relatively minor positive impact, which will not occur within the first five years.

It is the finding of this EIA that there are no significant negative impacts on the environment that may reasonably be expected to arise from the implementation of this project. There are moderate negative effects, particularly on the biophysical environment that can be cost-effectively mitigated. There are significant opportunities for environmental enhancement in this project, and wider societal benefits.

Based on the impact assessment the following objectives were established:

<u>Construction Phase</u>

1. To establish controls on contractors to ensure that the proposed mitigation measures are implemented in a timely and effective manner. This includes provisions for worker safety, road safety, waste and materials management.
2. To effectively minimize risks and negative environmental effects of natural disasters and hazards (hurricanes, fires, earthquakes, oil spills and accidental leaks).
3. To reduce and manage waste-streams predicted to occur.
4. To ensure that specific negative impacts on surface water quality from all aspects of construction
5. To minimize construction nuisances on other users and landowners throughout the development phase of the project.

Operational Phase

1. To develop and implement comprehensive environmental management plans, which clearly identify targets for environmental performance for the wastewater plant. This should involve some level of environmental education to all staff.
2. To conduct maintenance operations in a way that is compliant with environmental regulations and international best practices for pollution prevention, waste reduction, recovery and recycling wherever possible.
3. To maintain the project area in a manner that values adjacent eco-systems and its aesthetic appearance.
4. To work closely with the municipal service providers to ensure customer satisfaction and facilitation of the services.

The recommended mitigation and monitoring are designed to achieve these objectives. In terms of monitoring, it is recommended that an independent third party be separately contracted to monitor the construction activities, and to submit Quarterly Reports to NEPA in respect of (1) compliance with mandatory mitigation measures during construction (2) occurrence of any accidents or environmental incidents and the (3) the occurrence of impacts not anticipated by this EIA.

The final recommendation of the EIA is that with implementation of the recommended mitigation measures and the management plan, it is recommended that this project be granted the relevant environmental permits in order to proceed.

EIA PROCESS RECORD SUMMARY

Submission of applications to NEPA by BCR Industries Ltd.	December 12, 2006
Submission of Draft Terms of Reference (TOR)	May 9th 2007
First Public Notice: availability of the Draft TORs for the EIA for review.	May 11th 2007
Submission of comments on the Draft TORs from NEPA	June 8th 2007
Approval of TORs	July 4th 2007
Amendment to the Final TORs	August 28th 2007
Submission of the Draft EIA to NEPA	October 22nd 2007

The following dates are estimated based on the submission date.

2nd Public Notice: Announcement EIA availability and of the Town Meeting.	*October 25th 2007*
NEPA approval of the list of invited stakeholders and the chairperson	*October 26th 2007*
3rd Public Notice: Details of the Town Meeting.	*November 7th 2007*
Town Meeting (a Thursday evening)	*November 15th 2007*
Verbatim Report	*November 22nd 2007*
End of Public Review Period	*December 14th 2007*
Application tabled at NEPA's Internal Review Committee (IRC)	*To be determined*
Application tabled at the Technical Review Committee (TRC)	*To be determined*
Submission of Review Report to consultants from NEPA	*To be determined*
Submission of the Consultant's Response to the Review Report	*To be determined*
Tabled at the NRCA Board Meeting	*To be determined*
Notice of the decision to the Applicant	*To be determined*

PROJECT INFORMATION:

Project Name:	Colbeck Housing Estate “The Villages of Colbeck Castle”.
Location:	Colbeck Pen, St. Catherine
Developers:	B.C.R. Industries Company Limited, Old Harbour P.O., St. Catherine
Title Reference:	Volume 1056 Folio 630, Land area: 394 acres, 2 roods, 33·4 perches

B.C.R. Industries Company Limited was incorporated under the Companies Act in 1982. The current Directors are Mr. Nassiff Deenah, Mr. Michael Mintz and Mr. Jeffrey Fanning.

The owners/developers are new to real estate development and have engaged the following individuals/firms to provide technical expertise:

Edward Young Associates	Architect/Planner
Environmental Management Consultants (Caribbean) Ltd.	Environmental Compliance Advisor
Patrick Reece	Civil Engineer
Llewlyn Allen	Land Surveyor
Herbert Schroeter	Engineer/Surveyor
Goldson Barrett Johnson	Quantity Surveyor
Easton Douglas & Company	Development Consultant
Dudley Shields	Project Manager
Hydrology Consultants Limited	Hydrologists

1 PROJECT DESCRIPTION

1.1 INTRODUCTION

BCR Industries Ltd. is seeking environmental permission for the implementation of a mixed-use development called *Villages of Colbeck Castle* on a 159 ha (394 acre) parcel of land at Colbeck Pen that straddles the boundary of St. Catherine and Clarendon. Pursuant with the NRCA Schedule Natural Resources Conservation Act (1990), permits are indicated for the proposed residential sub-division and housing development, construction of a sewage treatment plant, development of a commercial complex and agricultural subdivision. An environmental license is being sought for the discharge of sewage effluent (tertiary) from the proposed the sewage treatment plant.

This Environmental Impact Assessment (EIA) is submitted in support of the application, in accordance with the directive of the National Environment and Planning Agency (NEPA) further to a review of the application. The Terms of Reference (TORs) for the EIA were formally approved by NEPA on July 4th 2007 (Appendix 1). Further to the approval of the TORs, NEPA requested amendment of the TORs (and expansion of the Scope of Works) on August 28th 2007.

1.2 PROJECT RATIONALE

The project intends to provide 2671 affordable housing solutions to middle income families that require a location within one hour of the KMA, Spanish Town, May Pen or Old Harbour. The Villages of Colbeck Castle is anticipated to have a population of about 12,000 inhabitants at full build-out. This development proposal has arisen as a result of the housing need that was outlined in the Portmore to Clarendon Park – Highway 2000 Corridor Development Plan 2004-2025, which indicated that 52,000 housing units will be needed, either completely new, or substantially upgraded over the period 2005-2010. In addition, that plan indicated that population of the urban area of Old Harbour was growing very rapidly, having shown a 29% increase between 2001 and 2005. The reason for this growth is related to the fact that this location in proximity to the major cross-island transportation arteries makes it ideal for persons who need an affordable sub-urban domicile or central location.

Since 1982 the Government of Jamaica has recognized that there is a major gap between the demand for affordable housing and the availability of it, which has resulted in a housing deficit. Twenty years ago the National Shelter Strategy Report estimated that there was a need to construct 15,500 new units and upgrade 9,700 units each year until 1990 to meet the demand. Based on the projected requirement Jamaica had a serious ‘back log’ problem, as housing deficit reached 53,049 units.

In 2004, the then Minister of Water and Housing, indicated that Jamaica required the construction of 13,260 new housing units annually from 2001 to 2005 to solve its 'back log' problem[1], compared to the 4,236 that were annually constructed between 2001 to 2003. In 2005, the then Prime Minister declared that 30,000 houses were required annually over the next 5 years to meet Jamaica's housing demand (Daley-Williams, 2006).

Available data from the PIOJ (Table 1), suggests that the state agencies (Ministry of Water and Housing, Urban Development Corporation, National Housing Development Corporation, National Housing Trust) have not been able to meet more than 14% of the required annual stock, creating a compound deficit over time.

Table 1 Completion of Housing Units (2001 to 2005)

	2001	2002	2003	2004	2005
Ministry of Water and Housing	401	1288	380	1843	n/a
UDC	94	306	0	0	0
NHDC	52	1190	1478	139	630
NHT	2484	2130	1281	2984	2246
Private Sector Contractors	164	630	828	866	1310
Total	**3195**	**5544**	**3967**	**5832**	**4186**

Source: Planning Institute of Jamaica, 2005

Additionally, it is apparent that the Private Sector has tended to contribute less than a third of the total annual completions.

The consequences of this pattern include:

1. Rising prices in the housing sector. In March of 2007, the Jamaica Gleaner published an article entitled 'High prices slow residential real estate market.' It was disclosed in the article that between June 2005 and December 2006 the price of 3-bedroom townhouses in Fort Charles and Stony Hill had increased from JA$ 8.3 million to JA$14 million. According to Janet Maureen of Coldwell Bankers (personal communication, 2007) house prices outside the corporate area have also increased, with prices in Portmore ranging up to $20 million.
2. Inflated rental prices due to the gross deficit of the housing stock.
3. Small-scale housing schemes are generally unable to take advantage of economies of scale, and tend to produce more expensive units. Schemes of less than 900 units are not required to allocate lands and resources for community facilities (schools, community centres, parks etc.), so many of the private sector schemes lack basic social amenities like schools. This has the effect of creating pressure on the government to meet the social and infrastructural demands of these settlements.

[1] www.jis.gov.jm/special_sections/budgetDebate2004/BuchananPresentation.pdf

1.3 PROJECT CONCEPT

The *Villages of Colbeck Castle* represents an investment of US $300 Million in the housing sector, with a planned 2671 dwelling units and 32 saleable agricultural lots at full-build-out, plus a major 30-acre Central Business District (CBD) and the creation of the water company. The residential component is divided into five "*villages*" (inclusive of a retirement village). The idea of using smaller cells within the wider context of the development is that each village will have between 809 and 78 households spread over smaller areas of between 74 and 14 acres respectively. This is intended to foster a stronger sense of community within each village than would a large scale development of 2671 households spread over 394 acres.

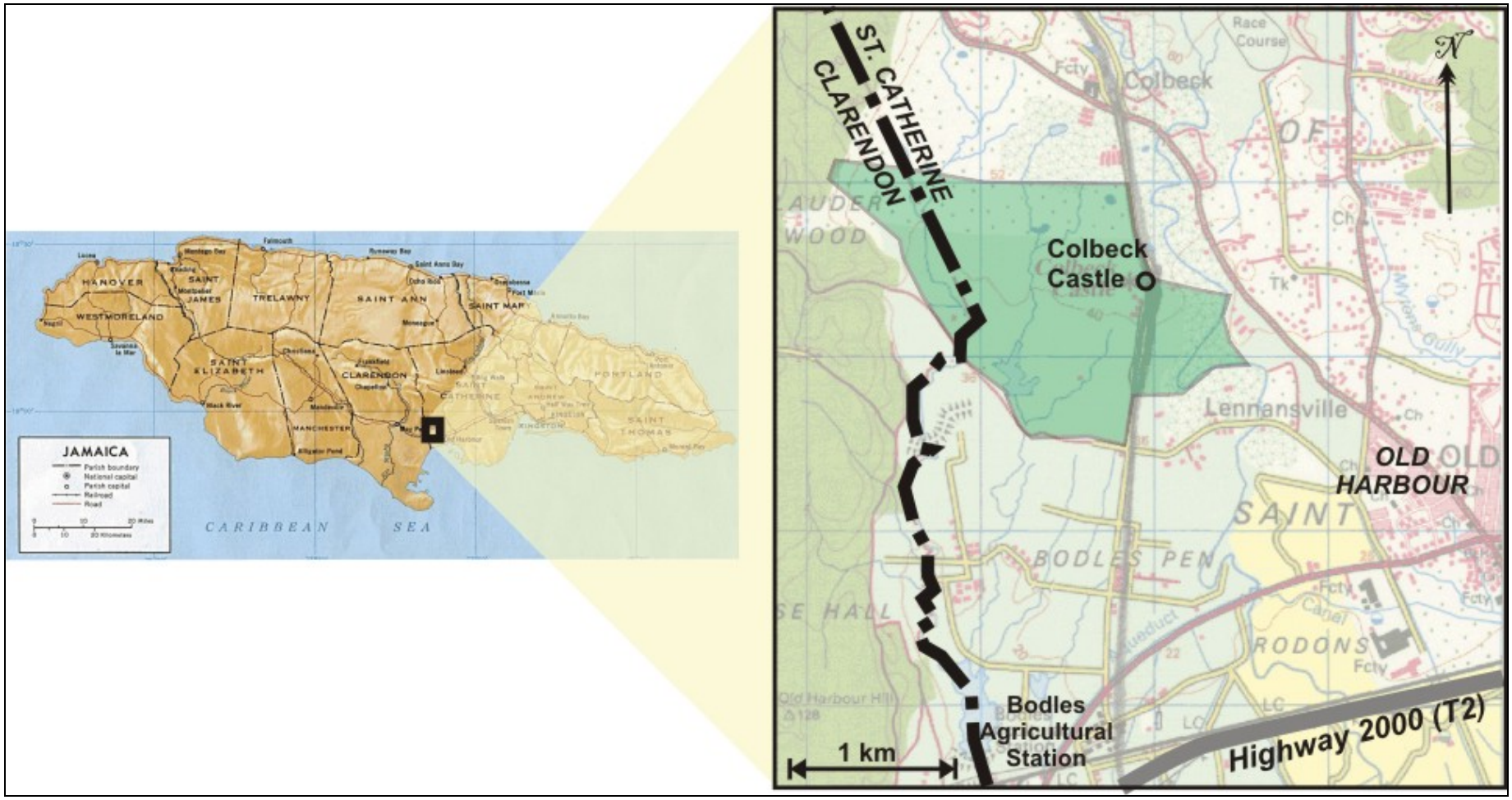
These communities are served by a 30-acre central business district, which acts as a buffer between the villages and the agricultural lots, which are located on 60 acres on the eastern side of the property. An eighth of the total estate is allocated for communal uses such as schools, parks and basic infrastructure. This allocation of lands is intended to develop the basic planning precept of Villages of Colbeck, which is to build integrated socially-equipped and functional communities rather than rows of houses.

The development has taken into account the fact that Jamaican middle class families tend to add-on as the family and its resources grow. Therefore, due consideration has been given to the "expandability" of both the Single Family Units and the Semi-Detached Units. For this reason, these units are intentionally kept small in size (800 sf and 830 sf respectively), which will be more affordable middle income families seeking to purchase a "starter home". The developers will provide suggestions for expansion in order to maintain a consistent visual aesthetic.

1.4 PROJECT LOCATION & BOUNDARIES

The site is located within an easy commute along the highway or Toll Road from several important urban centres, including the Kingston Metropolitan Area (35 km), Spanish Town (16 km), May Pen (10 km) and Old Harbour (2 km). The site is also located within 6.5 km of Port Esquivel and the Portland Bight, which is the nearest protected area. The site is also in proximity to the Jamaican Agricultural Society (JAS) farmstead at Colbeck Pen and the Bodles Agricultural Research Station. Situated on historically cultivated lands at elevations ranging between 38 m and 50 m above sea level, the proposed development site is characterized as part of an alluvial plain, with generally flat, undulating terrain in most part, becoming somewhat more from hilly on the northwestern side where it approaches Old Harbour Hills. The property falls mainly within the Bower River watershed, and has three existing water courses running through the proposed development site. The western and southern boundaries are delineated by a minor parochial road leading to a licensed quarry. The southeastern boundary is bordered by the estate road and extends to the Colbeck Castle heritage site. The southeastern boundary is marked by a segment of the Plantain River. The northern boundary is not however defined by any particular geographic feature. At the widest points, the northern boundary is ~1.2 km from the southern boundary, and the eastern boundary is 1.9 km from the western limit.

Figure 1 Location of Proposed Development Site, Colbeck Castle, St. Catherine



1.5 Overview of Master Plan (Core Design Layout)

The Villages of Colbeck Castle comprises three major land use components (residential, commercial, and agricultural), which have been divided into 11 land use zones (Figure 2). The total area allotments (inclusive of both built and passive use areas) are given in Table 2 below.

Table 2 Land Allotments (in acres)

Zone	Land Use	Expected Built Space	Passive Use, Reserved or Open Space	Total Allotment
Zone 1	Agricultural sub-division	3	57	60
Zone 2	Colbeck Castle Heritage site	1	5	6
Zone 3	Commercial lots	30	0	30
Zone 4	School and Playfield	1	14	15
Zone 5	Residential	50	10	60
Zone 6	Residential	64	10	74
Zone 7	Residential	46	14	60
Zone 8	Residential	33.5	12.5	46
Zone 9	Residential (Retirement Village)	6.5	7.5	14
Zone 10	Sewage Treatment	0	8	8
Zone 11	Community Park	0	11	11
	Roads and drainage	5	5	10
	Total Acreages	**240**	**154**	**394**

The general layout of each of these components is described in the following sections.

1.5.1 Residential Land Use (Zones 5 to 9: 254 acres)

1.5.1.1 Dwelling Types & Distributions

Three types of dwelling units are planned as given in Table 3 below. As stated before, these homes are designed to be affordable to middle income families, and are therefore relatively small units (800 to 830 sf) on small lots. Almost 40% of the total number of units will be provided in the form of duplex townhouses (semi-detached units). Another 36% will comprise detached single family units (with potential to “add on”), and the remainder will comprise 2-bedroom apartments located in 3-storey apartment buildings. Although provision is made in the water and sewage infrastructure for 32 3-bedroom homes in the agricultural zone, these are not going to be constructed by the developers, as not all farm plot owners may want a dwelling unit on the farm.

Figure 2 Master Plan

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Table 3 Dwelling Units

Type of Unit		Lot Count	Unit Size (sf)	Minimum Lot Size (sf)
2 bedroom semi-detached units [a]	DTH	1034	830	2325.0
2 bedroom single detached units	SFD	965	800	3487.5
2 bedroom apartments [b]	Apts	672	830	-

[a]Duplex Townhouses [b]3-storey apartment buildings

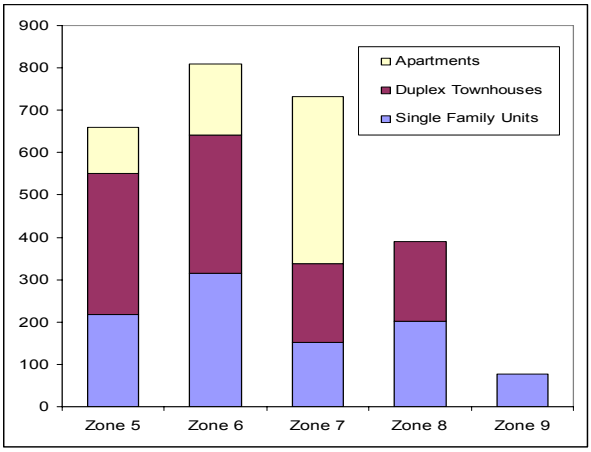
An application for outline planning was submitted to the St. Catherine Parish Council for 3,168. This number was reduced to the present configuration based on subsequent discussions.

The five villages (Table 4) have an average housing density of 10 dwelling units per acre, ranging between 6 dwelling units per acre (Retirement Village-Zone 9) and 12 dwelling units per acre (Zone 7).

In terms of residential design density per habitable rooms (HR), the Master Plan estimates an overall average density of 26.3 HRs per acre, where each dwelling unit is assumed to have 3 HR (2671 x 3) and there are 305 acres overall (395 minus the 30 acre commercial area and the 60 acres allocated for agricultural land use).

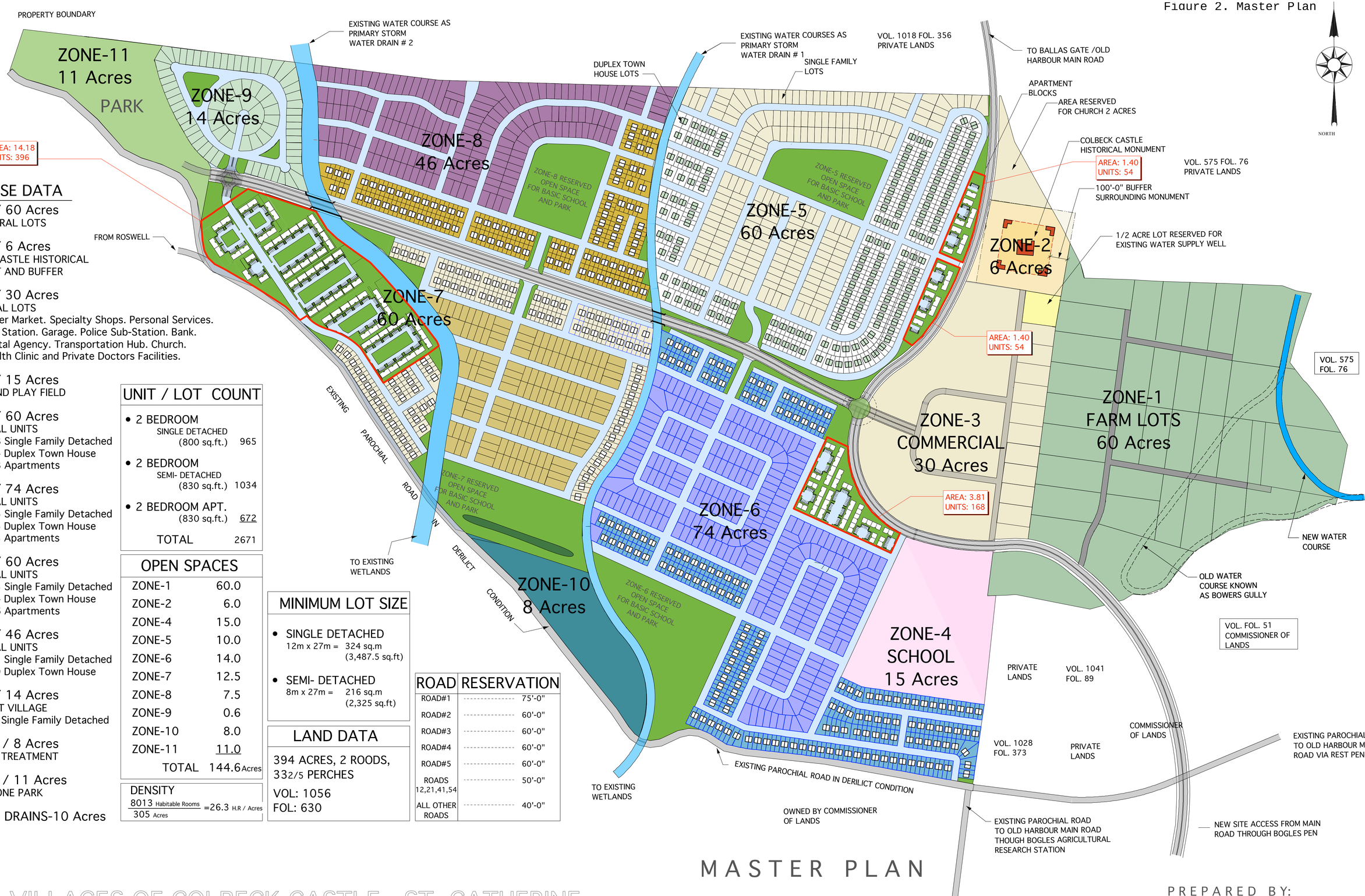
Table 4 Distribution of Dwelling Units in Residential Zones

Zone	Dwelling Units			Total	Acreage
	DTH	SFD	Apts		
Zone 5	334	218	108	660	60
Zone 6	326	315	168	809	74
Zone 7	184	153	396	733	60
Zone 8	190	201	0	391	46
Zone 9	0	78	0	78	14
Lot Counts	1034	965	672	2671	254



Please refer to Figure 2 (Master Plan) for the wider context for the following map extracts.

Zone 5 (60 acres): this village is located on the northern side of the property (Figure 3), and is bounded in the north by the property boundary. On the eastern side it is bounded by the eastern main road (EMR) which abuts Zone 2 (Colbeck Castle) and Zone 3 (Commercial area). On the southern side it is bounded by the central main road (CMR) which dissects the property into northern and southern areas, and faces townhouses of Zone 6 on the southern side of the road. The western boundary of this "village" is marked by the natural drainage course of a tributary of the Bowers River which runs across the property.



LAND USE DATA

- ZONE-1 / 60 Acres
  AGRICULTURAL LOTS
- ZONE-2 / 6 Acres
  COLBECK CASTLE HISTORICAL MONUMENT AND BUFFER
- ZONE-3 / 30 Acres
  COMMERCIAL LOTS
  Super Market. Specialty Shops. Personal Services. Gas Station. Garage. Police Sub-Station. Bank. Postal Agency. Transportation Hub. Church. Health Clinic and Private Doctors Facilities.
- ZONE-4 / 15 Acres
  SCHOOL AND PLAY FIELD
- ZONE-5 / 60 Acres
  RESIDENTIAL UNITS
  218 Single Family Detached
  334 Duplex Town House
  108 Apartments
- ZONE-6 / 74 Acres
  RESIDENTIAL UNITS
  315 Single Family Detached
  326 Duplex Town House
  168 Apartments
- ZONE-7 / 60 Acres
  RESIDENTIAL UNITS
  153 Single Family Detached
  184 Duplex Town House
  396 Apartments
- ZONE-8 / 46 Acres
  RESIDENTIAL UNITS
  201 Single Family Detached
  190 Duplex Town House
- ZONE-9 / 14 Acres
  RETIREMENT VILLAGE
  78 Single Family Detached
- ZONE-10 / 8 Acres
  SEWERAGE TREATMENT
- ZONE-11 / 11 Acres
  STAND ALONE PARK
- ROADS & DRAINS-10 Acres

UNIT / LOT COUNT

• 2 BEDROOM SINGLE DETACHED (800 sq.ft.)		965
• 2 BEDROOM SEMI- DETACHED (830 sq.ft.)		1034
• 2 BEDROOM APT. (830 sq.ft.)		672
TOTAL		2671

OPEN SPACES

ZONE-1	60.0
ZONE-2	6.0
ZONE-4	15.0
ZONE-5	10.0
ZONE-6	14.0
ZONE-7	12.5
ZONE-8	7.5
ZONE-9	0.6
ZONE-10	8.0
ZONE-11	11.0
TOTAL	144.6 Acres

DENSITY

8013 Habitable Rooms / 305 Acres = 26.3 H.R / Acres

MINIMUM LOT SIZE

- SINGLE DETACHED
  12m x 27m = 324 sq.m (3,487.5 sq.ft)
- SEMI- DETACHED
  8m x 27m = 216 sq.m (2,325 sq.ft)

LAND DATA

394 ACRES, 2 ROODS, 33 2/5 PERCHES

VOL: 1056
FOL: 630

ROAD	RESERVATION
ROAD#1	75'-0"
ROAD#2	60'-0"
ROAD#3	60'-0"
ROAD#4	60'-0"
ROAD#5	60'-0"
ROADS 12,21,41,54	50'-0"
ALL OTHER ROADS	40'-0"

MASTER PLAN

0 50 100 150 200 250 300 m

SCALE: 1:3000

THE VILLAGES OF COLBECK CASTLE , ST. CATHERINE

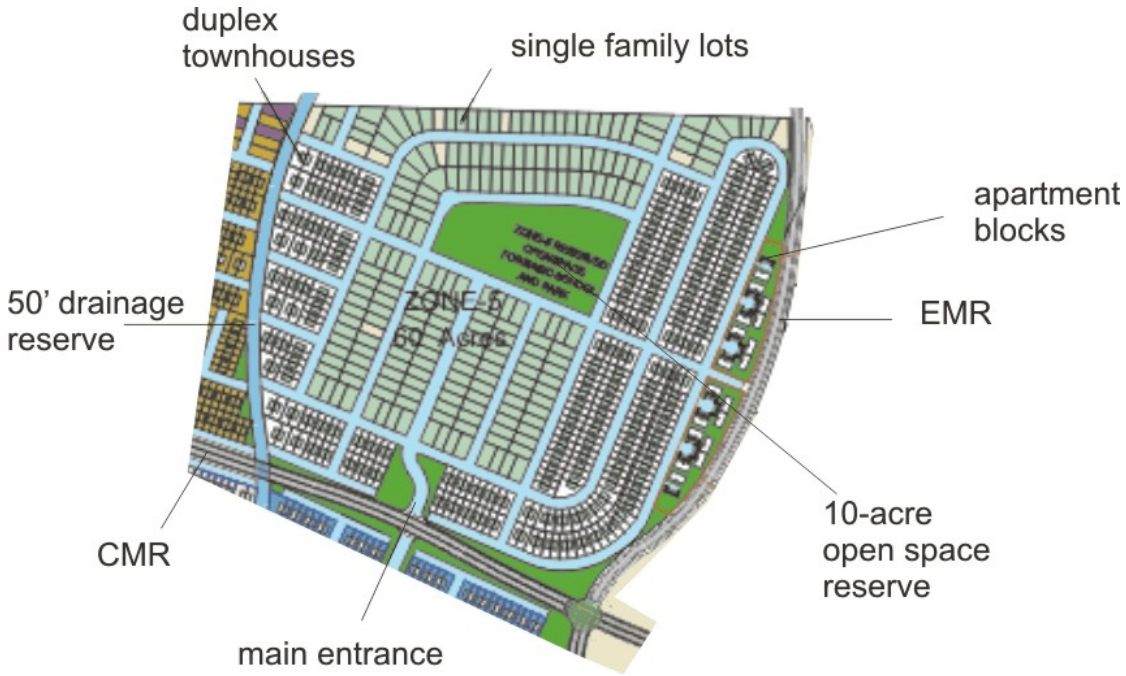
PREPARED FOR BCR INDUSTRIES, OLD HARBOUR, ST. CATHERINE

PREPARED BY:

EDWARD YOUNG ASSOCIATES
NOVEMBER '2006

The village is served by a basic grid of roads aligned roughly with the drainage reserve and main roads. The main entrance to the village is off the CMR. There is no entrance/exit from this village directly to the EMR.

Figure 3 Zone Five Village

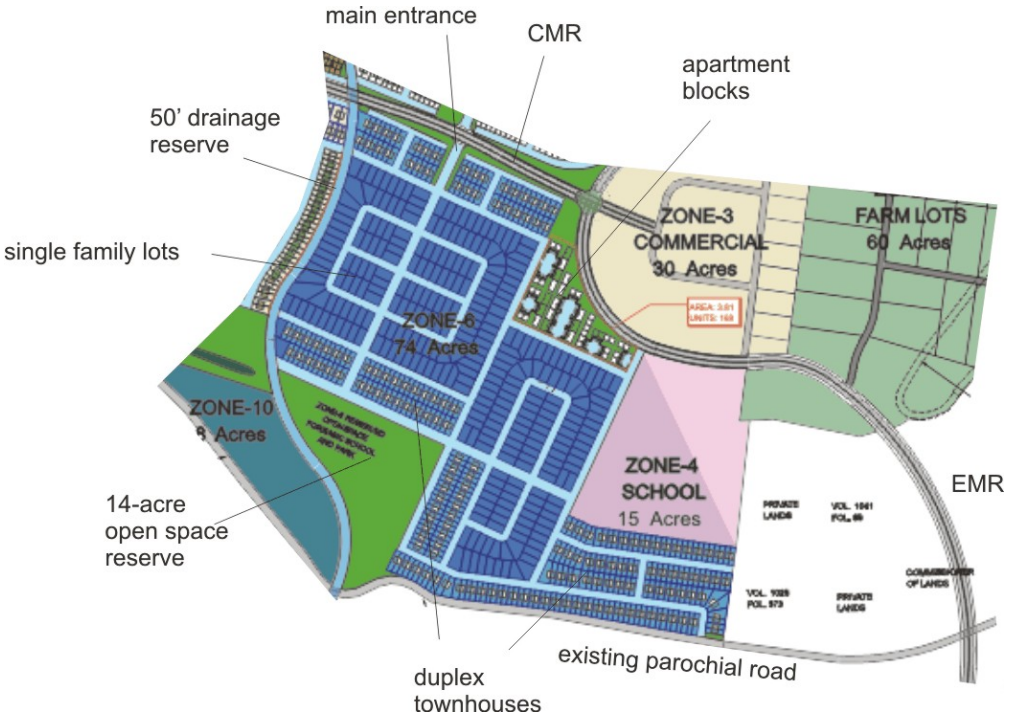


The village is laid out around a central 10-acre area of open space, which is reserved for a basic school and park. The single family units are arranged on the southern and northern sides of the park, with the townhouses on the outer areas of the western southern and eastern sides. The apartment blocks are located overlooking the eastern main road (Colbeck Castle and Business area).

The placement of townhouses facing the main access spine is intentional, to maintain the visual aesthetic. A fundamental planning that has been used involves staging the apartments and town houses in ways that use them to protect the single family lots as these types of structures possess, inherent defences that cope better with large traffic flow exposure.

Zone 6 (74 acres): This village is bound in the north by the CMR. The Apartment Blocks are located on the north-eastern side, overlooking the commercial zone. The eastern side of the village abuts Zone 4 which is a 15-acre parcel allocated for a school; on the south-eastern side the community is bounded by the property boundary. The southern boundary is delimited by a parochial road. The western boundary is delimited by the natural drainage course of a Bowers River tributary that runs across the property. On the south-western corner, separating the village from Zone 10 (STP) is a 14-acre open space reserve that can be used for locating a school and park. The 326 townhouses planned for this village are located on the periphery of the village, with the single family units (dark blue on Figure 4) generally located on the interior.

Figure 4 Zone Six Village



The main entrance/exit is off the CMR, and there is a minor entrance on the north-eastern side to the EMR. There will not be any connections on the southern side off the parochial road, with all sub-division roads terminating at the property boundary. As in the case of Zone 5, the commercial area acts as a buffer between this sub-urban land use and the agricultural area.

Zone 7: (60 acres) This village is bound in the east by the Bowers Gully tributary drainage reserve. The southern limit of the village has a 12.5 acre open space reserve which serves as a buffer between the STP and the lower courses of the gullies. The existing parochial road forms the western boundary, and the CMR forms the northern boundary. There is a 100-foot wide drainage reserve dissecting the village (~2200 feet from the northern boundary to the exit). This drainage reserve divides the apartment blocks (located on the western side of the reserve) from the single family lots. Townhouses are located on the south-eastern side of the apartment blocks, and on the northern and eastern peripheries.

There are two entrances off the CMR, on either side of the 100-foot drainage reserve. No roads connect either side. The road network on the eastern side is a simple grid system. A single main road roughly parallel to the drainage reserve serves the apartment blocks and townhouses on the western side.

Figure 5 Zone Seven Village

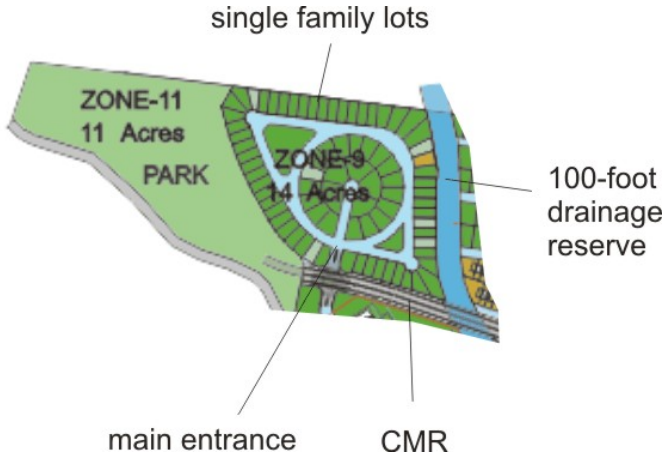
<u>Zone 8 (46 acres)</u>:

This village is located on the northern boundary of the estate between Zones 9 (on the west) and 5 in the east. The northern boundary is therefore the property boundary. The western boundary is a 100 foot drainage reserve for the Clarendon Gully, and the eastern boundary is a tributary of the Bowers River. The CMR marks the southern boundary. The only road entrance to the community is off the CMR.

Figure 6 Zone Eight Village

Zone 9 (14 acres): This proposed "Retirement Village" is the smallest of the villages, with only 14 acres, and 78 single family lots planned. It is located on the far north-eastern side of the property, and is bounded in the north by the property boundary. On the eastern side it is bounded by the 100-drainage reserve, and on the south by the CMR. It shares its western boundary with the proposed 11-acre rehabilitated quarry site, reserved as an open space (park).

Figure 7 Zones 9 and 11



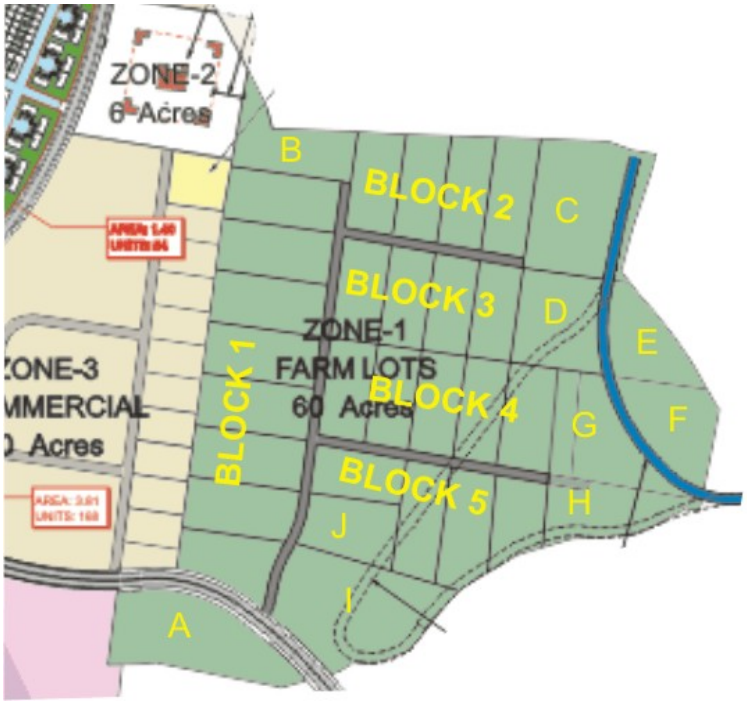
The layout provides for 0.6 acre of open space due to the proximity to the major park reserve, and the fact that there are no apartments or duplexes. There are three blocks of lots, concentrically arranged in a bird's eye pattern. The outer peripheral block is served by a "circular" road; the middle ring of lots is served by an inner ring road, and the core six lots is served by a central cul-de-sac, which is directly connected to the entrance to the village off the CMR.

The homes to be constructed in this village will be specially fitted to cater to the elderly. A central nurse's station with emergency facility is also planned for this village.

1.5.2 Agricultural Land Use (Zone 1: 60 acres)

The agricultural lots are confined to Zone 1 (see Figure 8), which is located on the eastern end of the property. Sixty (60) acres are being sub-divided into 34 farm plots of varying sizes (~2 acres on average). The largest lot actually occurs on the southern side of the eastern main road, and serves as a buffer between the main road and the school reserve. Only 32 lots are saleable as two lots will be reserved for other uses (including pond water storage). In addition to the 2671 housing units, each of these 32 lots will be sold with a 2-bedroom house. All the remaining lots are located on the northern side of the road, to which site access will be confined to a single main entrance off the main road. These can be divided into five regular blocks and ten irregular lots. Block 1 consists of 8 plots on the western side. These lots all abut the commercial lots, as does Lot B (near to Colbeck Castle). Blocks 2 and 3 face each other and consist of 4 long lots, with a larger end lot (C and D respectively). Blocks 4 and 5 also face each other across an access road. Block 4 consists of 5 lots, and Block 5 consists of 4 lots.

Figure 8 Zone One (Farm Plots).



The river bed presently runs through Blocks 4 and 5 and lots D, J, I, and H. Lots C, D. G and H lie on the western side of the proposed gully course, and lots E and F lie on the eastern side. It is expected that 32 of these lots will be homestead farm plots, where the owner will have a two to three bedroom dwelling unit on a part of the farm stead, and will farm the remaining area (this population estimate has been included in the calculations for water and sewage).

The following types of farming will be encouraged:

- Hydroponics- cultivation (or growth) of plants in a nutrient solution without soil.
- Aquaponics- combination of recirculation aquaculture and hydroponics. In aquaponics, plants and fish grow together in one integrated system.
- Aquaculture (aqua-farming) - cultivation of aquatic organisms (populations) under controlled conditions.
- Greenhouse and Controlled Environment Agriculture- cultivation of plants (or animals) in a greenhouse and controlled environment.

1.5.3 Business District (Zone 3: 30 acres)

The main commercial space in the Central Business District (CBD) will be located in Zone 3 on the eastern side of the property, adjoining the farm lots (Zone 1).

The Eastern Main Road (EMR) forms the western border of this zone, and divides it from the residential area which is accessed via a roundabout (Figure 9). The three-storey apartment blocks are designed to overlook this street. This EMR forms a two-lane bypass of the CBD,

which connects to the Old Harbour Main Road. The layout of the CBD is primarily controlled by a single north-south running road which ends at the Colbeck Heritage site (6 acres) and the well allotment. East of this road there is a block of 11 commercial lots (~3/4 acre). At the centre of the CBD is a “circular” road that connects to the roundabout on the bypass.

It is uncertain how the remaining area will be decided, but it is possible that there will be a central plaza in the middle of circular road. The remaining areas will be sub-divided to allow for optimal road access of individual commercial lots. An estimated 250,000 sf of commercial space is to be provided. It is expected that a range of urban services will be available. These are listed in Table 5.

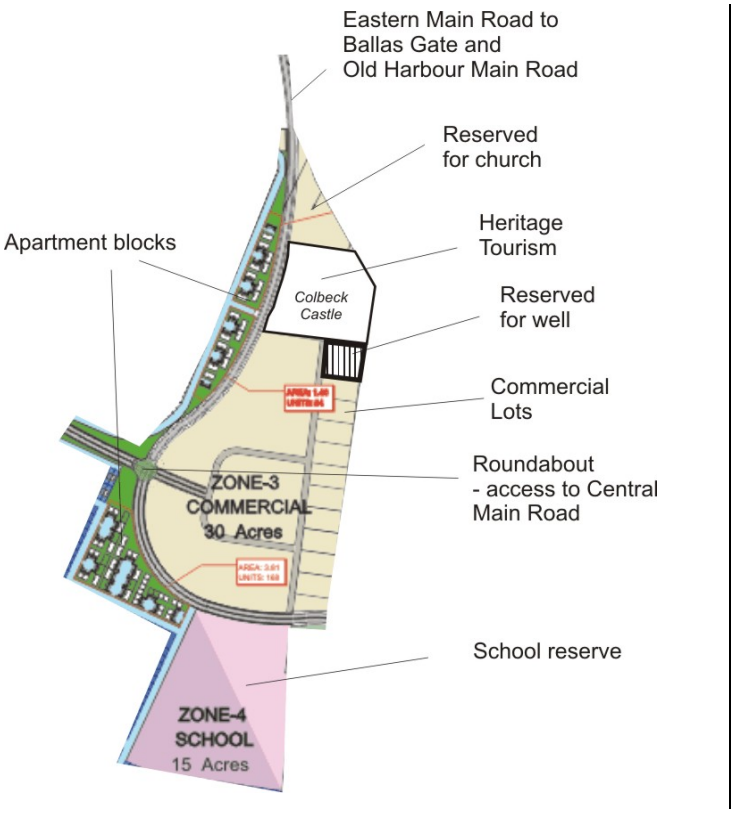
Table 5 Commercial Services

Transport and Industrial	Shopping and Financial	Social Services & Amenities
Gas Station*	Super-market	Health Clinic, doctor’s offices
Garage (mechanic)	Specialty Shops	Postal Agency
Transportation Hub	Personal Services	Church
Light Industrial/Tech Park	Banks, Credit Unions etc.	Community Centre/Hall; Craft Village

* a separate permit will be sought for the gas station once the details and the provider have been determined.

Fifteen acres are allocated on the south side of the CBD for a school (Zone 4 on the Master Plan). In addition, two acres are allocated on the north end for a church.

Figure 9 Zone Three (CBD)



1.5.4 Communal Land Uses

1.5.4.1 Parks and Open Spaces

Almost 40% of the total area (~154 acres) has been allocated for reserved lands, open space or low intensity land use (see Table 2 above). This includes open spaces within the residential villages, the agricultural zone and the nature park (stand alone park) identified in Zone 11 at the north western corner of the property (where the quarry is presently located). The quarry now shown at this location will be closed, and the lands graded and landscaped. Features will include hiking trails, picnic areas, rest rooms and gazebos.

1.5.4.2 Heritage Site

The Colbeck Castle, a 17th century historical monument, built in 1680 as a defence structure by the Spaniards, is the main heritage/cultural feature on the site (this is described more fully in the baseline section of this EIA). A six-acre parcel of land containing the monument has been reserved (Figure 2), and includes a 100-foot buffer zone surrounding the monument.

It is envisaged that this iconic monument can be developed and promoted as a heritage tourism site, and will serve as a focal point. The areas outside of the 100-foot buffer zone can be used to accommodate a range of tourism-related activities such as a museum and gift shop, ice-cream and snack bar, and an information centre, not unlike Devon House in Kingston.

The Jamaica National Heritage Trust (JNHT) has conducted a detailed assessment of the Castle and the Colbeck Estate in general. It is expected that any restoration of this monument or use of lands within the 6-acre site will be done in conjunction with the JNHT to ensure that the heritage resources are appropriately conserved. Guidelines for the development of this area are given in the Environmental Management Plan (EMP) of this EIA.

1.6 INFRASTRUCTURE

1.6.1 Utilities

1.6.1.1 Water

Demand: Potable water will be required for domestic consumption in the residential sub-division (including farmsteads) as well as in the schools, commercial and recreational areas. Water will also be needed for irrigation and firewater. Using the JIE recommendation of 2.5 persons per bedroom, a total population of ~16,000 was calculated as follows in Table 6. This is a design capacity rather than a real estimate as, it is expected that with households in line with the national averages (4.5 persons per household), the total resident population (assuming that all 32 farmstead lots are also used for residential purposes) is expected to be of the order of ~12,000.

Table 6 Population Estimates used in Water & Sewage Design

	Number of Units	Number of Bedrooms	Persons per Bedroom	Estimated Population
Apartments	672	2	2.5	3360
Single Family Units (extendable)	965	3	2.5	7237.5
Duplex Town Houses	1034	2	2.5	5170
Farmstead houses (extendable)	32	3	2.5	240
				16,008

A maximum of 2.3 MGD of water has been estimated as the demand for the development.

The WRA (March 2007) has issued an abstraction license for the Colbeck well for a maximum of 2.04 MGD. After monitoring the safe yield in the well for the first 5 years, the developers will explore with the WRA the possibility of amending the abstraction license if necessary. Rainwater harvesting at the site is not regarded as a feasible option for the site due to the relatively low annual rainfall. Additional recommendations for water conservation are be made in the Environmental Management Plan of this EIA.

Table 7 Water Demand

Category	Estimated Population	Water	rate/capita/day
Residential	16,008	1,344,630	84
School	4,000	48,000	12
Commercial	1,500	18,000	12
Fire		180,710	
Irrigation		702,500	
	21,508	2,293,840	

Abstraction: A water abstraction license has been acquired for the use of the Colbeck Castle well located on the eastern side of the property. The well, is to be used as the source of domestic, commercial and irrigation water for the development. The 18-inch diameter well (drilled to a depth of 68.3 m below ground level into the lower Rio Cobre Limestone aquifer), was found to have a high water quality standard and a high production capacity (600 m^3/hour). From the evaluation by Hydrology Consultants Limited (HydroConsult), it has an estimated safe yield of 600 m^3 per hour. Water Resources Authority (WRA) has accepted a design minimum pumping water level elevation of 1.5 m above mean sea level as a means of preventing saline up-coning (Hydrology Consultants Ltd, 2006[2]). The base of the well occurs 41 m above the saline groundwater.

Treatment/Disinfection: Supplies will be chlorinated at the well pumping station before entering the mains leading to the storage reservoir. Gas chlorinators with motive pumps will introduce a concentrated solution of chlorinated water into the main transmission line from the well pumping station to the storage reservoir. The chlorine contact time (15 minutes) with the supplies will be

[2] Hydrology Consultants Ltd. 2006. Evaluation Report. Colbeck Castle Well, St. Catherine. Project of BCR Industries Co. Ltd. 27 p

met within the transmission mains which have a travel time of 19 minutes. Chlorine dosage will satisfy residual chlorine requirements.

Distribution: Supplies will be lifted at the well pumping station directly to an elevated distribution storage reservoir on the western side of the development, from which the development will be gravity fed via supply mains and laterals. A fire flow of 95 l/s for 2 hours is proposed for each development block.

Approvals from the Environmental Health Unit (EHU) of the Ministry of Health, and a permit from the Office of Utilities Regulation (OUR) for the public supply system will be sought once the environmental permit has been granted.

1.6.1.2 Electricity

The Jamaican Public Service Company Limited (JPSCo) provides electrical power to the communities found within the general area of the Colbeck Castle development site. It is expected that once the development is completed, the development will be provided with electrical power from the mains that serve the area. Consumers will have individual meters, and will have contracts directly with the service provider.

1.6.1.3 Telecommunications

Telecommunication services will be provided by the existing telecommunication providers in the island. Cable and Wireless will provide the necessary telecommunications infrastructure to the site, to allow access to various telecommunication services as provided by the telecommunications industry. Cable and Wireless will provide land based telephone services, while cellular services will be provided by Cable and Wireless and Digicel. Internet service providers Cable and Wireless and Flow will provide the necessary internet infrastructure.

1.6.1.4 Solid Waste Collection and Disposal

Based on the population estimate used for water and sewage, and an estimated generation rate of 1 kg per person per day, it is estimated that as much as 21 metric tons of solid waste may be generated per day. The developers will work with the North Eastern Parks and Markets (NEPM) Limited and the National Solid Waste Management Authority to determine the best options for facilitating routine collection of this garbage.

According to a representative of the agency (personal communication, October 2007, Alicia Stewart), collection of waste from residential developments are the responsibility of the agency. The agency requires that each residential unit places an air-tight drum on the outside of the property, as collectors are not allowed to enter beyond property boundaries. In the event that collectors do not have road access to all areas of the community, the Agency provides

communal skips that are placed within walking distance of residential properties, and within road access parameters for the collectors.

The Agency is not responsible for collecting garbage from commercial properties. The management of the entity is required to contract the service of a private hauler. In the case of mixed developments, commercial entities are barred from using the Agency's skips provided for residential purposes. In the event that commercial entities have what is considered 'special' waste to be disposed of, they may contract the services of the Agency at a cost. Cost is determined according to the type of waste, amount and final disposal destination.

1.6.2 Roadways

1.6.2.1 Ingress/Egress Roads

As shown on Figure 2 (Master Plan), two separate ingress/egress points will allow pedestrian and vehicular access to the site:

1. From the Old Harbour/May Pen Main Road: a new road (single carriage way outside the development and dual within) with a 75 feet road reservation is proposed through the Bodles Agricultural Estate. The Ministry of Agriculture has confirmed this easement (letter dated November 9th 2006).
2. From the Ballas Gate/Old Harbour main road: a widening of the existing parochial road leading to the Colbeck Castle Monument is proposed.

1.6.2.2 Sub-Division Roads

As shown on Figure 2 (Master Plan), there will be two main access spines within the site:

1. A central main road through the residential area, running roughly ESE-WNW from a roundabout in the commercial zone, to the roundabout on the western end (near the Retirement Village). Roundabout to roundabout, this is 1.2 km or roughly three-quarter mile.
2. A bypass road connecting the southern and northern site ingress points. This is ~1.7 km of roadway (~1 mile). The central four-point roundabout on this road serves as the main gateway to the residential villages (going west), the CBD (going east), the northern ingress (and the church, and heritage site) and the southern ingress (and the main school allotment and agricultural sub-division).

The surface of each roadway will be paved using asphalted concrete. All access roads will be designed to include curb walls and side walks to allow safe and easy mobility by pedestrians. Within residential areas the carriage way for proposed road will be reduced in size to prevent excessive through traffic, speeding, and provide increased safety for residential users of the roadway. Preliminary assessment of the soil conditions from observed structural performance and agricultural mapping indicates adequate stability and bearing capacity for the economic

construction of roads on sub-grade formations using embankments of granular material of thickness ranging from 30 cm to 60 cm. As shown in Figure 2, and Figures 3 to 9, pedestrian-friendly sub-division roads are to be constructed to support village layouts that foster strong visual aesthetics and insularity of the community. See Proposed Sewage Treatment Plant Layout and Flow.

1.6.3 Sewage System (Zone 10)

1.6.3.1 Layout

The Sewage Treatment Plant (STP) is to be located on Zone 10 (8 acres) on the southern perimeter of the complex. The design footprint of the STP is 1.5 acres (6074 square m or 113.3 m x 53.61 m as shown on Figure 10).

The plant will be sited on the lowest elevation on the site, and presently has artificially ponds, created by the damming of the gully course. This location is considered suitable for the location of the STP as:

- Its low elevation allows for it to be effectively screened off from the residential zones by chain-link fences, grassed earth mounds, beautification landscaping, and open spaces, in addition to facilitating gravity flows and the required inverts.
- The elevation is above the 100-year event flood event. Additional safety from flooding is provided as the top hydraulic levels of the treatment basins are ~5.5 m five above top of foundations of treatment plant structures.
- There is space for reasonable set-backs: the closest residential lot is approximately 110 m (Environmental Health Units requires a set back of 50 m for oxidation ditch set backs), the distance to the road reservation boundary is 20 m.
- It is situated more than 1 km down-gradient of the water well that is to supply public drinking water.
- Down-gradient (both down stream and down wind) land uses are complementary: pig farm, cattle pasture (Bodles Agricultural Research Centre).

Because of the elevation of the site, the sewage from the development will be gravity fed to the plant. Two pumping stations are planned to deliver flows to the plant. An additional lift station is required for the agricultural area. The system has been designed in accordance with the guidelines of the JIE and NWC, with a maximum distance of 90 m between manholes, and straight sewage lines between manholes. The pipes are designed to have a minimum flow velocity of 1.0 m/s using the Manning flow equation with n = 0.015.

1.6.3.2 Design Basis

The selection of an appropriate STP was guided by the NWC's Developers Manual (1998), and the plant is designed to minimize energy consumption, maintenance requirements and operational inputs. The Oxidation Ditch System (ODS) was selected over the Stabilization Ponds due to set-back requirements of the Ministry of Health, Environmental Health Unit, and associated spatial constraints of the available lands. The proposed (ODS) is robust, able to withstand shock loading, easy to maintain, and free of any foul odors.

This facility precludes the need for additional basin or hydraulic retention capacity, facilitating treatment of variable flows, which best suits a phased development such as this.

The system requires continuous power supply, and a back-up electrical supply will have to be put in place. Continuous power supply is required for the pumping stations to lift sewage to the treatment plant also. A diesel power generating plant of a capacity adequate for the treatment plant and lift stations simultaneous operation is proposed for the development.

The system is designed for a minimum fifty-year life-span. It is assumed that no significant upgrading will be required during this period.

1.6.3.3 Design Capacity of the Treatment Plant

The STP was designed to accommodate and treat design flows of the order of 1.365 million gallons per day (MGD). Sewers are designed to allow maximum expected hourly flows, based on JIE Guidelines. The maximum sewage flow as estimated at 1.36 MGD (million gallons per day) based on the parameters given in Table 8. These estimates are consistent with those presented in the engineering report.

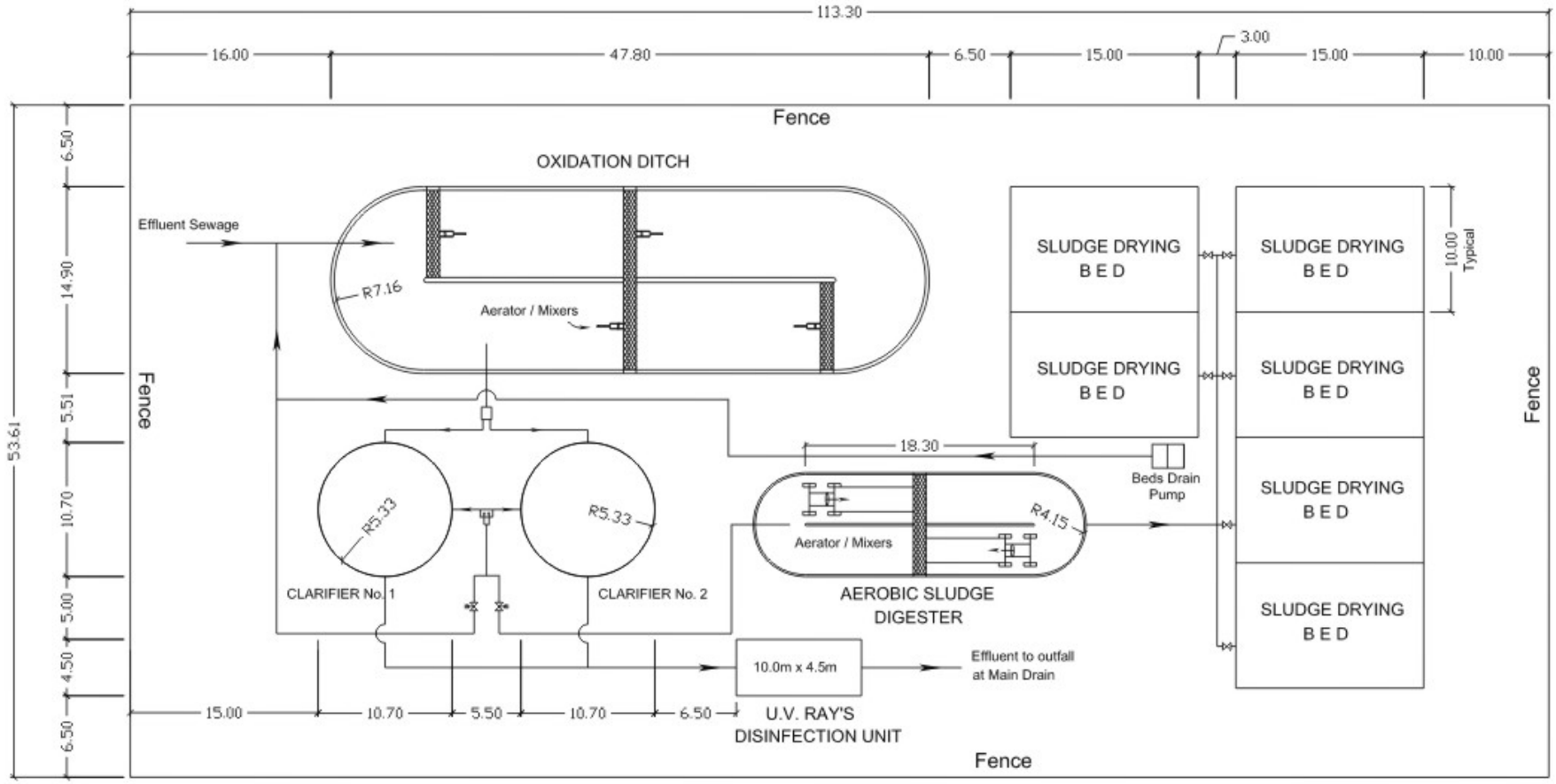
Table 8 Sewage Estimates (Daily production)

Category	Population	Rate in gallons/capita/day	Sewage (GPD)
Residential	18,593	70	1,301,475
School	4,000	10	40,000
Commercial	1,500	10	15,000
	24,093		**1,356,475**

1.6.3.4 Process Flow

As indicated above, an ODS is to be used. This process (Figure 10) uses a completely mixed activated sludge process with removal of nutrients. Aeration and mixing is achieved through a combination of mixing and air diffusion in the ditch flows. Multiple mixing and aeration units are distributed around the ditch. The flow from the oxidation ditch proceeds to the clarifiers for solids separation. Activated sludge is sent to the aerobic digester for storage and further solids reduction. Flow from the clarifiers goes to the disinfecting units then to the effluent disposal system. The effluent will be disinfected through chlorination, to produce a tertiary effluent that meets the Sewage Effluent Standards for New Plants (suitable for disposal in open drains).

Figure 10 Proposed Sewage Treatment Plant Layout and Flow



It is proposed that the treated tertiary effluent will outfall to the Clarendon Gully/Bowers River System, as this would be most economical, and is not expected to pose a public health risk downstream, as much of the area between the site and the Bodles Agricultural Station is maintained as cattle pastures and wetlands. There is an option to use treated effluent for crop irrigation or general landscaping, but this will require that the effluent meets the national irrigation standards.

1.6.4 Drainage Plan

1.6.4.1 Design Basis

There are 2 main drainage systems associated with the site Plantain River/Bowers Gully in the East (running through the agricultural lots) and Clarendon Gully/Bowers River (respectively the western and central tributaries). The Clarendon Gully/Bowers River system transmits significant storm flows from upstream the property to the wetlands on the Bodles Agricultural Estate. The drain in the centre of the property is a minor tributary which drains into the Bodles wetland before joining the Bowers River. The Bowers Gully system on the eastern side appears to be the major regional storm drain. These gullies presently transmit storm flows and are generally dry. A more detailed description of the existing drainage is given in Section 3.

The site is not prone to flooding. According to the engineering assessment, longstanding employees resident on the Bodles Agricultural Research Station report flows of the Bowers Gully overtopping its banks at least once in the last (20) years at a location South of the U-turn of the Gully at the south-eastern boundary of the development. The Bowers' River (Channel No. 1) runs through the centre of the property, exiting near the existing manmade pond and proposed STP site. The Bowers' River (Channel No. 2) occurs to the west of the proposed development site, and possibly represents a flood hazard if the channel capacity is diminished. Channel No. 3 enters the proposed development site running in an easterly direction at the western boundary and joins Channel No. 2 after ~280 m.

The following drainage design is guided by the best practice as there are no published NWA guidelines. The JIE recommendations were indicated as adequate and satisfactory by the Technical Officer (Mr. Roger Smith) of the NWA responsible for storm drainage works, during discussions with the project engineers. The Hydrology Report for the Highway 2000 Corridor Development Plan was also used to inform the design. The JIE recommended guidelines for storm water drainage indications for Design Storm Frequency are as follows: (i) For storm sewers: frequency of 2 years, and (ii) for culverts and boundaries: minimum 10 years. The current recommendations of the NWA are: (i) minor structures i.e. storm sewers along streets > 5 years; (ii) main drains and culverts > 10 years; (iii) major drains and gullies > 50 years. Additionally for major drains, a free board of the greater of the following should be provided: 25% of the designed channel depth -0.6 m or alternately, conveyance capacity (without free board) for the 100 year storm.

Engineered channels for conveyance of the Bowers Gully flow and structures crossing the Bowers Gully are designed to meet minimum design storm of fifty (50) years frequency. The other main drains (No. 1 and No. 2) are also designed with a minimum capacity for conveyance of the 50 year storm flows.

The 5 year storm is used for minor draining structures of curb channels, drain inlets and storm sewers. Design run-offs (see Section 3) were estimated using the Jamaica II method for all major catchments and the Rational Method for sewers and channels, assuming maximum run-off conditions (90%).

1.6.4.2 Design Aspects

According to the engineering design report, the objectives of the drainage plan (Figure 11) are:

1. *To provide safe and efficient conveyance of storm run-off from all areas of the proposed development such that:*
    a) *Damage to property and injury to persons from proposed development areas be highly improbable.*
    b) *Streets can be safely used by pedestrians and motorists during rain storms.*
    c) *Run-off levels in roadway curb channels to be limited to the service levels necessary to permit use of streets without much nuisance to the public during rain storms.*
2. *To protect areas of the development from flooding by run-off generated up-gradient of the proposed development by the engineering of waterways and flood plains as necessary.*
3. *To investigate gully courses, flood plains and other features of storm drainage waterways downstream of the proposed development with respect to its adequacy and efficiency to safely convey flows before the implementation of the proposed development and after the implementation.*

Road Drainage: The road layout will be used as far as practicable to drain lots and paved areas. Finish levels have been set below lot surface levels and cross-sloped to provide a curb channel to convey run-off. Drainage inlets are to be located at the calculated intervals along the curb channel to convey run-off to underground drains running below or adjacent to curb channels. The underground drains form a network along the roads with outfalls as close as practicable to the nearest main drainage channel. For roads abutting main drains, surface drainage over approved distances in accordance with the standards of the NWA (90 m) without inlets flows from road surface to the main drains directly. Details of lot and street drainage, inlet spacing, drainage inlets and sewers are given in Appendix 2.

Figure 11 Drainage Plan Layout

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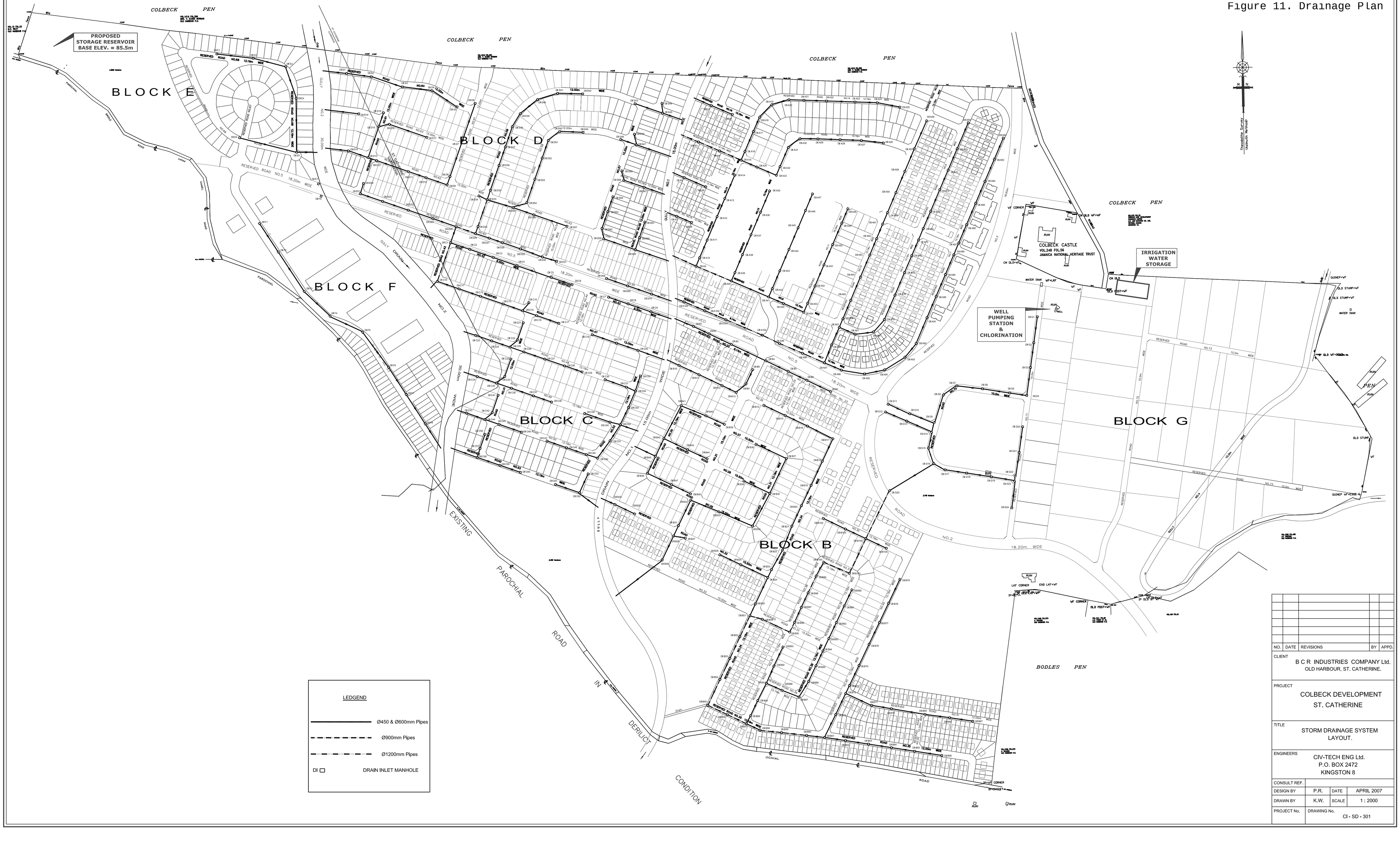
Figure 11. Drainage Plan



NO.	DATE	REVISIONS	BY	APPD.

CLIENT
B C R INDUSTRIES COMPANY Ltd.
OLD HARBOUR, ST. CATHERINE.

PROJECT
COLBECK DEVELOPMENT
ST. CATHERINE

TITLE
STORM DRAINAGE SYSTEM LAYOUT.

ENGINEERS
CIV-TECH ENG Ltd.
P.O. BOX 2472
KINGSTON 8

CONSULT REF.			
DESIGN BY	P.R.	DATE	APRIL 2007
DRAWN BY	K.W.	SCALE	1 : 2000
PROJECT No.	DRAWING No.	CI - SD - 301	

Channels 1 and 2: 50-foot and 100-foot drainage reserves (Figure 11) have been created for these channels respectively, and the following standard engineering approaches are proposed using design parameters specified in Table 9.

- Realignment for more streamlined and efficient flow;
- Uniform sloping of channel beds towards maintaining steady uniform flow regime;
- Increase in the flow capacity of the waterways by increasing cross section areas;
- Lining of channels where necessary to prevent erosion of channel banks and bed.

Additionally, two minor primary tributaries of the Bowers River that cross over the planned Zone 6 to join Gully 1 (the central gully) will be in-filled, and all drainage from this area directed along drains and culverts sized to the recommended engineering specifications.

Channel No. 3 (shown as Drain No. 3 on Figure 11): to be maintained in its natural alignment. An alternate alignment for Channel 3 may be created, with similar cross section and bed slope greater than Drain No. 2, to intersect with Drain No. 2 along the southern boundary of the proposed development. Multi-cell box culverts are proposed for road crossings.

Table 9 Design Parameters for Drain 1 and 2

Section parameters	Drain No. 1 (central)	Drain No. 2 (above intersection with Drain No. 3)	Drain No. 2 (western) below intersection	Drain No. 3 (alternate alignment)
Bed slope	0.01	0.005	0.005	>0.005
Channel depth	2.0 m	3.0 m	3.0 m	3.0 m
Cross-sectional area	14.0 m^2	30.0 m^2	60.0 m^2	30.0 m^2
Catchment area	140 ha	500 ha	1000 ha	
[a] Flow capacity	49.0 m^3/s	92.0 m^3/s		92.0 m^3/s
[b] Peak flow estimate	49.9 m^3/s	83.09 m^3/s	*166.18 m^3/s*	83.09 m^3/s

[a]Manning formula applying a friction coefficient of n = 0.033 [b]50-year design storm

Bowers Gully: A realignment of the Bowers gully at the eastern boundary is proposed. This is expected to improve the efficiency of run-off by reducing the 'back water' effect of the flow constriction of the 180º bend (u-turn) and reduce the flood risk of areas adjacent to the U-turn of the Gully. The proposed realignment is thus expected to improve the value of these areas and significantly reduce the risk of flooding of the Bodles property south of the u-turn of the Gully. The propose realignment will require bank stabilization to prevent scouring, and provision for the lost storm flow retention capacity through adequate downstream channel capacity. Storm run-offs and discharges from the agricultural plots from the agricultural activities will run into the Bowers Gully.

1.7 PROJECT SCHEDULE/PHASING

1.7.1 Planning and Permitting

Site planning and architectural design on the project have been substantively completed at this time. Pre-construction sales are expected to contribute to the project financing, with the NHDC acting as the chief sales agent for the project.

Sales are scheduled to commence as soon as the relevant permits, approvals and licenses are obtained. These include, but are not limited to:

1. Environmental permits and licenses from NEPA.
2. Planning permission from the St. Catherine PC, and relevant building permission.
3. Approvals from the National Works Agency (NWA) and Parish Council in respect of the proposed drainage and road developments.
4. Approval of the sewage treatment plant (STP) and water supply system from the Environmental Health Unit (EHU) of the Ministry of Health.
5. A license to operate a public water supply company from the Office of Utilities Regulation.

It is expected that all approvals, permits and licenses can be reasonably obtained before the end of the first Quarter of 2008. Sales are therefore expected to commence during this period.

1.7.2 Phasing

Construction is expected to begin shortly after sales have commenced (around the start of the Second Quarter of 2008, and continue in four main phases. Full-build-out is expected to be completed within 5 years of permitting (2012). It is expected that the following aspects will be completed in Phase 1, which is scheduled to be done within a 12-month period (2nd Quarter 2008 to the end of the 1st Quarter 2009):

1. Major infrastructure: main access and sub-division main roads, drainage, sewage treatment plant (STP), water supply system (supply mains), and other supply mains routed along the main sub-division roads.
2. Agricultural area sub-division development.
3. Build-out of 416 units of all unit types, focusing on Zone 6 (Figure 12).

Build-out is expected to proceed with demand and sales over the four-year period after the completion of Phase 1 is estimated (based on cash flow) as described in Table 10. Phase 2 will focus on construction mainly in Zone 6 and the apartment blocks of Zone 5. Phase 3 will focus on completion of Zone 5, and Phase 4 will focus on the completion of most of Zone 7. Zones 8 and 9 will be completed in the final year.

The commercial area will be constructed when the population it is intended to serve has reached a level that can justify its implementation. The development of the Colbeck Castle

Heritage site, and the community park in Zone 11, which will be used as the main construction (staging and stockpiling) camp, will be completed in Phase 5.

Figure 12 Phasing Diagram (Residential)

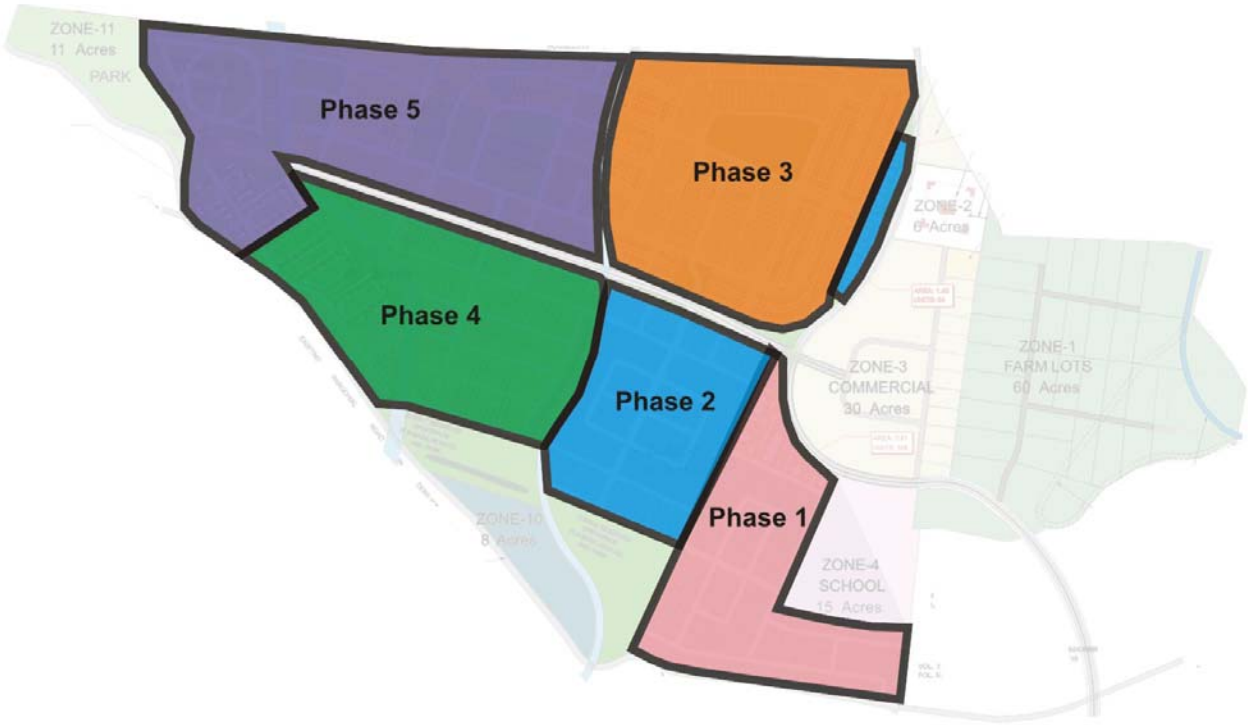


Table 10 Phased Delivery Schedule

Units	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5
Detached Single Family	136	179	218	153	279
Semi-Detached Townhouse	196	130	336	184	188
Apartments	84	192	48	252	96
	416	**501**	**602**	**589**	**563**

1.8 Post-Construction Management

1.8.1 Residential Villages

The phasing of build-out to avoid nuisances to early purchasers will be managed by the contractor. Property buyers will be expected to abide by a set of development standards that will be conveyed to them along with their purchase agreement. This will establish standards in respect of future "*add-ons*" or extensions to units that are sold them. All units that are sold will be tied into the sewage treatment plant (STP).

A Maintenance Agreement will be prepared by the developer's legal representative and signed by all purchasers as a part of the conveyance and transfer process. This will give the General Management Committee (see below) the authority to impose a maintenance charge commensurate with the cost of the services to be provided.

1.8.2 Agricultural Zone

Agricultural lots will be sold (with a housing unit) to interested purchasers. The developers are in discussion with the Ministry of Agriculture and Lands to create development models to offer to the purchasers, which will have some level of technical input from developers as well as and the Ministry/RADA. The type of agriculture that is being promoted is consistent with what is currently being recommended by RADA. Unchlorinated irrigation water (as well as potable water for domestic use) and sewerage connections will be installed at the sites prior to sale. Due to proximity to the water supply source, no soakaway systems will be permitted in this area.

1.8.3 Business Zone

A Strata Corporation will be registered to manage the commercial complex. Each shop will be for sale. If sales are slow, the shops will be rented until sale becomes possible. Management of the commercial centre will be undertaken by the Strata Corporation.

1.8.4 Community Services

1.8.4.1 General Maintenance & Other Community Services

A General Management Committee (GMC) will be created to administer the needs of the combined residential community, and to provide a forum for the needs and concerns of the residents. The GMC will mainly comprise representatives from the community. Each 'Village' will be expected to provide representation to the General Management Committee. Each 'Village' will therefore form a Local Committee to administer the needs of the local village.

The main focus of the GMC is expected to be:

1. Park maintenance. The Zone 11 Community Park and other smaller village parks will be maintained for community recreational use.
2. Security. Neighbourhood Watch Programmes developed in consultation with the Old Harbour Police Department.
3. Utilities. In the event that inadequate quality of service is being provided in terms of roads, water, sewerage, telephone, drains etc, the GMC will make the appropriate representations to the agency involved. A water company (described below) will be established by the developers to manage the water supply system and the wastewater plant.

4. Co-ordination of a community emergency response plan (ERP): A community-based disaster-sub-committee of the GMC will be established to implement the ERP, and will be done in partnership with the Office of Disaster Preparedness and Emergency Management through its Parish Disaster Committee.
5. Any issues pertaining to construction nuisances arising during the overlap period between commencement of sales and completion of full-build-out.

Parish Council and the National Works Agency are expected to take up responsibility for sub-division roads maintenance, and storm drain maintenance. It is expected that the NSWMA affiliate in the area will assume responsibility for collection and disposal of garbage generated by the development during its operational phase.

Similarly, schools that are constructed by third parties and operated by the Ministry of Education will be managed fully by the Ministry as government schools. Tie-ins to the mains (water, sewerage, electricity) will be provided, and it is expected that these services will be purchased at the rates approved by the OUR.

1.8.4.2 Heritage Site

The Colbeck Castle site will be restored to the extent recommended by the JNHT. The grounds, inclusive of the buffer zone and area immediately outside of this buffer zone will be operated by the developers as a tourist attraction on lease from the JNHT. Shops (Café, ice-cream parlour etc) on the compound outside the buffer zone will be operated as concessions. Some portion of the profits from commercial aspects of this development will be used to maintain the grounds, erect signage, and maintain the site and associated museum.

1.8.4.3 Water and Sewage

The developers are responsible for providing water to meet the project full build-out demand, inclusive of potable water, irrigation and fire water. It is proposed that a water and sewage company will be registered with the OUR. All residents will be supplied with water and wastewater connections by this company at the rates approved by the OUR.

It is expected that a Water Safety Plan will form part of the operational requirements of the EHU in respect of the Public Water Supply System. The EHU will conduct periodic inspections of the plants through Ministry of Health Inspectors.

All required testing of water and wastewater effluent, as well as operational maintenance will be done by the Water and Sewage Company.

1.9 IMPACT CAUSING ASPECTS OF THE PROJECT/ FOOT PRINT

Impact causing activities of the project are described in terms of the project implementation (Table 10 Phased Delivery Schedule) and the operational phases

(Table 11 Summary of Development Impact-Causing Aspects). The implementation phase includes preparatory activities, and on and off-site construction related activities. The operational phase activities include all activities normally undertaken once the construction works have been completed. Impact causing activities, in this case, are discussed in terms of their associated footprint, waste streams and resource usage. The discussion also considers the probability of upset conditions during each phase.

Table 11 Summary of Development Impact-Causing Aspects

Site Development Activities	Resource Usage	Waste Streams
Vegetation clearance and removal of any structures or bulky wastes on the property	Labourers	Vegetation and demolition debris Fugitive dust from bare soils Site run-offs Land fill space
Earthworks (grading, excavation, filling etc.) and drainage modification	Labourers and contractors Construction equipment Diesel fuel	Combustion emissions from equipment Possible suspended materials in run-offs Fugitive dust Noise emissions from equipment
Construction fencing & safety measures	Labourers Fencing materials (zinc or plywood) Signage	
Erection of scaffolding and decking	Shoring timbers and plywood	Noise emissions Source area run-offs from vegetation clearance.
Stockpiling of earth materials, aggregate, construction materials	Land space Dust management water Laborers Materials for bunding and covering	Site run-offs Fugitive dust
Worker camp and site office	Land space Portable lavatories Vendor services (food & beverage) Potable water Electricity for lighting and Security	
Haulage of construction materials, solid waste, septage from portable lavatories	Haulage equipment Land fill space	Vehicular emissions and fugitive dust Landfill space for solid wastes Sewage treatment for lavatory wastes Vehicular noise
Construction of civil structures (roads, culverts, sewers, STP etc.) & Installation of utilities conduits (water, sewage, electricity,	HR: laborers, supervising engineers, plumbers, electricians, masons, carpenters, and painters. Safety gear for workers Electricity	Vehicular noise

Site Development Activities	Resource Usage	Waste Streams
telephone, cable etc.)	Diesel fuel Aggregate & marl Construction water Concrete and concrete products PVC pipes Zinc	
Building construction	HR: laborers, supervising engineers, plumbers, electricians, masons, carpenters, and painters. Safety gear for workers Electricity Diesel fuel Construction water Concrete and concrete products Steel, pipes & cables Wood and stone Roofing and ceiling materials Fixtures, windows & paints	Construction noise Combustion emissions Site run-offs (suspended solids) Packaging wastes Fugitive dust
Commuting of workers	Transportation Fuel consumption Wear and tear on roads	Vehicular emissions (including noise, and dust)
Landscaping of park areas	Plants, fertilizers, pesticides	
Restoration of Colbeck Castle	Co-management agreement with JNHT	
Concrete batching plant operations	Laborers Mobile plant with silos Scales and mixing trucks Washwater system Fencing and security Concrete, aggregate and additives Diesel Generator Site office	Fugitive dust and plant operations from trucks. Equipment emissions Site run-offs containing cement particulates Washwater from mixing drums Solid waste from additive containers
Haulage of pre-mixed concrete & asphalt for roads	Wear and tear on roads Safety requirements for drivers Covers for haulage Maintenance & servicing of vehicles	Fugitive dust and combustion emissions along transport route. Washwater from vehicles Oil rags and lubricants
Accidental spillage of oils or lubricants	Materials for clean-up Landfill space for contaminated soils Emergency responders Staff training	Contaminated earth materials Contaminated site run-offs Chemical residues from clean up Oil rags used for clean-up
Occurrence of a hurricane during construction	Plywood & materials for repairs Equipment for site clearance Backup generators Emergency storage space	Noise pollution from generators Debris (from structures)
Fire or explosion	Fire water and equipment Trained response team	Smoke emissions including particulates Damaged or destroyed materials (solid waste)

Site Development Activities	Resource Usage	Waste Streams
Workplace accident or traffic accident due to operator error, equipment failure or earthquake	Trained response team Medical personnel and vehicles Materials for repairs Equipment for site clearance	Smoke emissions including particulates Damaged or destroyed materials (solid waste)

Table 12 Summary of Operational Impact-Causing Aspects

Operational Activities	Resource Usage	Waste Streams
Residential activities: commute, consumption of utilities etc.	Consumption of former agricultural lands Potable water and fire water Electricity Cable, phones Wear and tear on roads Domestic services: helpers, gardeners Landfill space Sewage treatment services Vehicles or public transportation (buses, taxis)	Domestic waste Grey water & sewage Site run-offs Vehicular emissions Light pollution
Commercial activities	Consumption of former agricultural lands Potable water and fire water HR: retail (managerial and sales), professional (doctors etc.), security guards, janitors Electricity, cable, phones Wear and tear on roads Domestic services: helpers, gardeners Landfill space Sewage treatment services Gas and fuels Vehicles or public transportation (buses, taxis)	Domestic and packaging waste Machine shop wastes (oil rags, lubricants, plastic containers etc.) Grey water & sewage Site run-offs Vehicular emissions Restaurant wastes: oil and grease, organic and food wastes, Styrofoam bottles and tins. Light pollution
Agricultural activities	Staff: laborers Electricity, Cable, phones Wear and tear on roads Landfill space Sewage treatment services Gas and fuels Irrigation and potable water Pesticides Fertilizers Plants or fish Storage and processing units Transportation units Vehicles and farming equipment	Domestic wastes and machine shop wastes (oil rags, lubricants, plastic containers etc.) Fugitive dust and emissions Run-offs from bare soils and machine shop areas Effluents from hydroponics or fish ponds (elevated nutrients and BOD)
Colbeck Castle Tourist Attraction & associated tour traffic	TPDCo approvals and inspection Possible need for entertainment or tour guides Team Jamaica training for staff Commercial aspects for shops Grounds maintenance staff Souvenir and craft supplies	Solid waste Grey water & sewage Site run-offs Vehicular emissions
Schools	Commitment from Ministry of Education	Domestic waste

Operational Activities	Resource Usage	Waste Streams
	Staff: teachers, administrators, janitors, etc. Electricity, Cable, phones Wear and tear on roads Landfill space Sewage treatment services Gas and fuels	Grey water & sewage Site run-offs Vehicular emissions Light pollution Daytime noise pollution
Parks and trails maintenance	Fertilizers Irrigation water Pesticides Public lavatories Food and beverage outlets Staff for grounds maintenance	Wood chippings Run-offs from vegetated areas and trails. Sewage from public bathrooms Packaging materials from food and beverage containers
Vector Control	Pesticides Collaboration with EHU (re mosquito control)	Pesticide residue Nutrient rich leachates
STP operations, monitoring and maintenance and Public water supply	Units needed for process Electricity Technical staff Pumps Chlorine gas	Treated effluent Emissions from backup generator Site run-offs Machine shop wastes
Drains, parking areas and roads maintenance	Consumption of former agricultural lands Street lights Safety signage and traffic calming devices (traffic lights, sleeping policemen, zebra crossings)	Run-offs with oil and grease and suspended materials Light pollution
Accidental spillage of oils or lubricants associated with maintenance of pumps or units.	Clean-up equipment Emergency responders	Contaminated run-off if not contained
Occurrence of a hurricane, flood or earthquake during operations	Plywood for storm shutters Materials for repairs Equipment for site clearance Backup generators Individual water treatment or storage	Noise pollution Debris (from structures)
Fire or explosion	Fire water and equipment Trained response team	Smoke emissions including particulates Damaged or destroyed materials (solid waste)
Traffic accident due to operator error, equipment failure or earthquake	Trained response team Medical personnel and vehicles Materials for repairs Equipment for site clearance	Smoke emissions including particulates Damaged or destroyed materials (solid waste)

2 REGULATORY AND INSTITUTIONAL FRAMEWORK

2.1 SECTION OVERVIEW (TOR)

The purpose of this section is to highlight relevant applications of regulatory control mechanisms to decision-makers and the concerned stakeholders, while providing the developer with information in respect of statutory and administrative requirements for the project. An outline of the relevant environmental regulations, policies and standards/guidelines governing the construction and operation of a residential subdivision as proposed is given. Relevant international guidelines, conventions and protocols described where local controls are absent or insufficient.

Regulatory controls and institutional frameworks with jurisdiction over the following main areas as they relate specifically to this site and project: planning, development and operational control, environmental conservation and waste management. The roles of agencies with responsibility for implementing legal mechanisms are described.

2.2 PLANNING CONTEXT

2.2.1 Physical Planning

The National Physical Development Plan (NPDP) is the major planning policy used to guide land use planning and development in Jamaica. It focuses on physical planning, settlement, conservation, income generators (i.e. forestry and fisheries, agriculture, mineral industries, tourism and manufacturing) and public utilities. To support modern planning objectives the NPDP has been used to inform the preparation of Development Orders, which are development control mechanisms used in the development control process. The proposed development is located within an area for which there is no Development Order, and as such there are no recent physical plans in respect of type of land-uses allowed in the parish of St. Catherine. NEPA is currently preparing a development order for the entire parish of St. Catherine.

According to the NPDP, however, the area is zoned for agricultural development. In recent times the planning authorities have granted approval for a '*change of use'* from agriculture to residential/commercial to housing developers, including Gore Development and WICHON Infrastructure Limited.

The Land Development and Utilization Act (1966) authorizes the Land Development and Utilization Commission (LDUC) to designate suitable lands as agricultural. The LDUC (NEPA) is mandated to ensure that agricultural lands are properly developed. With the implementation of the project, only 60 of the 394 acres remain under agricultural use. Although zoned for agricultural use, and historically used for such, these lands are presently not in active agricultural production, and are not being put to productive use.

The developers are in process of seeking approval for the "*change of use*" from agricultural to residential/commercial use, as has been allowed for other recent developments in the area.

The Ministry of Agriculture, through the Rural Agricultural Development Authority is responsible (under the Rural Agricultural Development Authority Act, 1990) for guidance of agricultural activities in areas outside Kingston, and will have some oversight and input into the proposed agricultural development.

2.2.2 Road & Infrastructure Plan

The National Construction Industry Policy developed under the Ministry of Housing, Transport, Water and Works is responsible for public infrastructure initiatives in Jamaica. The Policy outlines the Government's vision for the sustained growth and development of Jamaica's Construction Industry. The Ministry, which also developed the Road Sector Policy and the National Transport Policy, is responsible for the construction, improvement and maintenance of road infrastructure. These policies address the safety of road users, the efficient movement of public transport, and the minimization of negative environmental impacts arising from transport and infrastructure over the long term. With the recent development of the Highway 2000 which bypasses Old Harbour, no additional transportation plans are presently being considered for this area.

2.2.3 Water Resources Master Plan

The Water Resources Development Master Plan as required under the Water Resources Authority Act (1995), has been developed to allow the proper management of water resources. It evaluates and recommends how Jamaica should use its water resources. The site does not occur in an area classified as having high importance as a recharge zone, although it overlies an important aquifer, with several licensed wells in the area. The surface water resources associated with the site are not presently exploited, although there has been some speculation about the potential of the Bowers River below the Bodles dam (personal communication, A. Haiduk, October 2007)

2.2.4 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. Although the site is not located within or adjacent to a protected area, it is located within 3 km of the Portland Bight Protected area. The NRCA (Portland Bight Protected Area) Declaration Order (1999) declared the Portland Bight a Protected Area, and includes the Harris Savanna.

2.2.5 National Forest Management and Conservation Plan

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. The vegetation on the Colbeck Castle site is classified as being mixed and non-forest vegetation, and falls outside forest reserve areas as indicated on the 1998 Forest Land Use map.

2.3 REGULATED ASPECTS OF THE PROJECT

2.3.1 Development Control

2.3.1.1 Environmental Permits and Liscenses

The National Environment and Planning Agency (NEPA) is in charge of land use and development and natural resource conservation, as permitted under the Natural Resources Conservation Authority (NRCA) Act, (1991) which makes stipulations for Environmental Impact Assessments (EIA) in addition to the requirements of the Permit and Licensing System for a development proposal. The following elements of the project qualify it for the requirement of an environmental permit under the NRCA schedule:

- Development projects: Housing projects (10 and more units).
- Water treatment facilities, including water supply and desalination plants
- Irrigation and water management and improvement projects
- Sewage and industrial waste water treatment facilities
- Cement and lime production
- Construction of arterial roads,
- Shopping centres
- Aquaculture facilities and ponds and intensive fish farming
- Electrical transmission lines and substations greater than 69 kv

An environmental discharge license is also required for the sewage treatment plant.

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, WRA, EHU, Jamaica Bauxite Institute, National Works Agency, and Mines and Geology Division. 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.

2.3.1.2 Planning and Building Permission

The Town and Country Planning Authority governs the Town and Country Planning Act (1957), which regulates the development and use of land in Jamaica. All development projects must be granted planning and building permission, with due consideration to planning constraints such as zonation, parking and availability of municipal services, from the Town and Country Planning Authority and the Local Planning Authority, which in this case is the St. Catherine Parish Council. The area for the proposed development falls under the Town and Country Planning Act (1957) that guides physical development in the Parish.

2.3.1.3 Roads & Drainage

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 proposed construction of arterial and other access roads, as well as entrances and exits to main roads will have to approved by the NWA.

The NWA administers the Flood Water Control Act which regulates the management of watercourses concerning flood regulation, specifically, terms of surveys, civil works or clearance. 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 drainage plan will have to be approved by the NWA.

2.3.1.4 Water Supply

Section 19 of the Water Resources Act of 1995 states that no person shall abstract and use water; or alter or construct any works for the abstraction and use of water unless a licence is granted to him by the WRA. It further states that "*a person may abstract and use water without a licence if he has a right of access to the source of water; and if the water is required only for domestic use*". Applications are evaluated based on the following criteria:

- The quality of the source to meet the demand standard.
- The ability of the source to meet the demand reliably (safe yield).
- Existence of prior users with rights to the water.
- Impact of the disposal of any wastewater that may be generated.
- Any other matters that the Authority regards as relevant.

The proponent has acquired a license for abstraction of groundwater from an existing well at Colbeck. WRA's focus is the wise and sustainable use of water resources.

An environmental permit is required from NEPA to develop a public water supply system under the NRCA Schedule. NEPA's focus is primarily environmental protection and avoidance of construction or operational impacts and conservation of natural resources (which in this case is the main purview of WRA).

The Public Health Act does not provide for a specific licensing process in respect of the supply of drinking water to the public as it relates to water safety and public health. However, the EHU (Ministry of Health) is responsible for approving all proposals for public water supply, inclusive of the treatment and distribution systems. The EHU requirements for approval of water supply systems include:

1. The WRA abstraction license.
2. An Engineering Report, which should include:
    a. Technical design and layout drawings
    b. Characteristics of the raw water (water quality profile).
    c. Flow chart of the treatment process.
    d. Calculation showing that the treated water will meet National Water Quality Standards.
    e. Information on population to be served.
    f. Operations and Maintenance schedule.
3. A Monitoring Plan for quality assurance, including:
    a. Identification and designation of sampling points at source and within the distribution network (to be done in conjunction with MOH).
    b. Frequency of sampling and testing of water.
    c. Proposed record keeping arrangements.

The EHU now requires submission of Water Safety Plans (as described by the WHO Drinking Water Guidelines). The process to formalize the EHU's approval system has begun with the drafting of the a technical document to guide drafting of the Drinking Water Regulations that are scheduled to be made pursuant to the Public Health Act.

Once an Environmental Permit and MOH/EHU Approval have been obtained for the operation of a water supply system, Parish Council must approve the final construction of the buildings and infrastructure associated with the plant. This includes any infrastructure associated with minor supplies as well as larger treatment plants.

The Office of Utilities Regulation Act (1995) established the Office of Utilities Regulation (OUR) as the main government corporation with responsibility for regulating utilities services through a licensing system. As such the supply and distribution of water is regulated by the OUR.

Under subsection 4/2b, registered water supply utility companies are required to provide services that:

1. Meet the needs of the community.
2. Are efficiently provided in a manner to protect the health and well-being of the service and persons affected by its operations.
3. Take into account the need to protect the environment.
4. Are economical and reliable.
5. Are on terms which allow for a reasonable return on capital invested in providing the service.

The Office of Utilities Regulation (OUR) and the utilities develop standards by which the quality of customer service can be quantified and incentives provided for continuous improvement. It receives and reviews applications for rate reviews, investigates possible breaches of license, and takes enforcement action where appropriate. The OUR supersedes the Public Utility Commission Act, and subsumes the Public Utility Commission. The OUR is responsible for making recommendations for licensing to the Minister, and is funded by the ensuing licensing fees. Subsection 4 (3) of the OUR Act specifically provides for the encouragement of competition, and the use of modern and efficient utility services *inter alia.*

2.3.1.5 Sewage Treatment

All new Sewage Treatment Plants (STPs) are required to have a NRCA discharge license under NEPA's Permitting and Licensing system. This is granted by NRCA in consultation with the EHU and the WRA.

2.3.2 Conservation of Environmental Resources

2.3.2.1 Wildlife and Biodiversity

The Natural Resources Conservation Authority (NRCA) under the Natural Resources Conservation Authority Act (1991) is the government 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.

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 – Table 13).

Table 13 Third Schedule of the Wild Life Protection Act (Terrestrial)

Invertebrates:	Jamaican Kite Swallowtail, Giant Swallowtail Butterfly
Reptiles:	Crocodile Iguana
Mammals:	Coney

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.

2.3.2.2 Forestry, Watersheds and Water Resources

NEPA administers the Watershed Protection Act (1965), and is thus mandated to ensure the proper, efficient and economic utilization of land in watershed area. The Act also promotes the conservation of natural resources, particularly watershed areas.

The Water Resources Authority 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 manages the water resources of Jamaica by issuing five (5) year licenses for the abstraction of ground and surface waters. 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 Town and Country Planning Authority under Section 25 of the Town and Planning Act is the body that regulates the development and use of land in Jamaica. The Authority is also responsible for the preservation of forests, woods, trees, shrubs, plants and flowers.

The Forestry Deparment (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.

2.3.2.3 Heritage Resources

The Jamaica National Heritage Trust (JNHT) is a branch of the Ministry of Tourism, Entertainment and Culture which 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 such Colbeck Castle.

The JNHT mission statement states: "*to inspire a sense of pride through the promotion, preservation and developmentg of our material cultural heritage*…" The primary functions of the JNHT are:

- To promote the preservation of national monuments and anything designated as protected national heritage for the benefit of the Island;
- To conduct such research as it thinks necessary or desirable for the purposes of the performance of its functions under the Jamaica National Heritage Act;
- To carry out such development as it considers necessary for the preservation of any national monuments or anything designated as protected national heritage;
- To record any precious objects or works of art to be preserved and to identify and record any species of botanical or animal life to be protected;
- To promote the sustainable utilization and management of our material cultural heritage resources.

The heritage site at Colbeck Castle is owned by the JNHT, and any plans by the developers to alter the site or modify the existing built structure of the castle in any way will have to be approved by the JNHT. Appendix 4 is a letter of no objection from the JNHT further to their technical evaluation of the archaeological resources of the site.

2.3.3 Waste Streams and Public Health Criteria and Standards

2.3.3.1 Air Quality

The Natural Resources Conservation Authority (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 (PM_{10}), 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.

2.3.3.2 Noise Emissions

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 o'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.

World Bank Health Organization and the World Health Organization 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, although the World Bank night time (10:00 pm to 7:00 am) for residential zones is 45 dBA.

2.3.3.3 Effluents

The Pollution and Prevention Control Branch of the National Environment and Planning Agency (NEPA) regulates the control of groundwater contamination under Sections 15 and 16 of the NRCA Act. Section 12 of the NRCA Act stipulates that licenses are required for the discharge of sewage or any polluting matter. Section 17 allows for the periodic performance reporting from the owner or operator of any sewage treatment plant, industrial waste treatment facility or any facility for the disposal of solid waste or any other facility for controlling pollution. This can include information pertaining to the performance of the facility; the quantity and condition of effluent discharged and the area affected by the discharge of effluents. Table 14 summarizes the effluent criteria for Jamaica (NRCA standards)

Table 14 Jamaican Water Quality Standards

Parameter	Freshwater	Sewage Effluent (new plants)	NRCA Interim Irrigation Standards
Biological Oxygen Demand mg/L	0.8 - 1.7	20	15
Total Suspended Solids mg/L	-	20	15
Total Nitrogen		10	
Nitrates mg/L	0.10 - 7.5		
Phosphates mg/L	0.01 - 0.8	4	
Chemical Oxygen Demand mg/l		100	<100
Oil and Grease mg/l			10
pH		6 to 9	
Faecal Coliform – MPN/100 ml	-	1000	12
Residual Chlorine mg/l		1.5	0.5

The Public Health Act (1985) makes provision for the establishment of the Central Health Committee (appointed by the Minister chaired by the Chief Medical Officer). The Public Health

Act under Section 7 makes provision for the local health boards (Parish Council) to regulate *inter alia* such areas as public sanitary conveniences, lodging houses and camps, swimming pools, restaurants, public nuisances, garbage and waste. This is done in conjunction with the Central Health Committee. The Environmental Health Unit (EHU) of the Ministry of Health has responsibility for administering the act, including the review of designs for sewage treatment. The Public Health Regulations (First Schedule, paragraph 10) prohibit the discharge of sewage into the sea.

Other legislation with clauses pertaining to water pollution include:

- Section 37 of the Water Resources Act states that it is unlawful to cause underground water to run or to waste from any well unless for the purpose of testing the extent or quality of supply or cleaning, sterilizing, examining, or repairing the well.
- The Wildlife Protection Act (1945) (administered by NEPA) prohibits the pollution of any water body, whether rivers, lakes, canals, lagoons containing fish by the permitting of trade effluents, industrial wate or any other sewage, noxious and polluting matter.

2.3.3.4 Sediment Quality

Jamaica lacks specific sediment quality or soil guidelines. The most commonly internationally adopted sediment/soil quality guidelines are the Canadian Environmental Quality Guidelines (2002), specifically the Interim Sediment Quality Guidelines (ISQGs). These standards are used to compare sediment quality test result data for specific pollutants in the following chapter.

2.3.3.5 Solid Waste

The National Solid Waste Management Act (2001) regulates solid waste management in Jamaica. 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. The National Solid Waste Management Authority (NSWMA) is the governing body in charge of solid waste management in Jamaica.

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 *inter alia*:

- A cleared 15-foot buffer zone around the fire.
- Burning trash between 6 pm and 6 am.
- Leaving fires unattended.

3 DESCRIPTION OF THE ENVIRONMENT

3.1 SECTION OVERVIEW

The purpose of this section of the EIA is to describe Valued Environmental Components (VECs) within an area that could be impacted should the project be implemented. It is therefore not limited to a description of the site. The level of study given to any one VEC in this baseline is commensurate with the degree of change to baseline condition that may be expected as a result of project implementation. Information presented in this section allows for:

1. Evaluation of existing trends in environmental systems if the project were not implemented and the carrying capacity of the environment in respect of specific stresses;
2. Determination of existing environmental effect levels to which the project may contribute; and
3. Establishment of a baseline against which future monitoring data can be compared to determine whether and how a project is actually impacting specific receptors.

This section is organized according to the broad classification of physical environment, biological environment and human and built environment. Methodologies and data sources with respect to each sub-section are given at the start of that sub-section.

3.2 PHYSICAL ENVIRONMENT

3.2.1 Climate

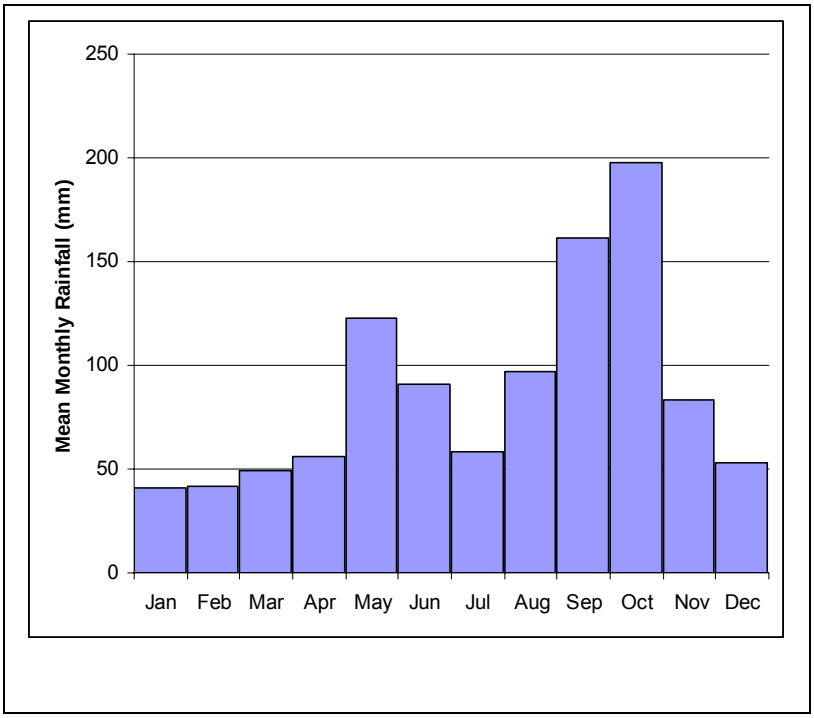
3.2.1.1 Rainfall

The mean annual rainfall for the Bodles Agricultural Research Station for the 30-year period 1951 to 1980 was ~1052 mm. St. Catherine and Clarendon are typically dry areas, being in the rain shadow of the Blue and John Crow Mountains. There is apparently considerable variation in total annual rainfall in the area (Figure 13). 2002 and 2005 were the wettest years in the 14 year period. Seven of the fourteen years experienced rainfall over 1000 mm but less than 1500 mm, and six of the fourteen years had less than 1000 mm of rainfall.

The annual distribution of rainfall (Figure 13) has the following characteristics:

- A typical bi-modal distribution with peaks six months apart. The May peak (123 mm) is considerably lower than the October peak (198 mm). “Dry season” months are December to April and June to August.
- In general, the minimum mean month rainfall occurs in January and February (41 and 42 mm per month respectively).
- Rainfall only exceeds a mean monthly depth of 161 mm in September and October.

Figure 13 Annual Rainfall Distribution, Bodles Agricultural Station (1951-1980)



Source: National Meteorological Service of Jamaica

3.2.1.2 Temperature & Relative Humidity

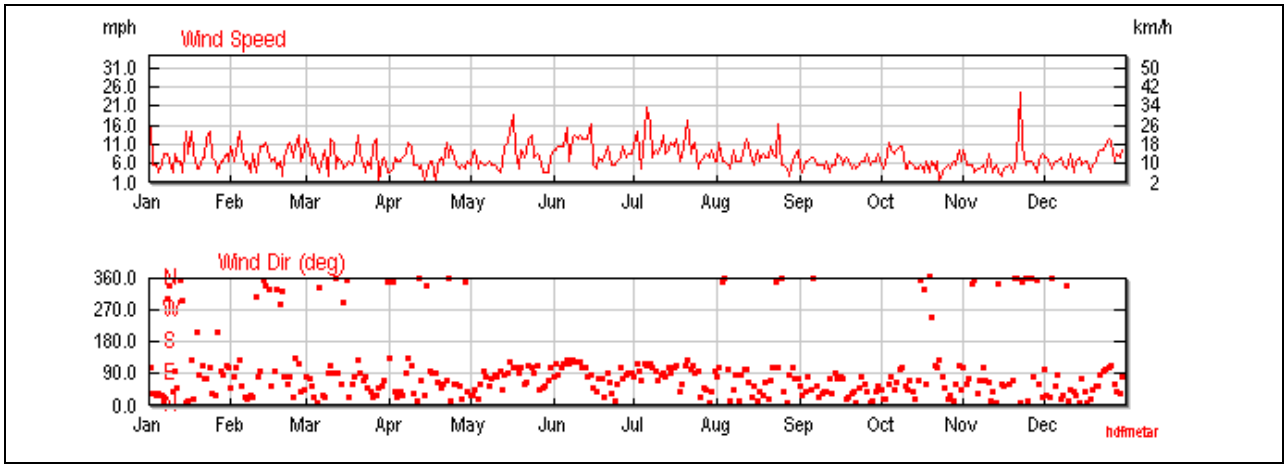
As is typical for Jamaica, mean monthly temperatures for the area vary slightly with the summer (June to October) and winter months (November to March). Temperatures range between lows of ~16 degrees C. in the winter months and highs approaching 32 degrees C. in the summer months. Relative humidity follows tends to be lowest in the drier months, and higher in the wetter months as expected. On average, the percentage humidity ranges between 74% (in July) and 82% (in October).

3.2.1.3 Prevailing Winds

Representative data from the NMIA indicate that wind speeds are greatest in the dry hot summer months (June to August), often exceeding 18 km/hr. After September, average conditions tend to be relatively calmer (less than 10 km/hour) until about mid-January. Between that time and the end of May conditions are somewhat windier. Windy conditions during the winter months (January to March) are often associated with norwesters, blowing in from the northern latitudes.

In terms of wind directions, the prevailing winds come from between 0 degrees and ~135 degrees (north to north-east). This is expected as the dominant system affecting the island is the North East Trade Winds. Between May and August prevailing winds appear to come from the east.

Figure 14 Wind speed and wind direction frequencies at the NMIA (2006)



http:www.wunderground.com

3.2.2 Soils

The Ministry of Agriculture's soils map of Jamaica (1:50,000) shows that the site is underlain by four main alluvial soils that are described below.

The dominant soil type is clay loam (St. Ann, Bodles, and Lodge). The St. Ann clay loam is found in the north-western side of the property, underlying most of Zone 9 and the northern parts of Zones 5 and 8. It is described as a red-brown bauxitic soil that is generally associated with limestone terrain. In general it is acidic and clayey with low moisture retention capacities and an extremely rapid internal drainage. They are generally deep soils occurring on slopes of between 10 and 20 degrees. The Lodge Clay Loam is found on the gentle slopes (less than 5 degrees) south-eastern side of the property, encompassing most of Zone 4 and the eastern part of Zone 6. This is a very deep soil with well defined horizons. The soil is generally saline with moderate internal drainage and a high moisture retention capacity. The Bodles Clay Loam dominates the gentle terrain of eastern side of the property, inclusive of most of Zone 5, Zone 3, and Zone 6. It varies from shallow to slightly deep, tends to be poorly drained with a high moisture retention capacity. It also varies from mildly alkaline to slightly acidic.

The next most important group is the Sandy Loams (SL), which consists of the Colbeck Sandy Loam and the Whim Sandy Loam, both of which are alluvial soils associated with the river systems. The Colbeck Sandy Loam is associated with the Clarendon Gully sub-basin (Bowers River), whilst the Whim Sandy Loam is associated with the floodplain of the Bowers Gully system. The Colbeck SL dominates the south-western part of the property, and underlies the gully course, and its flood plain in Zone 8/9 and 7/6. The proposed STP (Zone 11) is underlain by this type of soil. This brown soil tends to become reddish brown to yellowish brown in the lower strata. The depth of the soil varies from shallow to deep in some areas. It has a moderate moisture retention and internal drainage. The soil is also mildly to moderately alkaline with slopes of 2 to 5 degrees. The Whim Sandy Loam is mainly found underlying the agricultural

lands of Zone 1 that are within the Bowers Gully floodplain. It has a dark greyish brown sandy loam which becomes paler and heavier with depth. Internal drainage for these soils is moderate to good with low moisture retention. These are usually found on flat lands of about 0 to 2 degrees with deep fertile soils which are ideal for agriculture. This type of soil is found on the eastern most part of the site which is zoned for agriculture.

Soils that have relatively minor distributions on the property include the Bonnygate Stony Loam that is found on the northwestern side of the property, and is associated with the hilly limestone terrain (of Zone 11). The Union Hill Stony Clay is found in the vicinity of the old fish ponds (Zone 5 and part of Zone 3). It tends to have a moderate internal drainage with high moisture retention. The Bundo Clay is found in the eastern part of Zone 7, and tends to be associated with limestone bedrock. This soil is strongly acidic, relatively deep and has a high moisture retention capacity and slow internal drainage.

3.2.3 Topography & Drainage

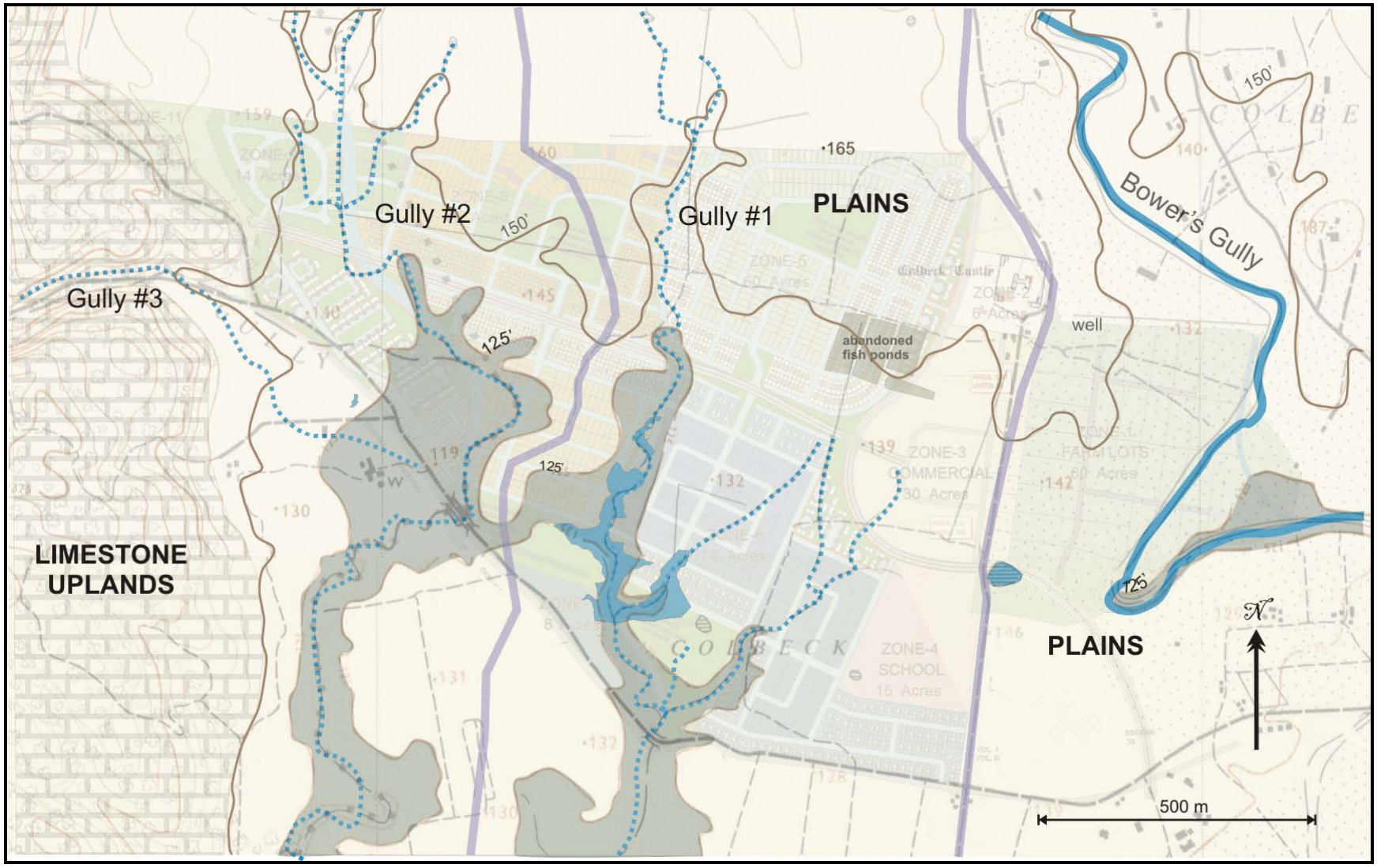
3.2.3.1 Geomorphology

The terrain at the development site (Figure 15) comprises undulating plains ranging from a high point of about 50 m (165 feet) above sea level (asl) along its northern boundary to a low of 36 m (119 feet) asl along its south-western boundary. To the west, the terrain changes dramatically from gently undulating alluvial plains to the limestone uplands extending northwards from the Old Harbour Hills. On the southwestern side the lowest elevations are associated with the main gullies that drain the property (shaded area on Figure 15).

3.2.3.2 Drainage

There are four important drainage channels that characterize the site. The Bowers Gully runs close to the south-eastern boundary of the site. This permanent stream flows south-westerly into the property for a distance of ~590 m before looping back in west-north-westerly direction and flowing another 410 m before exiting the site. According to the drainage engineer, the basin of the Bowers Gully covers extensive areas to the north the development and is the major water-way in the area, although its discharges and flood stages are not officially monitored at this time.

Figure 15 Geomorphology



Limestone uplands shown in limestone pattern. Grey-green shaded area denotes land below 125'. Drainage channels corrected based on Google imagery. Base map: 12,500 OS Map. Master Plan is shown for reference. Purple line denotes watershed divide.

On site the channel and floodplain of the Bowers Gully are confined to Zone 1 (the agricultural lots). The watershed boundary between the Bowers Gully in the east and the Bowers' River/Clarendon River system in the west is roughly demarcated by the existing parochial road which leads from the main road (in the south of the estate) to Colbeck Castle. The channels to the west of this divide are ephemeral streams, and are named gullies 1 through 3 by the engineer for ease of reference, and are so designated on Figure 15.

The Gully No. 1 is described as the central channel which empties into the large pond on the southern side of the property. This pond was created by damming the river previously for irrigation purposes. From north to south, it runs across a total distance of 1.1 km on the property from a maximum elevation of 48 m asl to 38 m asl. Therefore the gradient of this channel is very gentle (~1%). This gully drains ~57% of the site (225 acres) including all of Zone 5 and part of Zone 8 in its northern part, and all of Zone 6 and part of Zone 7 in its southern part. At its point of intersection with the parochial road in the south there is a culvert. At its widest, this gully is about 7 m wide and 2 m deep. A 15 m (50-foot) drainage reserve is provided for this gully.

Gully No. 2 enters the property on the north-western side, and travels approximately 550 m in a south-westerly direction before its changes direction and turns southwards, travelling another 350 m before exiting the property across the parochial road. This gully drains approximately 30% of the total property, which accounts for much of Zone 8 and all of Zone 9, and most of Zone 7. Although a 30 m (100-foot) drainage reserve has been provided for this gully, its bed is about 10 m wide at the widest point on the property, and ~3 m deep.

Figure 16 Gully No. 2 near road intersection

Gully No. 3 is shown on the 12,500 OS map as entering the property from the west along the parochial road, and crosses the property for a distance of ~250 m before joining up with Gully No. 2. However, the more recent satellite imagery (Google, 2005) suggests that this gully now flows south of the parochial road, not entering the property at all. Recent field observations suggest that this road becomes impassable after heavy storms because of the gully crossing.

3.2.4 Watershed Context

The project site falls within watershed management unit 20 (WRA), which is associated with the Rio Minho system. Groundwater resources are considered far more important in this particular area than surface resources. Figure 17 shows the location of the site within the wider watershed context. In this area there are three major south-draining river systems that empty into the north-western section of the Portland Bight in the general area of Old Harbour Bay. These include the Frasers Gully system, the Bowers Gully system and the Bowers River system. The site does not overlap with the Frasers Gully system, in which the proposed New Harbour Development is being proposed. Much of Old Harbour lies within this basin.

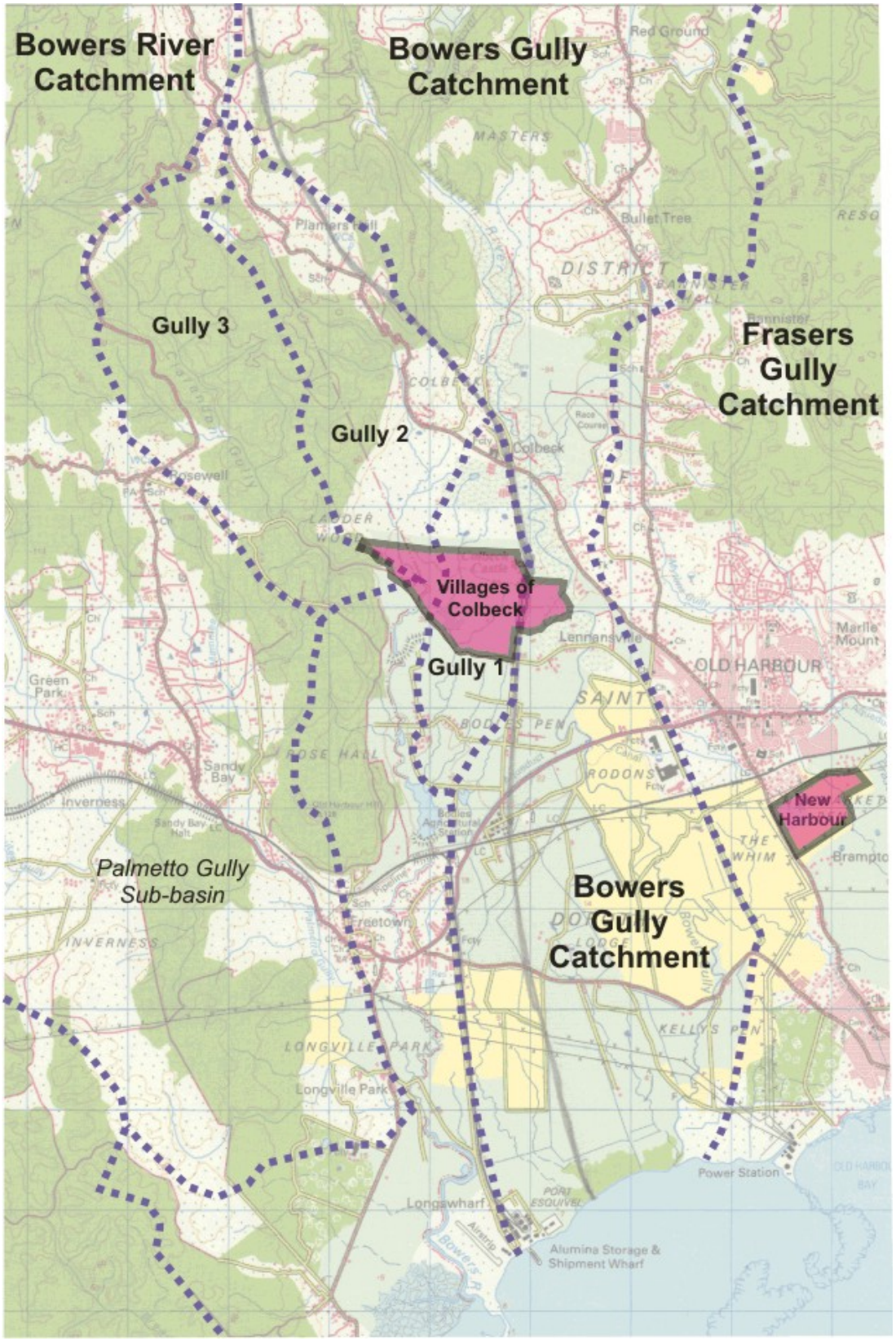
The Bowers Gully system only drains the eastern part of the property, which is not expected to be significantly built up, as the agricultural lots are planned for this area. The main down-stream receptors would be more affected in terms of water quality than flood potential. Lennansville, Bodles Pen, Rodons, Lodge, and areas behind Port Esquivel (including part of Kelly's Pen) lie downstream of the proposed development site.

The Bowers River catchment is sub-divided into four sub-basins. Most of the proposed residential development site lies within the Gully 1 sub-basin (Figure 17). Although the Bowers River Catchment starts much higher up, this particular sub-basin is interpreted as starting just above the Colbeck Factory. As the run-off co-efficient is expected to change significantly on the western part of the site, there is a concern with the potential to affect flooding downstream of the development. The gully system immediately below the site traverses over pasture lands and then empties into the Bodles dam, before exiting to Freetown and Longville Park. The Bodles dam and wetland area presently serve as a detention pond for flows from the upper catchment of this sub-basin and reduce the potential for flooding in Freetown.

Gully 2 has a much larger upper catchment (interpreted as beginning just above Planters Hall) and overlaps with the western portion of the site, where historically flows from Gully 3 have contributed to peak flows within the site.

The Gully 3 (Clarendon Gully) sub-basin is delimited on Figure 17, and encompasses an area of ~7 km^2. Much of this system lies in the forested limestone hills occurring to the west of the site. It is therefore expected to have a relatively low run-off co-efficient. The settlement of Rosewell occurs on the western side of the sub-basin. As described above, this system probably entered the main Bowers River system within the site previously, but is now thought to enter the main system below the site.

Figure 17 Surrounding Catchments



West of the Clarendon Gully system is the Palmetto Gully system, which is a major sub-basin of the Bowers River system. Although it is expected to be a major contributor to flows, it joins the system at Longville Park, which is less than 2 km from the sea. Neither the Clarendon Gully sub-basin nor the Palmetto Gully sub-basin is affected by flows from the Colbeck property.

3.2.5 Groundwater Hydrology

Hydrology Consultants Ltd. (HCL) conducted an evaluation of the Colbeck Castle Well on behalf of the project proponents in November 2006. This description is largely based on the findings of that evaluation. The well is drilled into the Lower Rio Cobre Limestone Aquifer. According to HCL, this is a coastal aquifer, in which the freshwater-saline water interface can be expected to fluctuate with pumping. To avoid saline upcoming, HCL recommended that "*pumping water level elevation in the well must be maintained sufficiently above mean sea level to prevent saline groundwater from entering the bottom of the well. The design minimum pumping water level elevation of 1.5 m amsl has been accepted by the WRA for the Lower Rio Cobre limestone aquifer, as at this elevation fresh groundwater extends down to 60 m bmsl. The bottom of the Colbeck Castle well is at 19 m bmsl, some 41 m above the saline groundwater, a sufficient distance to avoid saline upconing."*

According to WRA records the well was originally completed in 1962. The well was cased to a depth of 55.8 m below ground level, with a base at 68.3 m below ground level, although HCL reported that the lower 8 m needed cleaning to the original base level. The bottom of the well occurs at 19 m below mean sea level.

HCL reported that the long term yield of wells in the Lower Rio Cobre limestone aquifer near Old Harbour have a maximum fluctuation of 1.5 m. The yield performance tests conducted at the Colbeck well indicated a safe reliable yield of 600 m^3/hour (3.8 MGD). WRA issued an abstraction license for 2.04 MGD, based on the estimated total demand for the development of 1.9 MGD.

3.2.6 Geology

With the exception of the limestone quarry on the far north-western corner of the property, there are no outcrops of bedrock on the property. According to the published geology maps (Mines and Geology Division), the Old Harbour area, inclusive of Colbeck Castle, is underlain by Quaternary Alluviums (described above in Soils). According to borehole records for the well, the alluvium thickness is of the order of 50 to 70 m (see below).

This is likely to be underlain at depth by the Newport Limestone. This limestone is a relatively young shallow-water limestone, which belongs to the White Limestone Group. Lithologically, it is more than 99% pure carbonate, consisting of a fossiliferous micritic limestone that tends to be brecciated near shear zones.

The published geology map shows no major faults running through the property, although the Old Harbour Hills to its immediate west are likely to be a fault-constrained uplifted limestone block.

3.2.7 Natural Hazards

3.2.7.1 Flooding

Run-off for the main catchments that contribute to the peak flows conveyed by the main gullies passing through the site was determined by using the Jamaica II Method (outputs give in Table 15). This estimation assumed a run-off coefficient of 90%, which represents field capacity of the aquifer (saturated ground) or built conditions (over the entire catchment). Rainfall intensity, duration and frequency data used for the estimation of storm run-off was based on the estimates of maximum 24-hour rainfall for selected Return Periods by the National Meteorological Service, Jamaica and analysis of rainfall data for Norman Manley International Airport.

Table 15 Flood Frequency

Frequency	Gully 1 m^3/s	Gully 2 m^3/s (above possible confluence with Gully 3
10-years	34.45	53.03
25-years	43.11	68.89
50-years	49.91	83.09
Present Flow capacity	**49.0**	**92.0**

Based on the parameters given in Table 9, it was determined using this method that the present dimensions of the Gully 1 would be overtopped during a 50-year flood event. However, this flooding can be effectively contained with an adequate riparian buffer zone.

In the case of Gully 2, during a 50-year storm event, it is unlikely that there would be flooding beyond the banks given the present cross-sectional area and a 90% run-off from the catchment.

In general, both these gullies are ephemeral streams, transmitting storm flows during extreme rainfall events only. Due to the nature and depth of the alluvium, it is likely that during an extreme event, there would be vertical incision of the stream bed rather than extensive lateral erosion. Consequently, these channels show very little migration, and sedimentological evidence of repeated cycles of incision and aggradation.

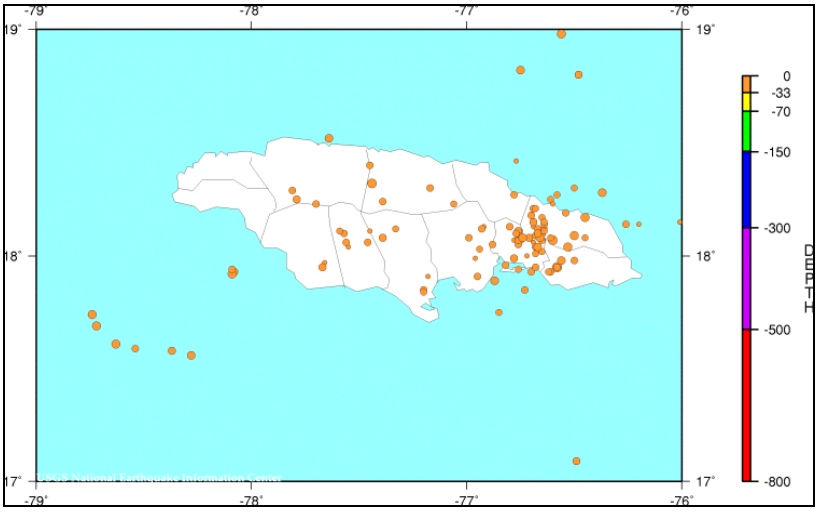
The main threat of flooding comes from Gully 3, which apparently floods the parochial road defining the south-western boundary of the property. Due to erosion from flooding emanating from this sub-basin, the section of road leading to the quarry has now become impassable. It is thought that storm flows from this catchment travel along the road, and joins Gully 2 at the road boundary.

According to the engineering design report, flows in this gully have been historically confined to the well-established channel within the boundaries of the site. The engineers indicated that "*reports from longstanding employees resident on the Bodles Agricultural Research Station indicate flows of the Bowers Gully over-topping its banks at least once in the last (20) years at a location South of the U-turn of the Gully at the South-eastern boundary of the development*". Comparison of the OS planimetric information of the channel and more recent satellite imagery (Google 2005) suggests there is very little change in the channel dimensions and route in the past 50 years. No peak flow capacity was calculated for the Bowers Gully system as the run-off co-efficient is not expected to be significantly modified.

3.2.7.2 Earthquakes

The site is prone to the worst effects of earthquakes by virtue of its proximity to a seismically active zone (Wagwater Fault). In addition, it is likely that it is particularly prone to liquefaction because of acceleration of the seismic waves in the alluvial soils. Figure 18 shows the number of major earthquake events (greater than magnitude 3) affecting Jamaica between 1977 and 2005, and shows the potential for earthquake epicentre to occur near the site.

Figure 18 Earthquake Events Affecting Jamaica (1977 – 2005)



Even though the risk appears to be lower in this area compared to Kingston, it must be cautioned that a major earthquake with an epicentre in the Kingston area or even off the south coast, can be felt in the Old Harbour area.

Source: NEIC (rectangular grid search): http://neic.usgs.gov/neis/epic/epic_rect.html

Earthquakes occurring around Jamaica of sufficient magnitude to be felt in this area could result in ground shaking (and liquefaction), which in turn can cause rock falls or landslides in steep brecciated limestone hills (on the western side of the property), or structural damage to property (e.g. cracks to buildings or falling objects). In rare cases, earthquakes can result in a linear ground rupture which can change the course of a gully or result in a vertical displacement of the land surface. Liquefaction is more likely to occur in saturated sandy soils.

3.2.7.3 Hurricanes

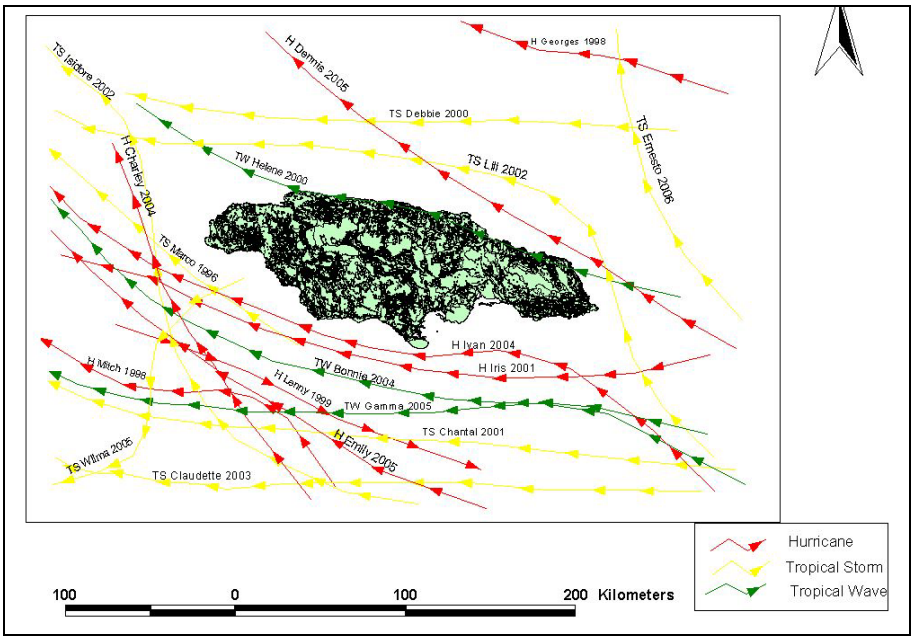
Jamaica lies within the Caribbean hurricane belt and has been directly affected by numerous hurricanes. During the hurricane season (June to November) these low-pressure systems form in the mid-Atlantic off the African west coast between latitudes 5 to 25 N, and move northwesterly into the Caribbean basin. Hurricanes normally steadily progress from a tropical wave, to a tropical depression, to a tropical storm, then to a hurricane. The hurricane itself has five categories according to the Saffir-Simpson Hurricane scale (Appendix 5) 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 subsequently its damage potential, the impacts of the hurricane depend on when and where the storm strikes.

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 the occurrence of the El Nino/La Nina phenomena and the development of high pressure cells, mid-Atlantic sea surface temperatures and the amount of Sahara dust in the upper atmosphere.

Although the eyes of the storms generally track south of the island, hurricane force winds can be felt across southern parishes and even northern parishes. Depending on the distance from the shores, and the actual size and organization of the storm, hurricane or tropical storm winds may be felt from the outer bands in the vicinity of Colbeck.

Detailed storm data (Table 16) are available from the US National Hurricane Center archives for the period 1995 to present. Twenty cyclones have affected Jamaica between 1995 and 2006. Of these, 70% (14) tracked south of the island of Jamaica, and impacted southern parishes.

Figure 19 Tracks of Hurricanes Affecting Jamaica between 1995 and 2006



Source: National Hurricane Centre Map Created using ARCView GIS 3.1

Table 16 Cyclonic Activity near to Jamaica 1995-2007

	Name	Date	Class		Name	Date	Class
1	Marco	24-Nov-96	TS	11	Claudette	9-Jul-03	TS
2	**Georges**	**24-Sep-98**	**H**	12	Bonnie	11-Aug-04	TW
3	**Mitch**	**25-Oct-98**	**H**	**13**	**Charley**	**11-Aug-04**	**H**
4	**Lenny**	**15-Nov-99**	**H**	**14**	**Ivan**	**11-Sep-04**	**H**
5	Debbie	4-Aug-00	TS	**15**	**Dennis**	**7-Jul-05**	**H**
6	Helene	19-Sep-00	TW	**16**	**Emily**	**16-Jul-05**	**H**
7	Chantal	19-Aug-01	TS	17	Wilma	16-Oct-05	TS
8	**Iris**	**7-Oct-01**	**H**	18	Gamma	16-Nov-05	TD
9	Isidore	18-Sep-02	TS	19	Ernesto	28-Aug-06	TS
10	Lili	29-Sep-02	TS	20	Dean		

(Source: NHC – north-tracking storms are given in grey font).

The threats from hurricanes in this area include:

1. Gale force winds, which can result in (a) damage to structures and crops, and (b) airborne debris (missiles), which in itself presents an additional hazard.
2. Flooding from increased rainfall associated with the system. Flooding from storm events will not only be associated with gully systems, as there may be sheet floods across areas that normally divert drainage to channels.
3. Erosion or scouring of gully banks and adjacent areas.
4. 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.
5. Disruption of lifeline services such as power, potable water, telephones, and access roadways.

Most recently (August 19th 2007), Hurricane Dean had devastating effects on southern parishes of Jamaica (nb. Dean is not shown on Figure 19). According to the Jamaica Information Services[3], Old Harbour Bay was one of the five most severely impacted communities, along with Bull Bay, Caribbean Terrace, Rocky Point and Portland Cottage. However, the recovery effort seemed to be relatively well-organized, and the Old Harbour area reportedly received electricity on August 24th, only 5 days after the passage of the storm.

[3] http://www.jis.gov.jm/land_environment/html/20070823t170000-0500_12833_jis_communities_most_affected_by_hurricane_dean.asp

3.3 POLLUTION BASELINE

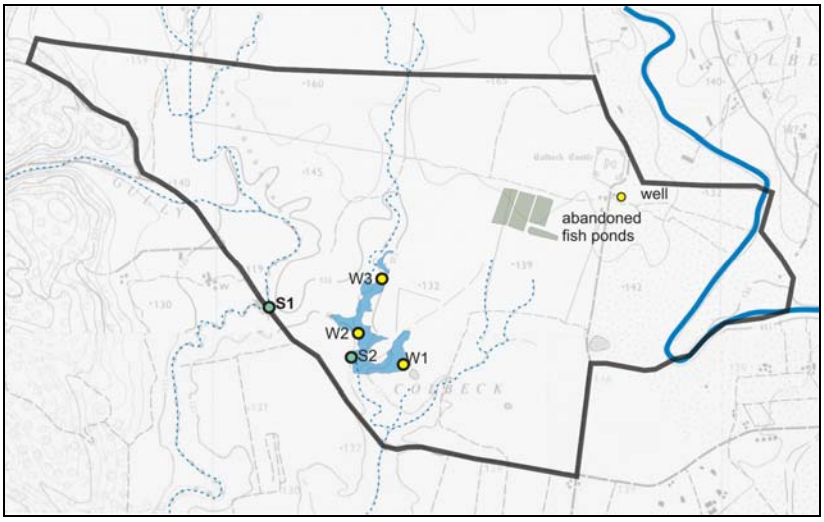
3.3.1 Air Quality & Noise Levels

As the proposed project is not expected to include activities that will impact noise and air quality in the long term, no primary surveys of these parameters were undertaken. Existing sources of air and noise pollution in the vicinity of the site are specifically associated with the major access roadways. There is very little vehicular traffic at present within the site, and along its boundaries. A pig farming operation is located across from the southern border (near to the proposed STP site) and is the major source of air and noise pollution on the south-western side of the property. The prevailing winds blow from the north and east north east towards south and west south west.

3.3.2 Surface Water Quality (Pond)

The gullies on the property generally only transmit water during storm events. The large pond occurring on the central gullies tends to contain water throughout the year, and was therefore the focus of the water sampling exercise. Water samples were collected at the start of the rainy season on May 15th 2007. Three sample stations were selected (Figure 20), from each of which, three replicates were collected.

Figure 20 Locations of Water and Sediment Samples



3.3.2.1 Faecal Coliform

Samples were analysed using SMEW Method 9221 by the SRC on May 16th 2007. The results are given in Table 17. There was considerable variability between the replicates at each station. However, in general the faecal coliform levels were above 240 MPN/100 ml. These levels exceed the recommended criteria for primary contact (200 MPN/100 ml) or consumption (0 MPN/100 ml).

Table 17 Faecal Coliform Levels (MPN/100ml)

Description	Station	Rep 1	Rep 2	Rep 3
Northern side pond	**1**	**460**	**240**	**>2400**
Central part of pond	**2**	**240**	**1100**	**1100**
Eastern side pond	**3**	**460**	**240**	**460**

3.3.2.2 Total Suspended Solids

Samples were analysed using SMEW Method 2540D by the SRC on May 17th 2007. The results are given in Table 18. In general, TSS values ranged between a low of 8 mg/l on the eastern side and a high of 29 mg/l. These values are representative of relatively wet conditions at the start of the rainy season in May. It is expected that intense high rainfall which results in soil erosion would result in elevated levels of turbidity in the pond. The concentration of suspended solids in the pond is likely to be lower after extended dry periods, which allow the sediments to settle out of the water column. No standards exist for TSS concentrations for freshwater systems in Jamaica.

Table 18 Total Suspended Solids Concentrations (mg/l)

Description	**Station**	**Rep 1**	**Rep 2**	**Rep 3**	**Mean**	**Std Dev**
Northern side pond	1	24	29	26	26.3	2.5
Central part of pond	2	12	24	12	16.0	6.9
Eastern side pond	3	28	8	22	19.3	10.3

Detection Limit: 2 mg/l

3.3.2.3 Phosphate (Available)

Samples were analysed using HACH Method 8048 by the SRC on May 17th 2007. The results are given in Table 19. The mean values found ranged between 0.31 mg/l to 0.63 mg/l. All values obtained were within the NRCA criteria for freshwater for phosphate (0.01 to 0.8). Values from the central station were found to be the highest, with one of the replicates approaching the criteria upper limit.

Table 19 Available Phosphate Levels (mg/l)

Description	**Station**	**Rep 1**	**Rep 2**	**Rep 3**	**Mean**	**Std Dev**
Northern side pond	1	0.33	0.32	0.28	0.31	0.03
Central part of pond	2	0.58	0.55	0.75	0.63	0.11
Eastern side pond	3	0.40	0.39	0.40	0.40	0.01

Detection Limit: 0.01 mg/l

3.3.2.4 Nitrates

Samples were analysed using HACH Method 8171 & 8039 by the ETAS on May 17th 2007. The results are given in Table 20. Mean nitrate values ranged between 2.8 mg/l and 4.7 mg/l, and were below the NRCA upper limit of 7.5 mg/l for nitrate concentration in freshwater systems.

Table 20 Nitrate Levels (mg/l)

Description	Station	Rep 1	Rep 2	Rep 3	Mean	Std Dev
Northern side pond	1	3.52	3.52	3.52	3.5	0.00
Central part of pond	2	3.08	2.64	2.64	2.8	0.25
Eastern side pond	3	4.4	4.84	4.84	4.7	0.25

Detection Limit: 0.76 mg/l

3.3.3 Ground Water Quality (Well)

The well (location shown on Figure 20 above) was evaluated in November 2006 by Hydrology Consultants Ltd. Two water samples were collected from the well on September 28th 2006. The tests were conducted by the Mines and Geology Laboratory. The parameters are divided after the USEPA classification according to common Priority Toxic Pollutants, Non-Priority Pollutants and other parameters. Water samples were not tested for all of the USEPA parameters as there 120 PTPs and 47 NPPs.

The USEPA criteria for human health (consumption in water and organisms) and WHO Drinking Water Guidelines are used for comparison as this ground water is intended to be used primarily for drinking water (Table 21). In all cases the samples were within acceptable levels for drinking water quality.

Table 21 Ground Water Quality Profile (Priority Toxic Pollutants)

Parameter	Sample 1	Sample 2	WHO DW (mg/l)	USEPA (DW) mg/l	IJAM
Arsenic	<0.01	<0.01	0.01	0.000018	0.05
Cadmium	<0.02	<0.02	0.003	0.01	0.01
Chromium	<0.02	<0.02	0.05	n/a	0.05
Copper	<0.01	<0.01	2	1.3	1.0
Cyanide	<0.02	<0.02	0.1	0.14	0.2
Lead	<0.02	<0.02	0.01	0.05	0.05
Mercury	<0.0005	<0.0005	0.006	0.000144	0.002
Nickel	<0.02	<0.02	0.07	0.61	n/a
Selenium	<0.003	<0.003	0.01	0.01	0.01
Zinc*	<0.02	<0.02	5	7.4	1.5

** This is an organoleptic criterion as zinc is required daily human health in quantities above those stated.*

With the exception of Total Dissolved Solids (TDS) all of the NPPs (see Appendix 6) were within IJAM, USEPA & WHO guidelines (where applicable). There was no indication of seawater (from intrusion or upcoming), nutrient loading (from fertilizer use) or metal contamination (industrial). The samples were also tested for faecal coliform concentrations, which were found to be nil in one sample and 2 MF/100 ml in the other. Samples were also tested for a range of PAHs, and

none was detected. According to the hydrology evaluation, the discharge was found to be "*suitable for use as a source of domestic and irrigation water. Break-point chlorination should be adequate to achieve potability*."

3.3.4 Fluvial sediments

Two stations (western gully and pond station as shown on Figure 20 above) were sampled at the start of the wet season (May 15th 2007). The samples were screened for a range of heavy metals (mercury, copper, lead, nickel, zinc), with the intention that additional testing would be undertaken if any were found to exceed recommended criteria. As Jamaica does not have sediment or soil quality criteria, the Canadian Environmental Quality Guidelines (2002) were used to compare the results.

Table 22 Sediment Quality at Colbeck Castle

Concentration (mg/kg)	W. Gully Station 1	Pond Station 2	Detection Limit	*Soil Residential/Park	*Freshwater Sediment
Copper	26.9	**42.2**	*2.0*	63.0	35.7
Nickel	20.1	8.21	*2.0*	50.0	-
Lead	25.2	16.5	*2.0*	140.0	35
Zinc	48.2	69.4	*2.0*	200.0	123
Mercury	0.0227	0.0412	*0.0005*	6.6	170

***Canadian Environmental Quality Guidelines (2002)**

Although the copper level in the pond station exceeded the recommended Interim Sediment Quality Guideline (ISQG) for freshwater sediments, it did not exceed the Probable Effect Level (PEL) of 197 mg/kg, nor the recommended criteria for soils in residential areas or parks. With the exception of copper, all parameters were within acceptable levels for freshwater aquatic life and public health.

3.4 Biological Baseline

3.4.1 Flora

3.4.1.1 Species List

The vegetation on the property has been cleared for farming at various times, although at this point there is very little farming activity being undertaken. Most of the vegetation on the property is disturbed secondary woodland. For the vegetation assessment, the Point-Centred Quarter (P.C.Q.) method (Appendix 7) was used, along with random transects through the property. The sample sites were placed at selected points on the property, representing the different vegetation types.

A species list of 67 plants was generated (Appendix 8). The list includes all plant life forms including native, endemics and introduced species. The plant species list represents a sample of the vegetation types on the property, and is not exhaustive beyond practical means.

Logwood, Acacia, Guango and *Ziziphus mauritiana* are the four dominant tree species on the property. There were also four grass species on the property. Three species were imported for the pastures. Two species of bromeliads associated with xerophytic conditions and an endemic epiphyte, *Hylocereuss triangularis*, were noted during the survey. Although the epiphyte is endemic, it is common is wet and dry limestone forest. There were not many plants of socio-economic value. Only the lignum vitae and the fruit trees are of socio-economic value.

Figure 21 Typical Vegetation on site

Grassy areas

Gully Course

3.4.1.2 Spatial Distributions

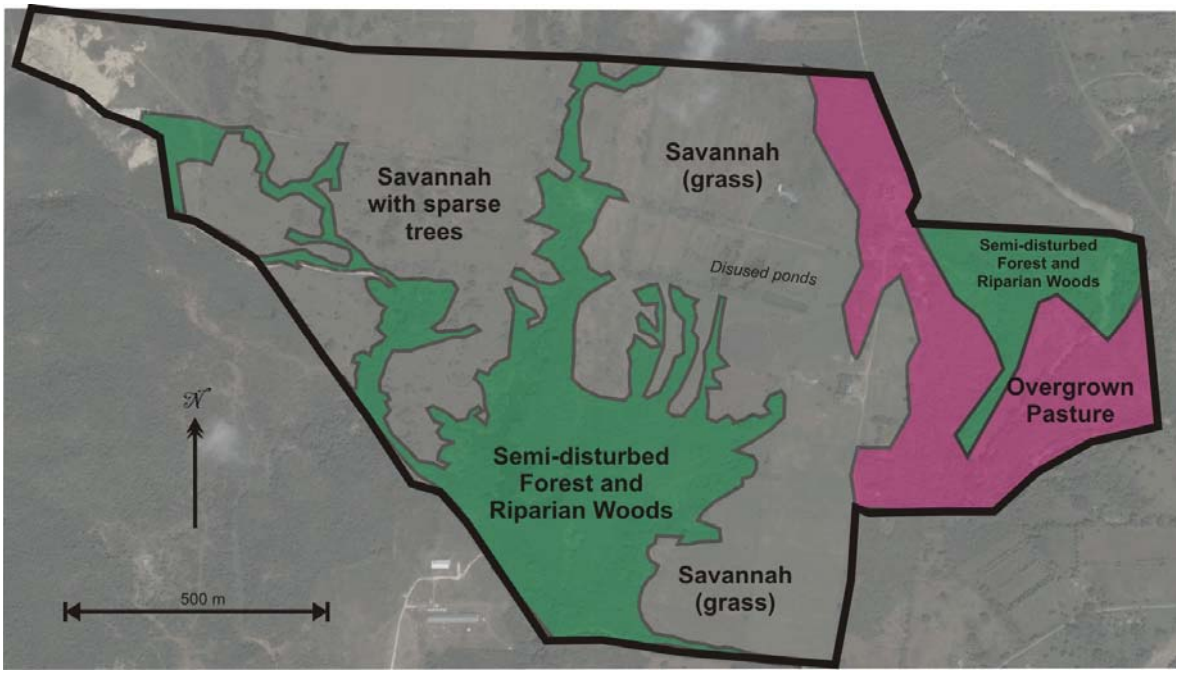
In terms of spatial Zonation, three major vegetation types were identified (Figure 22).

1. Savannah with areas consisting of grasslands or grass interspersed sparsely with trees. This is the dominant vegetation type on the property, occupying an estimated half of the total site acreage. Less accessible areas on the western side show more trees (guango) in the savannah area. This area is likely to have been used in the past as pasture lands. The most accessible area on the south-eastern side appears to be mainly pasture, and may be still grazed.
2. Semi-disturbed (closed) forest and Riparian Woods. This comprises areas of the densest tree cover. In general the trees are taller and the community appears to be well-established. The largest wooded area is associated with Gully 1, and the water-body associated with the dam. In most areas the edge of the pond was devoid of vegetation while in others the vegetation extended to the edge of the water. No water lilies or other aquatic plants were observed. The vegetation on both sides of the southern parochial

road is also quite dense, and dominated by acacia. There is also a small patch of riparian woods on the northeastern side of the property, associated with the Bowers Gully.

3. Overgrown pasture. This area is confined to the eastern side of the property, and extends across part of the Bowers Gully floodplain, as well as the Colbeck Castle site, and homestead operations of the landowner.

Figure 22 Vegetation Distribution



Based on Google 2005 satellite imagery.

3.4.2 Fauna

3.4.2.1 Avifauna

Point counts, which involved recording all birds seen and heard at selected locations were used to generate a species list. The list is inclusive of residents, migrants and endemic birds. A total of 52 points (each point 150 m ≤distance) were located randomly across the property. Point Counts were done in the mornings (sunrise to 10 am), in the peak of the local breeding season for most birds (April – June 2006), as at this time many of the birds are vocal (Downer and Sutton 1990), and most of the winter migrants had already departed. Bird distribution and habitat usage varies throughout the property, with an average of 9 individuals per point count (min = 2: max = 19).

Forty two (42) species were observed during the surveys (Table 24). Of the eleven observed endemics, only three species were not seen in the gullies (forest patch). Four of the 11 endemic birds found on the property were forest dependent and it was not surprising that most of them were found in the riparian habitat.

In general, the area contained birds known to range in the area, the Red-tailed Hawk and endemic Yellow-shouldered Grassquit. Endemic birds such as the Jamaican Mango Hummingbird, Jamaican Oriole, Jamaican Vireo, White-chinned Thrush and Jamaican Woodpecker were also observed in the area. Rarer species found on the property included the Yellow Shouldered Grassquit (Endemic) and the Red-tailed Hawk (Resident).

Table 23 Bird species identified at Colbeck Estate

Common Name	Scientific Name	Local Name
American Kestrel	*Falco sparverius*	Lizard Hawk / Killy-killy
Antillean Nighthawk	*Chordeiles gundlachii*	Gimme-me-bit
Black-faced Grassquit	*Tiaris bicolor*	Grass Bird
Cattle Egret	*Bubulcus ibis*	Ticks bird, Gaulin
Common Ground Dove	*Columbina passerine*	Ground Dove
Common Moorhen	*Gallinula chloropus*	Common Gallinule Water Hen
Glossy Ibis	*Plegadis falcinellus*	
Greater Antillean Grackle	*Quiscalus niger*	Cling Cling
Great Blue Heron	*Ardea herodias*	Blue Gaulin
Greater Antillean Bullfinch	*Loxigilla violacea*	Jack Sparrow
Jamaican Euphonia	*Euphonia Jamaica*	Blue Quit
Jamaican Lizard Cuckoo	*Saurothera vetula*	Old Woman Bird
Jamaican Mango	*Anthracothorax mango*	Mango Hummingbird
Jamaican Oriole	*Icterus leaucopteryx*	Auntie Katie
Jamaican Tody	*Todus todus*	Robin Redbreast / Rasta Bird
Jamaican Vireo	*Vireo modestus*	Sewi-sewi
Jamaican Woodpecker	*Melanerpes radiolatus*	Woodpecker
Killdeer	*Charadrius vociferous*	Killdee / Tell-tale
Loggerhead Kingbird	*Tyranus caudifasciatus*	Loggerhead
Mourning Dove	*Zenaida macroura*	Pea Dove
Northern Mockingbird	*Mimus polygottos*	Nightingale
Olive-throated Parakeet	*Aratinga nana*	Parakeet
Red-billed Streamer Tail	*Trochilus polytmus*	Doctorbird
Red-tailed Hawk	*Buteo jamaicensis*	Chicken Hawk
Sad Flycatcher	*Myiarchus barbirostris*	Little Tom Fool
Smooth-billed Ani	*Crotophaga ani*	Savanna Blackbird
Stolid Flycatcher	*Myiarchus stolidus*	Little Tom Fool
Turkey Vulture	*Cathartes aura*	John Crow
Vervain Hummingbird	*Mellisuga minima*	Little Doctorbird
White-chinned Thrush	*Turdus auratius*	Hopping Dick
White-collared Swift	*Streptoprocne zonaris*	Rainbird / Collared Swift
White-crowned Pigeon	*Columba leucocephala*	Bald Pate
White-winged Dove	*Zenaida asiatica*	White-wing
Yellow-crowned Night Heron	*Nycticorax violaceus*	Crab Catcher
Yellow-faced Grassquit	*Tiaris olivacea*	Squit
Yellow-shouldered Grassquit	*Loxipasser anoxanthus*	Yellow Back
Bananaquit	*Coereba flaveola*	Beeny / Bird Sugar Bird
Saffron Finch	*Sicalis flaveola*	Canary
American Redstart	*Setophaga ruticilla*	Butterfly Bird

Species that tolerate high disturbance were found across the site, particularly in the overgrown pastures. These included the Great Antillean Grackle, Smooth-billed Ani, Common Ground Dove, White Wing Dove, American Kestrel, Black-faced Grassquit, Jamaican Euphonia and Jamaican Oriole. The pasture areas to the west contained Cattle Egrets and the Anis.

The riparian woodlands had the highest species diversity. The forest patch had all the endemics that were listed in the survey and also the residents that are not seen in pasture. Birds such as the White-crowned Pigeon, Hummingbirds, Jamaican Tody, Jamaica Vireo and Lizard Cuckoo were seen in the forest patch. The open pasture had few trees and the bird activity was very low. The acacia/logwood woodland is prime habitat for neo-tropical migrants.

The presence of the ponds on the property contributes to species biodiversity. The presence of water bodies in dry areas has two major effects on the avifauna. It provides an accessible source of water in the harsh environment which is able to support few species at lesser densities. Water bodies provide a source of food in the form of plants or invertebrates, which are normally not accessible in dry regions. Water birds such as the Little Blue Heron, the Cattle Egret, the Common Moorhen, the Yellow-crowned Night Heron, the Killdeer and the Great Egret were observed the ponds on the property.

3.4.2.2 Terrestrial Invertebrates

Butterflies and other larger invertebrates were observed during the bird counts and vegetation survey. Specimens that could not be identified in the field were collected for examination in the laboratory; this included most of the smaller individuals. Insects hidden in the vegetation were collected using sweep nets while other materials were collected by hand picking or using flight nets. Stones, logs etc. were overturned in search of soil dwelling organisms. Nocturnal insects were collected using light traps equipped with 120W MV lamps, powered by portable generators. Two types of light traps were used: a Robinson's light trap for general collection and white sheet for more selective collection. All materials collected were taken back to the laboratory for examination. Sampling was conducted between 7:00 pm and 2:00 am.

In the laboratory, the materials were examined using a dissecting microscope (mag, x10 – x90). In cases where the identification was not immediately known, identification was attempted by comparison with specimens in the Invertebrate Collection of the Department of Life Sciences UWI, and the Natural History Museum of the Institute of Jamaica; in addition to using keys and description where these were available. Because keys and descriptions of much of Jamaica's insect fauna has never been produced, several species could not be identified below the level of Family or Sub-Family. The collected material is stored in the Invertebrate collection of UWI.

The animals were classified to the level of species whenever possible. In other cases a higher taxa, genus, family, suborder or order was used. A significant portion of Jamaica's invertebrate fauna is yet to be classified. In addition the classification of some of the material collected required a significant amount of work, (as much as one day per specimen) including dissections and even electron microscopy. Many could be sent abroad to various specialists, but this will be an expensive undertaking. However, since species not covered by the Endangered Species (Protection, Conservation and Regulation of Trade) Act, 2000, do not automatically attract conservation measures, it was not necessary to incur the expenses associated with the identification of these species. Species not identified are indicated as Unk. Sp. (unknown species). In cases where the genus was known but the species name unknown, this was

indicated by the use of the abbreviation, sp. (e.g., *Papilio* sp. = Papilio species). Common names were indicated where this was available. Each species can have only one scientific name and hence this was given when ever possible.

One hundred and thirty eight (137) species of terrestrial invertebrates were recorded. These were 14 species of bugs, 14 species of ants, wasps and bees, 2 species of lacewings, 5 species of grasshoppers and crickets, 25 species of butterflies, 33 species of moths, 7 species of dragonflies and damselflies, 1 millipede, 4 spiders, and 3 species of land snails. Details are given in Appendix 9.

Butterflies: One fifth (25) of Jamaica's 125 species of butterflies were observed. Two species, *Mestra dorcas* and *Leptotes cassius theonus*, are endemic but wide spread across Jamaica. There were three endemic subspecies, *Anartia jatrophae jamaicensis, Heliconius charitonius jamaicensis, Danaus gilippus jamaicensis*. These are also widely distributed. One species, *Papilio andraemon,* is an introduced species. Perhaps the only surprise was the abundance of *Siproeta stelenes stelenes* (Antillean Malachite), a species which is generally associated with moist area. It is not clear why this species occurred in this very dry area, and in relatively high frequency. While there are a number of endemic species and subspecies of butterflies, these are all widely distributed across Jamaica in relatively high numbers and consequently merit no special conservation effort.

Moths: Thirty-nine species of moths were recorded, primarily of the families Noctuidae and Pyralidae. The 39 species recorded here is considered low compared to some other Jamaican sites studied by this group, (>300 species were recorded at some sites in one night). Colbeck is clearly not a significant habitat for moths, therefore no special conservation measure is necessary in relation to the moths.

Dragonflies and Damselflies: Five species of dragonflies were identified. All five are commonly associated with ponds where the eggs are laid. The single damselfly species generally found is associated with ponds and slow flowing streams. No conservation measures are needed.

Land Snails: Five species of Jamaica's 564 species of land snails were recorded, one species was native, three were endemic and one was introduced. The number of species recorded here represents a tiny part of the Jamaican fauna and the level of endemism (60%) is lower than the national average (90%). This is likely to be due to the dry conditions, human disturbance and bushfires. The three endemic species of land snails listed here are widely distributed in dry disturbed areas across Jamaica and hence do not merit any special conservation measures.

3.4.2.3 Fresh Water Fauna

The large pond on the southern side of the site was investigated. The fauna is dominated by a large population of the shrimp *Macrobrachium sp.*, and the small fish *Gambusia punticulata* which is also very numerous.

Thirteen aquatic insects were recorded. Included were the nymphs of dragonflies and damselflies, the larvae of several species of flies as well as larvae and adult beetles. Three snails were present, with one species, *Thiara granifera* being very numerous. One species of earthworm and a leech were also recorded. The common cane toad (*Bufo marinus)* also occurs in the wet areas.

None of the species collected was endemic to Jamaica or protected species. All species are widespread in distribution and have been recorded in many of the freshwater ponds in that part of the island.

3.4.2.4 Reptiles

There are reports of a freshwater turtle living in this pond. While no turtles were collected during this short study, there were disturbances in the water which suggest an animal about the size of a turtle. A number of young men found collecting shrimp during two of the visits to the pond, were interviewed in relation to this turtle. One young man claimed to have caught four individuals and a second claimed he caught three. Two fresh water turtles occur in Jamaica; the red-eared pond turtle, *Trachemys scripta elegans* and the Jamaican pond turtle, *Trachemys terrapin,* (Jamaican Slider). The former is an introduced species (a terrapin known from North America and South America) which has become by far the most common species in Jamaican fresh water systems. It is easily distinguished by the distinct red colour on the sides of its head (hence 'red-eared'). The second species, *Trachemys terrapin* is endemic to Jamaica and is a protected species. Careful interviews with the young men who collected turtles from the pond clearly indicated that the species present here is the common, introduced red-eared terrapin.

There are no reports of the pond being inhabited by crocodiles (*Crocodylus acutus*). However, these animals are known to range in the wider area. This species is protected by law, and typically inhabit wet riparian zones. They are therefore unlikely to occupy the dry river bed areas of the Bowers River.

The reptile fauna is expected to include common anoles.

3.4.2.5 Mammals

The mammals on site are mainly believed to be introduced species, such as rats, mongoose and farm animals. With the exception of the limestone quarry area on the far western side of the property, the site does not contain habitats suitable for bats.

3.5 Human and Built Environment

Secondary statistical data and observations were the primary methodologies used to describe the socio-economic baseline. Secondary data were obtained from the Statistical Institute of Jamaica (STATIN), the Planning Institute of Jamaica, the National Works Agency (NWA), and the World Wide Web (internet). The 2001 Population Census was the main data source for the social baseline.

3.5.1 Demographic Profile

Based on the 2001 Population Census, St. Catherine had a population of 482,308. This shows an increase of 26.2% since the 1991 Population Census. The population of Old Harbour showed a similar pattern with a substantial increase of 30.3% for the same period. According to the Statistical Institute of Jamaica (STATIN), St. Catherine is predominantly urban with ~93% of the population classified as urban. The high growth rate in the parish may be attributed to rapid in migration from other parishes especially from Kingston and St. Andrew.

The parish of St. Catherine shows a ~50/50 male to female ratio with approximately 234,202 males (48.5%) and 248,106 females (51.5%). The same is true for Old Harbour which shows ~50/50 male to female ratio with 11,737 males (49.2%) and 12,086 females (50.8%). According to STATIN (2001 Population Census), St. Catherine has a dependency ratio of 68%.

According to the 2001 Population Census, the parish of St. Catherine had 151,235 employed persons and 30,865 unemployed persons (17%).

3.5.2 Municipal Resources

3.5.2.1 Education

The Old Harbour area has one High School and five Primary Schools. Old Harbour High School, the only High School in the area is well above its enrollment capacity with approximately 2,500 students. Like the High School, the Primary Schools have also exceeded their enrolment capacities. The Primary Schools include the Old Harbour Primary, Old Harbour Bay Primary, Marley Mount Primary, Davis Primary and Good Hope Primary, all of which feed directly into the Old Harbour High School. The overcrowding in the schools makes it very difficult for teachers.

3.5.2.2 Medical Services

Medical facilities in the Old Harbour area are limited to a single Type 3 as well as a mobile clinic. The nearest hospitals are located in Spanish Town, May Pen and Kingston. The Type 3 clinic in the Old Harbour offers a full compliment of services and comprises approximately two medical practitioners, a dentist, and nurses on staff. The clinic is served however by twelve

medical practitioners. The mobile clinic offers some of these services but focuses mainly on child health care. The clinic in the area is inadequate to meet the health needs of the rapidly growing population of Old Harbour and its suburbs.

3.5.2.3 Emergency Services

Police: The Old Harbour Police Station is located in the centre of the town and is one of seven out stations within the division. The closest station to the Old Harbour station is the Old Harbour Bay station. Both stations monitor the areas around the general project area. According to one sergeant at the Old Harbour Police Station, the station has a total of 60 staff complement, fifteen (15) of which are part-time and made available three days per week. Both police stations in the area report that the crime in the area is generally low despite a marginal increase in the crime rate in the area.

Fire: The Old Harbour Fire Brigade Station is located within close proximity to the town centre and provides fire services to Old Harbour and its surrounding communities as well as back up services to other areas in the parish. The Old Harbour Fire Station has a total staff complement of 28 (interview with the Fire Chief). There are 7 persons on each shift, all of whom are trained in medical services. There is no Emergency Medical Specialist (EMS) at the station and the closest one is located at the Linstead fire station. On average, the station receives 400 calls yearly, of which some 75% are genuine. The station had two fire units, however one was damaged beyond repair and the other carries a limited supply of water. There are limited recharge areas in the area and most of the fire hydrants are out of service. Fire fighters complain that the hydrants that do work have a very low water pressure and this makes it very difficult to fill their trucks. In most instances, the fire fighters have to depend on the tank at the station for emergency situations. This tank holds enough water to serve three to four trips.

3.5.2.4 Utilities

Electricity: Based on the 2001 Population Census, electricity was the source of lighting for more than 80% of Old Harbour. The Jamaica Public Service Company (JPSCo) supplies electricity to the Old Harbour area and will be the main source of electricity for the proposed project.

Telecommunications: Land line telephone services are primarily provided by Cable and Wireless. Cellular coverage in the Old Harbour area is available from a range of licensed providers.

Potable Water: The main water supply to the communities surrounding the site is provided by the NWC. There are a number of NWC operated wells in the area, all of which have their own chlorination and treatment system (minor supplies). One such well is located at Claremont and supplies water to the Old Harbour town.

Solid Waste: The North Eastern Parks and Markets Limited is also responsible for public cleansing and sanitation as well as the operation of markets and the beautification of parks. The solid waste management in this area is undertaken by North Eastern Parks and Markets Limited. This is a subcontracted agency operating under the NSWMA and on behalf of the St. Catherine Parish Council. Garbage is collected twice a week.

Public Transportation: Public Transportation in the Old Harbour area is generally reliable. The area is located north of Highway 2000 which links Spanish Town to May Pen. The highway also has a major exit which leads directly into Old Harbour. The other main transportation route is the Old Harbour main road which runs through most of the major communities of Old Harbour and its environs. Other important transport routes include the Old Harbour Secondary Road, Bartons Secondary Road, Bellas Gate Secondary Road, Bowers Drive, Bellas Gate Secondary Road, Colbeck Road, and the Old Harbour/May Pen Main Road. These routes are readily traversed by taxis and mini buses. Public transportation out of the area to Kingston, Spanish Town, and May Pen is also readily accessible by taxis and mini-buses.

3.5.3 Traffic Flows

3.5.3.1 5-day 24-Hour Volume

Traffic counts were conducted by the National Works Agency (NWA) between 2007 March 29 and April 3 over a 24-hour period (12:00 am – 12:00 am). The data were collected on the Old Harbour main road. Table 24 summarizes the NWA dataset.

Table 24 Traffic Volumes (24-hour volumes)

Date	Westbound (W)	Eastbound (E)	Difference (W-E)
Friday 29 March	7301	7167	134
Saturday 30 March	6981	6660	321
Sunday 1 April	5945	5920	25
Monday 2 April	7476	6980	496
Tuesday 3 April	7511	7076	435

The flow characteristics can be summarized as follows:

1. The daily mean volume of traffic was of the order of 13,800 cars. Peak flow occurred on Tuesday with a total of 14,587 cars passing.
2. Although generally the traffic was somewhat equally divided between the two directions, westbound (towards May Pen) traffic exceeded eastbound (towards Old Harbour).
3. Traffic volume was generally higher during the weekdays, peaking on the Tuesday. Traffic volume fell off on Saturday to ~93% of the Tuesday peak flow, and to ~81% of the Tuesday peak flow on Sunday.

3.5.3.2 2-day 12-Hour Volume

Table 25 below summarizes the more recent 12-hour 2-day traffic survey which was conducted in June for this EIA collected from a point on the road between the Bodles Agricultural Station and Old Harbour that is immediately in front of the main site access road. This time period is expected to represent normal work-day traffic which would be affected by flows from the proposed development.

Table 25 Traffic counts by time period (June 2007)

	Thursday June 21		Friday June 22	
Time	**Eastbound**	**Westbound**	**Eastbound**	**Westbound**
6:00-7:00	318	351	338	338
7:00-8:00	**402**	**511**	**409**	**384**
8:00-9:00	**352**	**415**	**356**	**398**
9:00-10:00	317	345	297	345
10:00-11:00	327	317	279	306
11:00-12:00	319	324	295	334
12:00-1:00	296	360	305	305
1:00-2:00	305	325	327	318
2:00-3:00	297	352	298	376
3:00-4:00	349	330	346	320
4:00-5:00	**362**	**379**	**344**	**374**
5:00-6:00	**411**	**442**	**390**	**398**
Total	**4054**	**4451**	**3984**	**4196**

The main characteristics of the survey are:

1. 12-hour total flows were 8505 and 8180 for Thursday and Friday respectively.
2. In general westbound traffic exceeded eastbound except at 3:00 to 4:00 on both days.
3. Morning peak flows occurred at 7:00 to 9:00 on both days. An afternoon peak occurred at 4:00 to 6:00 pm. Peak hourly flow represents a 35% to 45% increase in traffic from the minimum hourly flow recorded on these days.
4. Peak hour combined flows are presently below 1000 cars per hour.
5. Sustained total flows between peak hours exceeded 585 cars per hour.

Table 26 shows the data disaggregated by vehicle type for the two days.

Private vehicles comprised the dominant vehicle class. Cars (56%) and SUVs (5%), accounted for 61% of all vehicles recorded during the two day period. Bicycles and bikes contributed another 2%.

Commercial vehicles (vans and trucks) accounted for the second and third largest groups (16% and 14% respectively), together contributing another 30% of total flows. Typical public transportation vehicles contributed only 6% of the total flows.

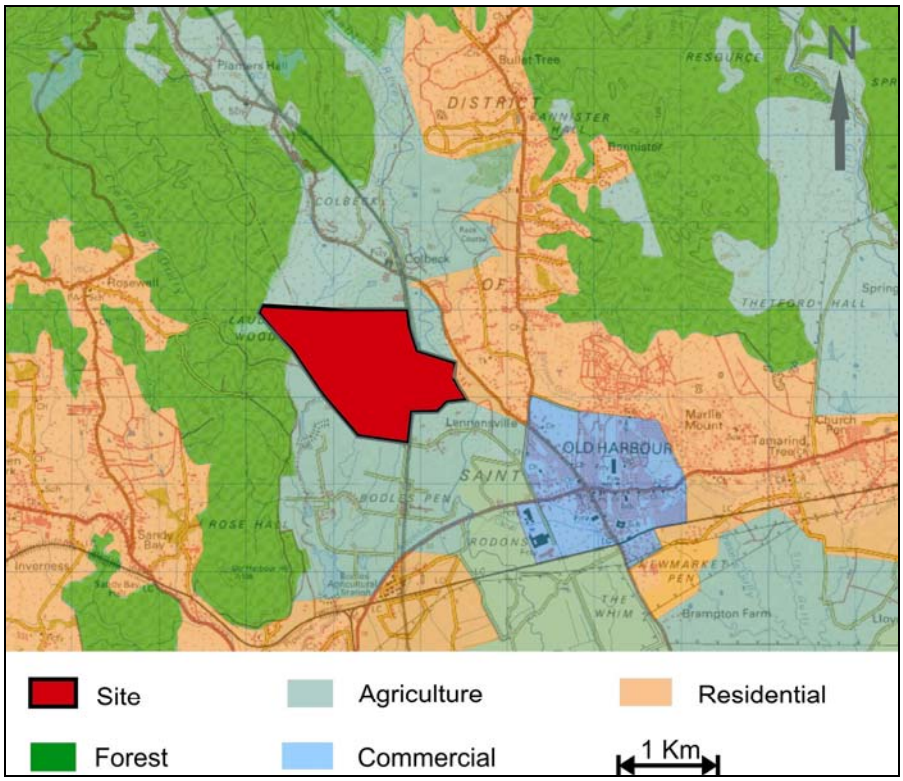
Table 26 Traffic counts by type of vehicles (June 2007)

	Day 1		Day 2		
	Eastbound	**Westbound**	**Eastbound**	**Westbound**	**Total**
Car	2323	2458	2283	2287	**9351**
Van	632	734	714	669	**2749**
Truck	579	602	558	602	**2341**
SUV	180	249	179	231	**839**
Bus	142	161	125	139	**567**
Minibus	103	136	41	187	**467**
Bicycle	56	77	46	54	**233**
Bike	39	34	38	27	**138**
Total	**4054**	**4451**	**3984**	**4196**	**16685**

3.5.4 Land use

Figure 23 shows the general classification of land uses around the proposed site. The major regional classes that are described include residential, industrial/commercial and agricultural.

Figure 23 Regional Land Use



The hills to the west of the site are under natural vegetation cover. Generally, the region appears to be in transition, with increasing urban encroachment into lands historically used for agriculture. This transition is the result of rapid population growth in Old Harbour, the preference of most people for urban dwellings, recent improvements in the road network, the decline of employment opportunities in agriculture, as a result of its vulnerability to natural hazards.

3.5.4.1 Residential

Within 16 km of the property there are several major urban areas including Old Harbour, Spanish Town and May Pen. The site is easily accessed by the new Highway 2000, which contributes to the ease of movement to and from other areas. Old Harbour has grown rapidly over the last two decades and has seen a major shift in its economic base from agriculture to light manufacturing and service activities. The town may be considered a business hub between Spanish Town and May Pen where there is intense day and night business activity.

A number of other large-scale residential developments exist or are proposed for the general area and represent a change of use from agriculture. These include the Aviary, Colbeck Heights, Old Harbour Glades, Old Harbour Village, Grove Scheme, New Harbour and Marley Acres.

These developments do not represent a loss of agricultural productivity, as these farm lands are not now being used for agricultural activities. A small portion of the Colbeck property was used previously for aquaculture, but this failed after Hurricane Ivan destroyed electrical infrastructure in the area.

3.5.4.2 Industrial & Commercial Activity

The service sector is the main income generating sector in Old Harbour. General building construction activity is also an important employment generating activity, which is followed by small-scale agriculture and fisheries. Manufacturing in the area has been on the decline since the last decade. Despite this, there is still heavy manufacturing present in the area. The largest electricity plant is present in Old Harbour as well as a bauxite plant. Both are major contributors to the area's GDP. Port Esquivel in Old Harbour Bay is one of the oldest manufacturing activities in the area. The port was built for the export of bulk alumina and also the handling of bulk commodities such as oil, caustic soda, lime and cement grain. The port is also envisaged to become a major import facility for Liquid Natural Gas (LNG) and a regasification and distribution facility.

3.5.4.3 Agriculture

Old Harbour has a rich agricultural history being dominated by sugar cane, tobacco, fisheries, and cattle and livestock rearing. Most of these activities have come to an end as the town has shifted towards the service and manufacturing sectors as its main source of livelihood. There are still some individuals who practice agriculture on a subsistence basis. The large-scale sugarcane and tobacco plantations no longer exist. Cattle and livestock rearing have also declined considerably. The Bodles Agricultural Research Station, operating under the Ministry of Agriculture is located south of the site. The station is responsible for technology-led agricultural research development and initiatives. These activities include but are not limited to pig, dairy

and poultry farming; livestock research; crop and plant protection; animal training programmes; and genetic breeding and management systems.

The site itself is classified as agricultural and to produced sugar between 1740 and 1882 (JNHT, 2007). According to the JNHT (2007), the site passed to the Jamaica Tobacco Company (Machado family) in 1918. It was operated as tobacco farm and cattle pasture until ~1930, when the lands were sub-divided and operated as grazing pens. The lands remained under pasture for an unknown period of time, after which they were allowed to become overgrown. More recently, the present owners operated an aquaculture plant which was abandoned after power losses associated with Hurricane Ivan caused massive losses of fish stock.

3.5.5 Heritage Resources

The JNHT conducted a detailed archaeological appraisal specifically on the property and development site (JNHT, 2007). They found that the area contains both prehistoric and historic sites, as can be expected from the available historic information that the site was occupied by the English from ~1655 when John Colbeck received a grant of 1,340 acres from the Crown. The JNHT's Sites and Monuments Records (SMR) indicated a Taino site within Zone 1 (near Bowers Gully).

The JNHT conducted a site investigation on February 13 and 19, 2007, and found:

- Zone 1: a Taino site **(Sites and Monument Records).** Other Taino sites in the area include a site at Old Harbour Hill and in an area close to Old Harbour, where Taino villages were reported by the Spaniards.
- Zone 6: an artifact assemblage including ceramics, earthenware, and olive green glass, all dating between the 18th and 19th century.
- Zone 7: an artifact assemblage including Taino, Spanish and Afro-Jamaican earthenware sherds, red and white clay smoking pipes fragments. A seasonal freshwater spring was identified here by the JNHT, and may have been used by the Taino and later as a watering hole for animals.
- Zone 9: Fragments of Spanish jars were also observed.
- Zone 11: a well and the remnants of building foundations were found.

The JNHT concluded:

> *"Based on the archaeological evidence available to us at this time, the value of archaeological features and artifact assemblages observed are not significant to the point that will hamper the development of the area. However by the virtue of their presence we need to proceed with caution when carrying out ground work in these areas.* ***The JNHT has no objection against the proposed development providing that an archaeological watching brief is conducted during the infrastructural excavation phase of the development."***

The most well-known historic site/monument within the proposed development site is the Colbeck Castle, a massive three-storey stone ruin with towers at each of its four corners. It is situated on the eastern side of the property. The ruins are owned by the JNHT, and the site was declared a National Monument in 1990. Although little is known about the origins of the structure, it believed that it was built by John Colbeck, who is known to have died in 1682. According to the JNHT, "*The great house site consists of five buildings in a terrace-wall compound. The great house has four square stone towers and two floors and was at the centre of the property. The other four were out-buildings which are L-shaped in plan. They are symmetrical with one in each corner of the compound with their outer walls forming the outer corners of the compound wall."*

Figure 24 Colbeck Castle

4 STAKEHOLDER CONSULTATION PROCESS

4.1 SECTION OVERVIEW

This section aims to summarize the key environmental concerns arising during the stakeholder consultations done prior to submission of the EIA. At a minimum, this section aims to:

- Document the public participation programme for the project.
- Describe the public participation methods, timing, type of information to be provided to the public, and stakeholder target groups.
- Summarize the issues identified during the public participation process
- Discuss public input that has been incorporated into the proposed project design; and environmental management systems

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.

4.2 STAKEHOLDER CONSULTATIONS

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:

1. Prior to conduct of the EIA, the Terms of Reference for the study were advertised and public comment invited (May 11th). Comments arising from this process were sent to the EIA consultant on June 8th and August 28th 2007 by NEPA. These were taken into consideration in the conduct of the EIA between June and October 2007.
2. The developers and the consultants have been in dialogue with relevant public agencies including NEPA, the St. Catherine Parish Council, NSWMA, NWA, WRA etc.
3. A questionnaire survey of 100 households within proximity to the site was conducted during May 2007 to determine:
    a. The general acceptability of the proposed project, with consideration of the community-based stakeholders' willingness to make trade-offs, given the potential benefits of the project to the local and national economies.
    b. The fears and expectations about the specific project, including any anticipated social conflict and crime.
    c. The perceptions and attitudes of present community-based resource users.
    d. Any health, safety and environmental concerns related to the project.

4. After the Draft EIA is submitted for public review, there will be a town meeting held at Old Harbour, approximately three weeks after the public notification goes out to press. This meeting will include presentations outlining the project, its environmental impacts, and proposed mitigations. There will be a question and answer session, at which time both the development team and the environmental consultants will be available to answer questions. A Verbatim Report of this meeting shall be made available for review within 7 days of the meeting.
5. The public and concerned stakeholders will have 30 days from the date of the public meeting to submit any additional comments on the EIA or concerns about the project.
6. During the course of the review period the public will be able to access hard copies of the Draft EIA at NEPA's documentation centre and the Old Harbour Public Library. A digital copy will be posted at both NEPA and the emc^2's websites (www.eiacaribbean.com/colbeck). All post-submission documentation including the verbatim report and the responses to any comments will also be available for download at the emc^2 site.

4.3 COMMUNITY SURVEY

4.3.1 Methodology

A 100-person questionnaire survey was administered in May 2007. The target population (sample) was stratified to be proportionately representative of 9 Enumeration Districts that are near the site. The population of each ED is shown in Table 27.

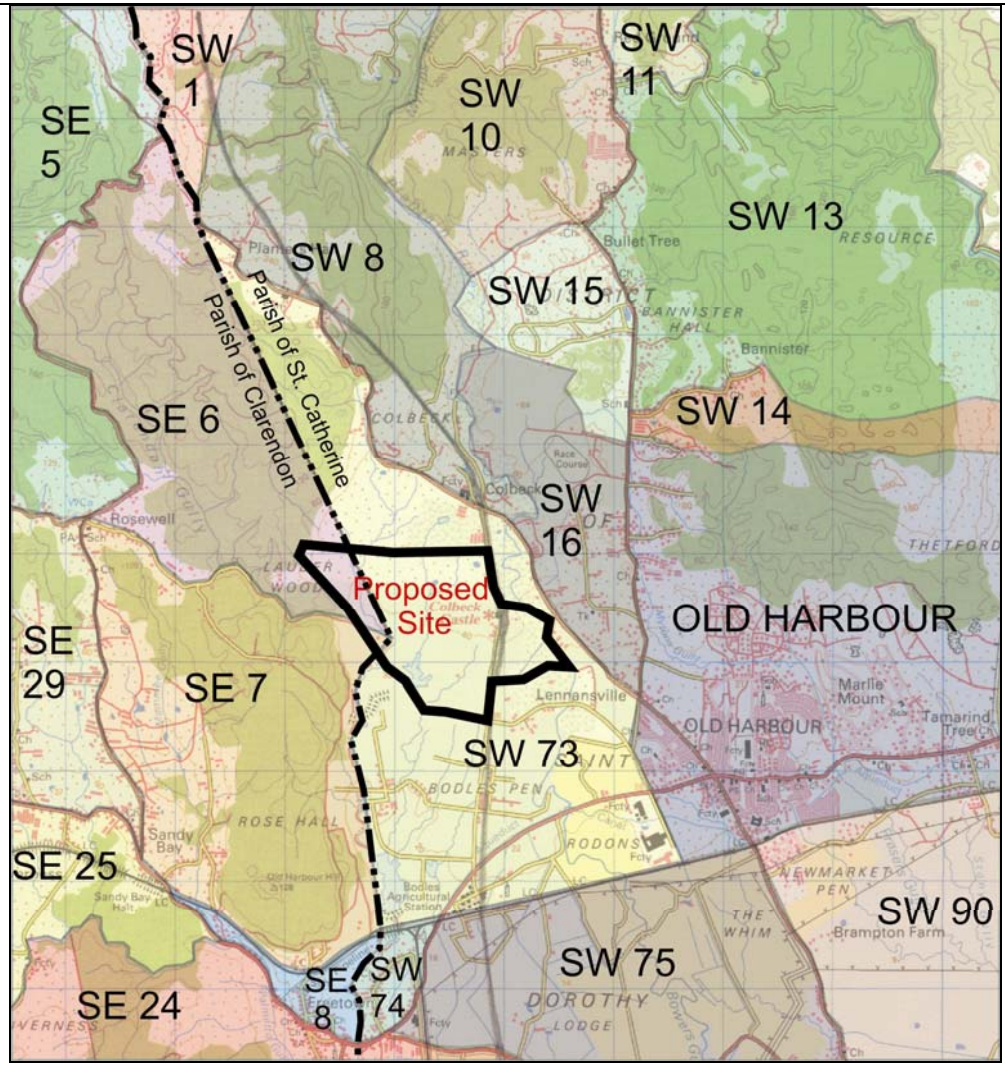
4.3.2 Profile of Survey Respondents

4.3.2.1 Basic Demographics

- Of the 100 household heads interviewed, 58% were males and the remaining 42% females. The majority of the respondents (44%) fell within the 30-39 age groups. This was followed by 23% in the 40-49 age group. Only 5% of those surveyed were above 60 years. The remaining respondents fell in the 20-29 and 50-59 age groups, 17% and 11% respectively.
- 96% of the persons surveyed were educated. Of this, the majority (71%) had secondary level education or higher (11%).
- Of the 100 persons interviewed, 91% were employed. 7% were unemployed and the remaining 2% were retired.

Table 27 Population Distribution in the EDs

ED	Population	Percentage
Old Harbour (part of)	11911	70
SW 8	425	2
SW 16	245	1
SW 73	537	3
SW 74	628	4
SW 75	523	3
SW 90	754	5
SE 6	116	1
SE 7	1470	9
SE 8	462	2
TOTAL	**17071**	**100**



- Respondents were employed in a number of different jobs, the majority of which were in the service sector (business persons, taxi drivers, domestic workers, shop-keepers and bartenders, teachers, fire-fighters, police officers, and sales persons). Ten percent reported that they were skilled workers (mechanics, carpenters, refrigerator technicians, construction workers, masons, and farmers).
- Although the income levels for the respondents varied, approximately a third of those employed (38%) earned less than $5000 weekly. Another third (34%) earned between $6000 and $10000, while 10% of the respondents earned above $11000 weekly. Of the persons employed, 18% refused to indicate their weekly earnings.

4.3.2.2 Land Tenure & Social Capital

- Most persons interviewed (~90%) had lived in the area for more than 10 years, and more than a third of these (~25%) had lived all their lives in the area.
- Almost half (44%) of the respondents rented or leased their premises. Another 28% lived in a rent-free arrangement or squatted (4%). This lack of home ownership amongst the surveyed population reflects the general lack of affordable housing.
- Only 37% of the respondents admitted to belonging to an identified social group. Of this number, the majority belonged to a church groups, followed by a community group then by a political group. This suggests a relatively low level of social organization and sense of community in the area.
- When asked if they voted in the last election, more than half (55%) indicated they did not vote. This suggests a level of apathy in the political process within the area.

4.3.2.3 Quality of Life Indicators

- Electricity: the majority (88%) of the respondents indicated that the main source of lighting for their homes was from the JPS. The remaining 12% used other sources such as kerosene lamps, candles and flashlights.
- Sanitary facilities: 81% indicated that they had indoor toilet facilities, while 19% used outdoor pit latrines.
- Piped water: 69% of the respondents had indoor piped water in their homes. The remaining 31% obtained their water from other sources such as outdoor pipes, public standpipes, well, rivers and water trucks.
- Public transportation: 62% of the respondents indicated that public transportation was their main mode of transport; 28% owned their own vehicles (including six taxi drivers). The remaining 10% relied on other means of transportation including cycling.

4.3.3 Attitudes & Perceptions

4.3.3.1 Community Values and Complaints

All the respondents indicated that they valued their community; however they were not satisfied with some of the public services offered.

- 44% of the respondents indicated that road maintenance was a problem in the community and that it needed immediate attention.
- 15% of the respondents highlighted transportation as a problem in the area.
- Although 73% of the respondents relied on garbage trucks for collection, some 40% identified solid waste collection as major problem.
- 69% of the respondents had indoor piped water, although a significantly large percentage (37%) indicated that the water supply was a major problem as the service is very unreliable. They also voiced concern that the development will further deplete the already limited supply of water in the area.
- Security was also believed to be a major problem among 22% of the respondents. This view is shared primarily among taxi drivers, other motorists and some business persons.
- ~5% of the respondents indicated that the education, communications, fire, and electricity services needed improvement.

4.3.3.2 Awareness & Attitude towards Project

- When asked if they were aware of the proposed development, 67% indicated that they first heard of it during the interview. Twenty nine percent (29%) indicated that they had heard of it from others in the community, while 4% heard of it in the media.
- The vast majority (95%) of respondents had no objection to the project. The minority indicated their opposition based on the perception that the project would mean a loss of agricultural lands and cause various social problems in the area.
- Most people regarded the project as being extremely important to the community. When asked to rank out of ten the importance of the project to the community, half ranked it over 9, with 42% ranking it a perfect ten. Another 40% ranked its importance between 6 and 8 (15% ranked it eight, 16% ranked it seven, 9% ranked it six). Only 10% thought the importance of the project ranked below 5.
- More than half (58%) of the individuals were of the view that there would not be any negative social effects arising from the project. When asked if they believed the project will cause problems for those living in the area, 78% responded no.

4.4 ISSUES RAISED BY STAKEHOLDERS

4.4.1 The Bio-physical Environment

1. Effects on micro-climates.
   See section 5.3.1.1

2. Effects of increased vehicular emissions on air quality.
   See section 5.3.1.2

3. Changes to hydrological conditions and flood potential arising from vegetation clearance, the proposed drainage modifications and site run-offs. The majority of survey respondents (45%) thought flooding would be a possible problem faced after the development is carried out. NEPA in the revision to the approved TOR (Appendix 2) also highlighted the need to conduct a wider watershed analysis, which would specifically look at downstream potential for flooding particularly in respect of the main road and Highway 2000 as potential receptor. The effects of gully straightening were also highlighted as a potential impact that should be included in the assessment. Officers of the St. Catherine Parish Council also raised the need to minimize flooding effects and promote infiltration (aquifer recharge) in the design. The effect of gully training, particularly in Bowers Gully on the downstream channel (scouring and flash flooding), was also raised.
   See sections 5.3.1.3 and 5.3.1.4 and Section 3.2.3 for baseline information.

4. Water Quality: effects of tertiary effluent discharges on downstream water quality (including irrigation). Twenty percent of the respondents thought the project would have an impact on the water. The potential contribution to salinization over the coastal aquifer by the operation of the Colbeck well;
   See Section 5.3.1.6

4.4.2 Biological Environment

1. Effects on biomass and biodiversity from vegetation removal.
   See Section 5.3.2.1

2. Modification of existing habitats including potential effects of removal of dam and some of the riparian habitat on the Bowers River, and change over from ephemeral flows to continuous flows at the STP outfall to Bowers River.
   See Section 5.3.2.2

4.4.3 Human and Built Environment

1. Potential nuisances in both construction and operational phases: dust, noise, heavy traffic. This included concerns with the operation of a concrete batching plant.

Construction nuisances such as dust and noise were highlighted by 40% of the survey respondents.
See Section 5.3.3.1

2. Change in land use: Only 15% of the respondents were opposed to the change in use. Some thought that agriculture could once again become a thriving industry in the area or that the site should be preserved for its historical value. Twenty nine percent (29%) perceived that the development of the land resources would benefit the whole community and the wider society. Officers of the St. Catherine Parish Council suggested that an adequate reserve of open space should be created in the agricultural area (Zone 1) as this zone may become built up over time.
   See Section 5.3.3.9

3. Changes to the heritage site at Colbeck Castle;
   See Section 5.3.3.8

4. The creation of a major access road and effects on traffic flows. Traffic congestion was cited by 40% of the respondents as another important negative effect. NEPA indicated (Appendix 2) that: "*With respect to the Traffic Impact Study (TIS) requested, the study should determine the specific infrastructure needed to mitigate the impact of the proposed development on the local transportation network and establish the site design features needed to support the system-wide transportation objectives. The TIS should be prepared in consultation with the Planning and Research Directorate of the National Works Agency*." However, discussions with NWA (Mark Richards, Environmental Department, and NWA) suggest that the specific traffic infrastructure requirements are usually made after the project and the EIA have been evaluated by the NWA.
   The potential impact of the development on traffic flows are discussed in sections 5.3.3.1 (construction nuisances), 5.3.3.5, and 5.3.3.11. See also Section 3.5.3 for baseline surveys.

5. Development of a major sub-urban community with a Central Business District (CBD), including effects on:
   a) Increased availability of affordable housing stock in proximity to a major arterial road and related demographic changes.
      See Section 5.3.3.10

   b) Social changes: Social effects such as crime (23%), political tension (16%) and an increased presence of strangers (11%) were named during the survey. Security: 19% believed security would be improved.
      See Section 5.3.3.6.

c) Economic effects: Employment: 85% believed the project would provide employment both during and after the construction phase. 76% believed the project would provide business opportunities for investors and other stakeholders in and outside the community.
See Section 5.3.3.10

d) Quality of life effects: Overcrowding (21%) and traffic congestion (19%) were identified as possible effects during the survey. Improved quality of life: 57% believed the project would improve the quality of life in the area thus raising the standard of living for the residents.
See Section 5.3.3.11.

e) The municipal carrying capacity and community resources: health care, education, urban burial capacity, solid waste disposal capacity, postal services, emergency services (police, fire etc.) and electricity. Demand for municipal services: 26% noted that municipal services such as water, electricity, sewage, drainage and solid waste will be impacted. Twenty six percent (26%) indicated that they thought that community resources would be improved as a result of the project.
See Section 5.3.3.4

f) Public health management and vector control. Only 8% of respondents believed the project would have a negative effect on public health.
See Section 5.3.3.3

g) Site vulnerability to natural hazards (flooding, earthquakes, hurricanes);
See Section 5.3.3.2, and also Section 3.2.7

5 ASSESSMENT OF IMPACTS

5.1 SECTION OVERVIEW

The purpose of this task is to identify the major environmental and public health issues of concern and indicate their relative importance to the design of the project and the intended activities. The main objective is to determine whether there are any environmental considerations that need to be taken into account in reviewing the applications for environmental permits, and whether there is any environmental reason why the project should not proceed as proposed.

5.2 METHODOLOGIES

5.2.1 Impact Identification

Both positive and negative project impacts were identified using the following methods:

- □ Stakeholder consultation.
- □ Technical inputs from environmental specialists on the EIA team.
- □ Review of the possible impact-causing aspects of the project. Review of impact assessments done for similar projects, particularly those in this area.
- □ Regulatory criteria governing aspects of the environment likely to be impacted.
- □ The sensitivity of valued environmental components (VECs) likely to be impacted.
- □ Review of the risks arising from the project and the range of environmental consequences that could arise under upset conditions.

5.2.2 Impact Assessment

Each identified impact is classified according to the assessed effect level (no impact, minor, moderate or major). Each identified impact shall be assessed using the following criteria:

1. Scale: this refers to the magnitude of the adverse effect in terms of the geographic extent of influence arising from frequency and magnitude of the causative action. This allows higher assessment of impacts with a wider sphere of influence.
2. Affected Numbers: this considers the numbers of individuals (organisms, people etc.) from a valued population that stand to be impacted. This parameter can refer to indicator species or general receptor populations.
3. Secondary Effects: This parameter looks at the impact as a trigger mechanism for other effects, particularly those manifesting downstream of a pathway emanating from a project component, latent effects that could occur in the future, such as bioaccumulation of heavy metals in the food chain, or effects on future generations.
4. Resilience: This criterion examines ecological resilience/sensitivity (ability of a population to cope with effect). Existing stresses and variability of sensitivity (spatial or seasonal) shall be considered. Resilience/sensitivity can be determined by eco-toxicological response, dose/response relationships and exposure of the population given effect pathways.

5. Persistence: This addresses the frequency and duration of effects in the environment. In general, chronic (persistent) or acute (short-term but severe) effects are regarded as more significant.
6. Reversibility. This criterion evaluates the extent to which an affected receptor can be returned to its pre-project state.
7. Baseline change: This relates to any model or prediction of the extent of change that can be expected. This shall compare predicted levels of change with normal fluctuations as well as trends in the parameter without the effect of the project.
8. Extent to which the impact can be mitigated: This addresses the feasibility (ease of implementation and cost-effectiveness) of measures to prevent or reduce environmental costs. It shall also consider the benefits or moderating circumstances given these environmental costs.
9. Uncertainty: This allows for disclosure of the level of scientific confidence in the predicted outcomes, and the general reliability of the data and models used to predict impacts.
10. Acceptability to stakeholders: This examines the willingness to make trade-offs and the degree of objection, given potential benefits of the project. This also includes planning constraints and scientific criteria (maximum allowable limits).

The criteria given above are used in a simple rating scale, which further defines each of the criteria, according to the four basic effect levels commonly used in EIA practice (No Impact, Minor, Moderate and Significant). These are defined in Tables 28 and 29 and are consistently applied to each of the impacts identified.

Each impact is evaluated against each of the set criteria, with the assignment of a score (based as far as possible on the available scientific data presented in the EIA), and given a score between 0 and 5. The scores ranged from less than 1 (no impact to negligible), 1 to 1.9 (minor), 2 to 3.9 (low to high moderate), and more than 4 (low to high significant). Total score is averaged out of the scores in respect of the criteria to determine the overall averaged effect level for the impact. Where a criterion is not relevant, no score is assigned, and the average calculated only on the number of relevant and scored criteria.

Table 28 Negative Impact Assessment Criteria

	0	0.1 2	2.1 4	4.1 5.0
CRITERIA	**No impact**	**Minor**	**Moderate**	**Significant**
Scale:		Isolated effects within project site.	Localized area close to borders or offsite dispersion pathways.	Widespread: offsite regional effects
Affected Numbers:	None	<1% population or habitat area is directly exposed.	1% to 10% population or habitat directly exposed.	> 10% population or habitat area is directly exposed.
Secondary Effects	None	Few indirect effects.	Many indirect negative affects. One trophic level within one generation affected.	Many indirect negative affects. > 1 generation affected. Several trophic levels involved.
Resilience:	Receptors are resilient. Nuisance but no real loss of revenue or amenity. Impact does not occur at a time when receptors are vulnerable		Morbidity or health concern. Temporary loss of revenue or amenity. Impact occurs at the start or end of a period when receptor is particularly vulnerable	Receptors unable to cope. Mortality or trauma in populations. Loss of revenue or amenity is sustained after remedial action is taken. Impact occurs at the peak time when receptor is vulnerable.
Persistence:	Lasting less than a few months before recovery occurs with no observable residual effects. Related to duration of event.		Lasting from a few months to two years before signs of recovery	Impact persistent after 2 years. Impacts on a biological population over a number of recruitment cycles.
Reversibility:	Can be returned to original state completely with removal of structural elements.		Can be returned to a productive state with removal or change of use of structural elements.	Cannot be easily or cost-effectively returned to previous state or be re-used for any other productive purpose.
Baseline change:	None	Effects are barely measurable against baseline conditions – within 1 standard deviation of the mean.	Moderate deviation from baseline conditions. Within 2 standard deviation of the mean.	Major deviation from baseline conditions: > 2 standard deviations of the mean.
Manageability:	None	Very easily and cost-effectively mitigated. Significant opportunities for environmental enhancement or benefits in the short to medium term (arising within a few months).	Cost-effectively mitigated. Long term environmental benefit as a result of the short-term negative impact associated with project (arising within 2 years)	Cannot be easily mitigated or requires major design change to causative activities. No mitigation possible. No opportunity for environmental enhancement or no perceptible environmental benefit.
Scientific Uncertainties	>99% confidence in the validity of the prediction of the impact parameters. No data gaps or uncertainties. Data is reliable.		76-99% confidence in the validity of the predictions. Numeric models extrapolate data set.	<75% confidence in the validity of the predictions. Inadequate data available for numeric modelling. Predictions based on qualitative or anecdotal evidence. Worst-case scenarios have to be applied.
Acceptability:	Impacts are acceptable to affected community. Complies with legal thresholds and /or best practice or wise use of resource, physical plans and land use policies.		Acceptable with mitigation. Affected stakeholders willing to make trade off. Approaches legal limits or criteria or maximum allowable levels.	Public outcry. Prohibitive legislation, plans or policies. Exceeds legal thresholds, limits or criteria or maximum allowable levels.

Table 29 Positive Impact Assessment Criteria

	0	0.1 2	2.1 4	4.1 4.9
CRITERIA	**No impact**	**Minor**	**Moderate**	**Significant**
Scale:		Isolated effects within project site.	Localized area close to borders or offsite dispersion pathways.	Widespread: offsite regional effects
Affected Numbers:		Less than 1% population or habitat affected.	1-10% population or habitat affected.	More than 10% population or habitat affected
Secondary Effects		Few indirect positive effects.	Many indirect positive affects. One trophic level within one generation affected.	Many indirect positive affects. > 1 generation affected. Several trophic levels involved.
Resilience:	Receptors are not able to take full benefit or benefit indirectly. Minor advantage but no real increase in revenue or amenity. Impact does not occur at a time when receptors are receptive.		Medium term increase of revenue or amenity. Impact occurs at the start or end of a period when receptor is able to benefit.	Receptors benefit directly. Revenue or amenity is sustained in the long term. Benefits are accessible at best time for receptor.
Persistence:	Lasting less than a few months before recovery occurs with no observable residual effects.		Lasting from a few months to two years before signs of recovery.	Impact persistent after 2 years. Impacts on a biological population over several recruitment cycles.
Baseline change:	Effects are barely measurable against baseline conditions – within 1 standard deviation of the mean.		Moderate deviation: 1-2 standard deviations	Major deviation: >2 standard deviations
Scientific Uncertainties	<75% confidence in the validity of the predictions. Inadequate data available for numeric modelling. Predictions based on qualitative or anecdotal evidence. Worst-case scenarios have to be applied. Numerous conditions that are likely to occur that would affect impact of benefits.		76-99% confidence in the validity of the predictions. Numeric models extrapolate data set. A number of conditions that could off-set benefits.	>99% confidence in the validity of the prediction of the impact parameters. No data gaps or uncertainties. Data is reliable. Few conditions that could off-set benefits.

5.3 ENVIRONMENTAL IMPACTS

5.3.1 Physical Environment

5.3.1.1 Heat Island Effect

During the operational phase in particular there will be changes to micro-climate as a result of increased heat and humidity. These changes occur as a result of:

- Increased paved surfaces, buildings and fugitive dust which trap heat.
- Increased humidity and emissions associated with air conditioning units, restaurants and kitchens, particularly in the CBD area, where higher building densities are likely to restrict air flows.

CRITERIA	ASSESSMENT	Score
Scale:	Approximately 60% of the 394 acres are proposed for fairly intense land use. Within this area, it is expected that the actual percentage of built area will vary (for example the 965 SFU will result in a combined total of 18 acres of built space over a minimum total combined lot area of 77.5 acres, or 23% of the allocated area). The heat island effects are generally expected to be confined to the development area.	3
Affected Numbers:	At full build-out the population on the site could range anywhere between 12,000 and 21,000. However, due to the low level of change expected, it is not expected that they would be negatively impacted through exposure.	1
Secondary Effects	The increased heat will cause the need for cooling devices such as air conditioning units which will further add to the problem as they will contribute to the heat island effect. This will also increase consumption of non-renewable energy, which adds to the national fuel bill, and the national emissions of combustion gases.	3
Resilience	The impacts are not expected to be greater than any other urban area.	1
Persistence:	For the lifetime of the project and as long as the physical structures (roads, air conditioning units etc) remain in place.	4
Reversibility:	Although it is completely reversible with the removal of all structures and reinstatement of vegetation cover, this could not be easily or cost-effectively accomplished.	4
Baseline change	Barely measurable against the normal range of temperatures.	2

Manageability	This can be managed by: ▪ Landscaping within the built spaces, and along roadways etc. ▪ Maintenance of riparian zones, reserve areas and parks as planned. ▪ Designing houses that do not trap heat and allow for natural ventilation to minimize the need for air-conditioning systems.	2
Uncertainty	The actual change in micro-climate and increases in temperature and humidity are unknown.	3
Acceptability:	Normally acceptable to stakeholders given the benefits of urban life.	1
Classification:	**MODERATE**	2.4

5.3.1.2 Increased Vehicular Emissions (Air Quality)

During the operational phase, it is expected that there could be as many cars in the area as there are housing units, with a full-build estimate of 2671. In addition, there might be non-resident vehicles associated with persons having business in the CBD, or with the farmers in agricultural zone. Combustion emissions from fossil fuels include hundreds of compounds, some of which may be toxic in high concentrations. These include carbon monoxide (CO), nitrogen oxides (NOx), sulphur dioxide (SO_2), and hydrocarbon particulates. NOx can contribute to the development of photochemical smog, and fine (breathable) particulates. This effect is cumulative to the regional concentrations. SO_2 can contribute to the acidity of rain. No regional studies have been done to determine ambient air quality levels or pH of rain.

CRITERIA	**ASSESSMENT**	**Score**
Scale:	Regional	4
Affected Numbers:	Not relevant as concentrations will be in too low doses to impact receptors. Cumulative effect only.	0
Secondary Effects	Acid rain, global warming, poor visibility (smog), heat island (from particulates)	3
Resilience	Because of the low concentrations directly exposed receptors are likely to be resilient.	1
Persistence:	Long term	4
Reversibility:	Not reversible.	4
Baseline change	The amount of pollutants entering the atmosphere from emissions can be determined empirically, although the change may not be measurable due to rapid dispersion.	3

Manageability	Provision of reliable public transportation should be able to reduce dependence on single family vehicles. However, the success of this mitigation depends on the availability of such, and the willingness of socially mobile individuals to not use a personal vehicle. Smoky vehicles should not be allowed to operate. Vehicles older than 10 years should be voluntarily replaced.		4
Uncertainty	The actual numbers of cars and actual emission loads are uncertain.		4
Acceptability:	Generally there is a high degree of acceptability of this effect. There are no regulatory controls in Jamaica on vehicular emissions.		1
Classification:	**MODERATE**		2.8

5.3.1.3 Flood Potential in the Bowers River System

Onsite Flooding

The potential for flooding on the property is related to (1) sheet floods on impermeable surfaces such as roads, pavements, parking areas, and removal of vegetation and (2) insufficient capacity in the design capacity of drains and culverts and the main storm water drainage courses. The occurrence of sheet floods is best minimized in the gradients and design of structures to take water off these surfaces and safely channel it into the appropriate sewers. This has been taken into account in the drainage design, which has used the recommended specifications. In respect of the sufficiency of the design capacities of the storm water courses, again, these meet recommended specifications and the design parameters use a 90% run-off estimate to determine peak flow capacity. Along the major courses, sufficient reserve has been made (100-foot reserve for Gully 2, and 50 foot reserve for Gully 1), with the intention for these to be maintained as natural systems with a riparian buffer zone. No onsite flooding arising from the project is predicted as the drainage plan itself is a mitigation response to any potential for this, and is designed to accommodate the predicted peak flows.

Downstream Flooding

Estimated peak discharge rates at the south boundary of the development are given in Table 30. These rates were estimated using the Jamaica II method previously described and are further detailed in the Engineering Design Report.

Table 30 Peak Discharge Rates

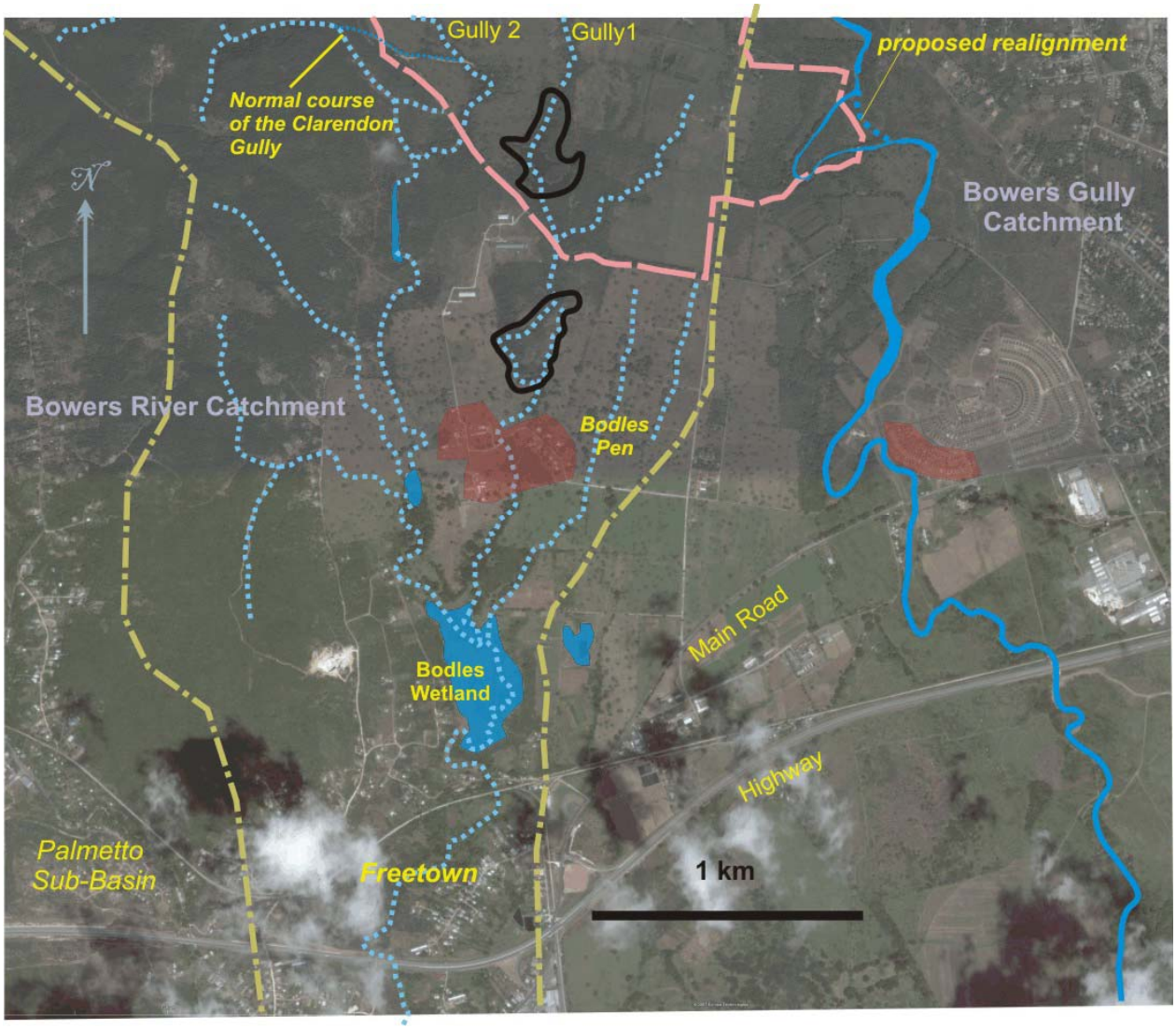
	Estimated Peak Flow (m^3/s)		
Gully	**50-year**	**25-year**	**10-year**
Gully 1 (central)	19.1	17.2	13.8
Gully 2 (western)	7.9	6.5	5.04
Gully 2 (below confluence with Gully 3)	166.9	138.4	106.5
Gully 3 (Clarendon Gully)	36.3	31.1	24.7

It is likely that these peak flow events off-site would lead to (a) more rapid responses to storms in the main gully to Bodles (b) higher volumes of storm water, to a level that would be similar to run-offs from saturated ground in these catchments (90%) (c) vertical incision of the alluvial base of the gully (scouring), and potential bank erosion (d) possible overtopping of channel, and flooding of the pasture lands that occur to the south of the proposed development.

CRITERIA	ASSESSMENT	Score
Scale:	Offsite: a 50-acre dam occurs within 1.3 km of the site boundary at the Bodles Agricultural station. In general, this dam will act as a retention pond and will protect the main road, Freetown and Highway 2000 from flooding. However, a zone of concern (~100 acres) occurs between the site and the dam, marked red on Figure 25 is identified.	4
Affected Numbers:	The total estimated area within this zone is ~100 acres. Much of the land in the northern part (first 650 m) of the zone is pasture. After this area, there is a small settlement, assumed to be part of Bodles Pen (within ED SW73), where the elevation is <20 m asl. Although this area may be exposed to a flood, the level of risk is low as the catchment for Gully 1 is relatively small, and the 50-year peak flow (19 m^3/s) can be accommodated within the existing channel between the site and the Bodles dam. Less than 10% of the exposed receptors are expected to be negatively impacted. There is a potential for flows from Gully 3 to impact on downstream lands. However, these lands are known to be wetlands, and there are two intermediary retention ponds that buffer the small settlement between the site and the agricultural station main wetlands and dam.	3
Secondary Effects	Scouring and vertical incision in the channel downstream due to more frequent higher velocity flows arising from the built area. This leads to higher bed loads and turbid flows. Scoured sediment (including boulder size material) may be deposited on the lower gradient sections of the channel or near confluences or bends (creating braid bars).	3
Resilience	The exposed receptors are not regarded as unable to cope, as much of it is pastureland. The Bodles Pen area is not expected to be specifically flooded as the channel in this area is expected to be able to accommodate the 50-year flood event.	2
Persistence:	Long term	5
Reversibility:	Not easily or cost-effectively reversed.	5
Baseline change	Increased flows are expected to be ~60% greater than normal flows (with run-off from un-built pasture estimated at ~35%) and the planned removal of the retention dam that now exists on Gully 1.	5

Manageability	▪ A more detailed drainage investigation of the zone of concern is indicated to ascertain the level of human occupation and risk presented by the flows from the area above it. ▪ Maintenance of the Clarendon Gully as a separate course that does not enter the property. Its normal course appears to run south of the parochial road, although there is historic evidence that it has breached this road and entered the property. Future breaches can be prevented by filling any channels leading to the road, and placing a berm on the south side of the road to protect the road and prevent storm flows from the Clarendon Gully sub-catchment from entering the property. ▪ Maintenance of the Bowers River (Gully 1) channel through the Bodles Pen property: this includes periodic clearance of any vegetation or debris within the channels. ▪ If there is continued development in the Bowers River (Gully 1) catchment above the site as can be expected, some provision should be made to create a retention pond between the culvert for Gully 1 leaving the site (southern boundary) and Bodles Pen (see black enclosed area on Figure 25). Alternatively, consideration could be given to leaving the existing pond on the property as a retention pond (see Figure 26 and notes), modified by dredging to increase capacity. The additional benefits of this include elimination of the cost of filling, preservation of the wetland habitat, aesthetic value, off-set location near to STP with the value placed on waterfront lands. ▪ There should be an earthen berm marking the southern boundary of the property to prevent sheet wash leaving the site from further eroding the parochial road. ▪ Use of infiltration-promoting approaches for pavements and parking areas. ▪ Restriction of extension of building units to a maximum ground floor footprint of 2000 square feet.	2
Uncertainty	The actual level of risk to the zone of concern requires more investigation. However, this uncertainty should not preclude precautionary intervention.	3
Acceptability:	This risk is acceptable with the appropriate preventive measures put in place.	2
Classification:	**MODERATE**	3.1

Figure 25 Flood Risk



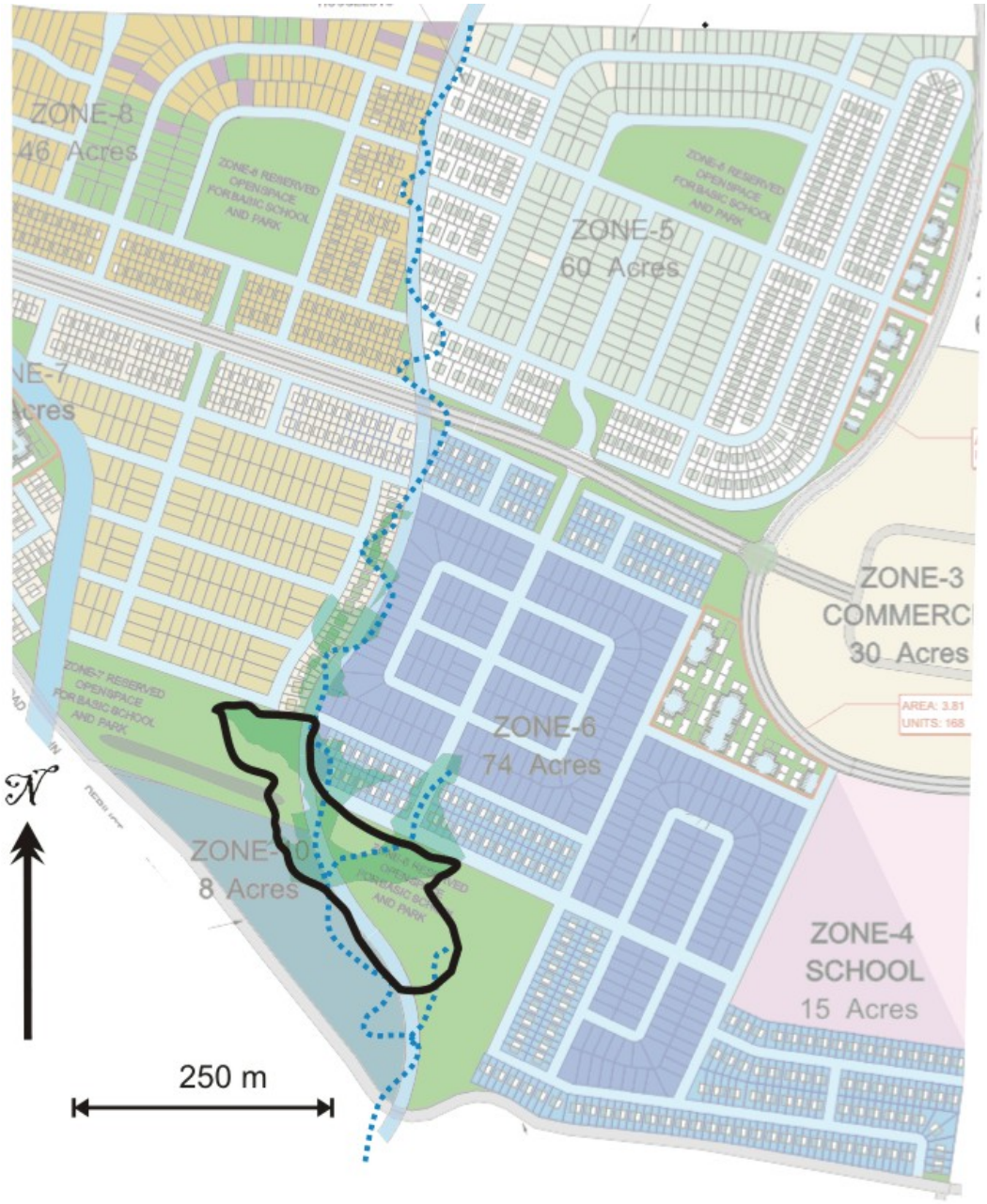
Red area shows the zone of concern.

Yellow dashed lines show catchment divides.

Dams and gullies are shown in blue.

There is no apparent direct flood risk presented to either the Main Road or Highway 2000 from predicted storm flow pathways emanating from the development site.

Figure 26 Proposed Design Modification: Storm Water Retention Pond on Property



Notes: As a possible downstream flood mitigation measure, it is recommended that part of the existing pond (dark green shading) be kept, and the boundaries be modified to accommodate the site plan as shown by the heavy black line. The pond should be excavated to a design depth to ensure adequate capacity for storm water flows from the Gully 1 catchment. If a basic school is to be placed on either side of the pond, the school yard should be completely fenced off from the pond, and should be placed as far as possible from the pond.

5.3.1.4 Flood Potential in the Bowers Gully System

The run-off coefficient for Zone 1, which contributes to flows in the Bowers Gully, is not expected to change, as the area is not expected to be significantly built-up. Water will be imported to the site for the purposes of aquaculture and irrigation. This is expected to run-off to the river, along with any storm flows from the property. Consequently, the change to the baseline run-off from the site is expected to be relatively small.

A realignment of a deep bend that dissects Zone 1 is now proposed. This will add approximately 400 m of new channel along the eastern boundary of the site, and will remove a 900 m segment of the river now running through Zone 1 (Figure 25). The main effect of this realignment is expected to be a 500-m shorter distance for flows from the upper catchment to travel between the start of the realignment and the end of it. This may result in a flashier flood response than normal in the Lennansville area, and resulting channel scouring. However, the wide channel and low bed gradient between Lennansville and the main road is expected to slow flows down considerably so as to minimize any threat to the main road or communities below it. There is some concern about the proximity of the houses in the settlement scheme near this river (shown in red). However, maintenance of a clear channel should prevent any risk of overtopping at this point.

CRITERIA	ASSESSMENT	Score
Scale:	Offsite.	4
Affected Numbers:	The affected area is a floodplain. There is one area of housing near to the river at a distance of ~1 km downstream. The length of the channel over this distance is more than 1.5 km, and the channel itself is between 15 and 60 m wide in this stretch. It is expected that the faster flows created by the curve flattening will be dampened out by the greater downstream cross-sectional area and low gradient.	2
Secondary Effects	unknown	2
Resilience	Floodplain receptors can cope with flood conditions.	2
Persistence:	Long term	5
Reversibility:	Not cost-effective.	5
Baseline change	Flows are expected to be faster because of lower sinuosity in new alignment and shorter distance.	4

Manageability	Uncertain whether this requires any management. ▪ The alignment should have a high surface roughness and very low gradient to slow flows down. ▪ Consideration could be given to making the new alignment more curved than is presently proposed. Creation of a detention basin along the alignment is not recommended as this would starve the downstream wetland of water during low flow periods and affect eco-systems downstream.		2
Uncertainty	See above		4
Acceptability:	There is no reasonable engineering or hydrological reason why this alignment should not be implemented.		2
Classification:	**MODERATE**		3.2

5.3.1.5 Effects on Groundwater Resources

A concern was raised that loss of agricultural lands to urban land use may represent to some extent loss of aquifer recharge. Approximately 40% of the total lands will remain under passive use or open space. Of the remaining 60% slated for more intense land use, less than two thirds (40% of the total acreage or ~160 acres) are actually estimated to be converted to impermeable surface (buildings, roadways, and parking areas). Consequently, the estimate of 90% run-off change is an intentional over-estimate for the purpose of conservative storm water design, rather than a realistic representation of the change in run-off from natural conditions (estimated to be ~35% now). It is more likely that the run-off from the site during unsaturated conditions will be between 60% and 75%, depending on the rate of build-out, conversely giving an infiltration rate of ~25% down from an estimated 65%. The mitigation measures used to reduce the flood risk in the Bowers River system will also serve the function of promoting infiltration into the aquifer.

The WRA in issuing the abstraction license for the Colbeck Well has accepted a design minimum pumping water-level elevation of 1.5 m above mean sea level as a means of preventing saline up-coning (HydroConsult, 2006). The base of the well occurs 41 m above the saline groundwater, so there is no threat to groundwater resources from this well.

For these reasons, the project is thought to have a negligible impact on groundwater resources in the area.

5.3.1.6 Changes to Water Quality

During the construction phase, site run-offs may contain elevated levels of TSS and possibly hydrocarbons, arising from:

1. Vegetation clearance.
2. Earthworks (for drainage modification, grading, etc.)
3. Stockpiling of top soils, aggregate and other construction material.
4. Cement batching plant run-offs (washwater from dispenser trucks, and hopper area).
5. Increased use and servicing of heavy equipment and vehicles at the site during construction.
6. Potential for an oil spill.

During the operational phase, the potential sources of pollution to groundwater resources arising from the proposed project include:

1. Discharge of treated effluent from the STP to the Bowers River system. This may have above ambient levels of TSS, nitrogen, and phosphates. Based on the baseline values of faecal coliform (ranging up to 2400 MPN/100 ml) and the present pasture land use, it is expected that the change in land use and STP will actually reduce the amount of faecal coliform, nitrates and phosphates entering the system.
2. Urban site run-offs, which may contain non-biodegradable floatables, oil and grease roadways and parking areas, and machine shop areas from the commercial area, mainly to the Bowers River system.
3. Effluent discharges from the proposed agricultural operations in Zone 1 to the Bowers Gully system. This may include above ambient levels of pesticides, fertilizers (nitrates, phosphates and potassium), and BOD (related to aquaculture effluents). This area has been historically used for both farming and aquaculture.
4. Potential for an oil spill.

CRITERIA	ASSESSMENT	Score
Scale:	Offsite: to Bodles Pen/Bodles wetland in the case of the Bowers River (main site outfall) and the Bowers River and Lennansville wetland (Zone 1 outfall). Although moving pass the site boundaries, these effects are predicted to be contained within the wetland areas to which the run-offs outfall. Ultimately, there is a potential for water from the site to enter the Portland Bight.	4
Affected Numbers:	Direct receptors are wetland communities. Actual change in ambient levels and the percent of receiving population that could be impacted is uncertain. There is no abstraction of potable water downstream of either system at present time.	2

Secondary Effects	It is expected that the use of pesticides will be greatly restricted in hydroponic or organic farming; therefore the negative effects of this are expected to be negligible if any. Increased nutrients will promote lusher vegetative growth in the wetland areas. Uncertain use of raw water in the Bodles Pen area. The system presently only carries storm flows so it is unlikely that the residents use the water for domestic purposes, and more likely that they have an alternative piped source. If residents do begin to use the more continuous flows in the Bowers River before it enters the Bodles wetland, it could impact deleteriously on public health, as it is basically sewage effluent. If non-biodegradable floatables and elevated TSS do enter the river system, they could impact on visual aesthetic, and eventually end up in the Portland Bight marine area, where they could negatively impact marine eco-systems.	4
Resilience	The proposed project will not introduce any pollutants in any quantities that are not presently within the expected ambient range, given the historic use of this area for large scale cultivation and animal pens. Consequently biological receptors are expected to be able to cope with changes.	2
Persistence:	Long term	5
Reversibility:	Not easily or cost-effectively reversed.	5
Baseline change	Relatively minor.	2

Manageability	Construction phase: ▪ Manage construction materials and stockpiles: covering, marshalling, bunding. ▪ Avoid major works during April-May and October-November in any given construction year. ▪ Restrict concrete batching, equipment servicing and washing to the main construction staging area, which should have in place a washwater system. That system should be capable of removal of solids and oil and grease. ▪ Implement a construction site waste management plan to effectively manage and dispose of construction related wastes (including vegetation debris, packaging materials, additive containers construction camp wastes, oily rags etc.) ▪ Restore vegetation cover as early as possible. Fast growing trees can be used. ▪ Ensure that there is a construction phase Emergency Response Plan (ERP) for containing and cleaning up spills before they leave the site. Operational phase: ▪ Explore option of containing STP outfall to the inside detention pond suggested (Figure 26). ▪ Advise the population downstream of the sewage effluent discharges. ▪ Ensure that solid waste is properly managed in the residential, agricultural and commercial areas. Separate zone plans should be prepared. ▪ Ensure that there is an operational phase Emergency Response Plan (ERP) for containing and cleaning up spills before they leave the site. ▪ Maintain the proposed buffer zone for sewage outfalls in respect of the property line. ▪ If possible, the treated effluent should be beneficially reused within the development for irrigation. This will also reduce the demand for irrigation water. ▪ Ensure that the STP is properly maintained, and that there is a secondary power system in place. The system should be designed to minimize impact or disruption of operations from hurricanes. ▪ Monitor STP effluent outfalls as required by law. ▪ Organize farming areas so that aquaculture and	2

Uncertainty	Actual quantities of outfalls are unknown.		4
Acceptability:	Generally acceptable with mitigation as outfalls are expect to meet national standards.		3
Classification:	**MODERATE**		3.3

5.3.2 Biological Impacts

5.3.2.1 Reduced Biomass and Habitat

Actions of the project that are likely to have an effect on biomass include:

- Clearing and filling of ~25 acres riparian vegetation (mature trees) in Zone 6 (Figure 27). A smaller area with a less well-developed vegetation community will be cleared in Zone 1 as well.
- Removal of the artificial dam in Zone 6, 7 and 10, and the vegetation around it (Figure 26).
- Change from mixed pasture and pasture elsewhere on the property (another 215 acres) to built area.
- Return from overgrown pasture to agricultural land use (60 acres).

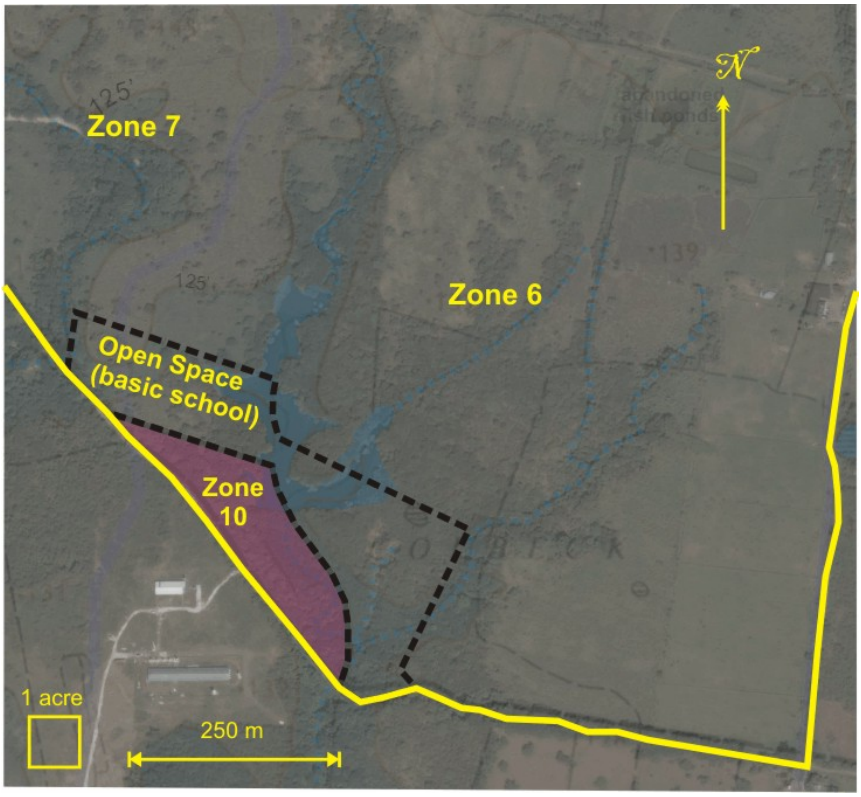
The effects of these will be:

1. Reduction in the biomass (and diminished carbon sequestration, and carbon removing functions of the plants).
2. Loss of habitat for the birds and other wildlife now found in the affected areas.

CRITERIA	**ASSESSMENT**	**Score**
Scale:	Restricted to the site, but there are indirect off-site effects.	2
Affected Numbers:	All of the population within cleared areas will be impacted.	5
Secondary Effects	Migration of wildlife to refugia (e.g. open space reserves, Bodles wetlands and adjacent areas that are available). This may create increased competition for resources in these areas.	2
Resilience	This area has been historically disturbed and has gone through cycles of clearance for plantations and grazing. It is expected that the wildlife would be adaptable.	2
Persistence:	Long term	5
Reversibility:	Not very cost-effectively reversed.	4

Baseline change	Moderate		3
Manageability	None necessary		0
Uncertainty	-		0
Acceptability:	Generally acceptable, particularly as the vegetation has been historically very disturbed and is neither natural nor pristine. The area is not protected, and is in a zone now slated for agriculture which allows for complete replacement of the natural eco-systems. Removal of the pond reduces the risk of crocodile and mosquito infestations to the residential communities. No rare or protected species were found in this area, and removal is not expected to threaten regional biodiversity.		1
Classification:	**MODERATE**		2.4

Figure 27 Affected Riparian Vegetation



Nb: the yellow line represents the property boundary along parochial roads.

Zone 10 is shown in pink shading, and the open space allotments for Zones 6 and 7 are shown within the dashed line.

The central gully (Gully 1) which now runs through the pond separates zones 6 and 7.

5.3.2.2 Change from ephemeral flows

It is possible that the nature of flow downstream of the property in Gully 1 (Bowers River) will change from being an ephemeral stream to one with a more continuous flow. This is likely to arise from the higher level of run-off from the built area, and from the outfall of treated sewage effluent to this area. The effects of this are not considered negative, and include:

1. The downstream riparian vegetation community may be expected to become denser.
2. An aquatic fauna similar to other river systems and ponds in the area can be expected to develop. Aquatic plants may colonize the area as well.

This effect is considered to be a negligible positive one.

5.3.2.3 Ecological Barriers

Fences or perimeter berms are extremely important to the site in terms of landscaping, visual barriers, flood control and security. These structures, along with roads and drains can create barriers or hazards for fauna that are used to being able to cross these areas. Fortunately, the wildlife in this area consists mainly of birds that are not easily impacted by barriers. Species such as mongooses may fall victim to cars on roadways. **Due to the general lack of sensitive receptors to this impact, it is classified as a very negligible negative impact in this case.**

5.3.3 The Human Environment

5.3.3.1 Construction Nuisances

Although all the major earthworks, infrastructure and part of Zone 6 will be constructed in the first year, the development plan requires phased construction over a 5-year period (Figure 12). It is possible that persons who have purchased units in an earlier phase might be impacted by later phase construction. However, in general, the construction will be phased in such a way as to minimize the nuisances to residents, particularly as it is largely divided between the village units, which tend to be fairly self-contained, and separate from each other. The main construction camp will be located near the quarry site at the western end of the development, so construction camp nuisances (cement batching, stockpiles, equipment storage and maintenance, construction offices and worker facilities) will be minimized by physical isolation of the camp. This area will also be fenced off from sight using zinc sheeting or plywood.

Construction nuisances that are likely to affect the community in include:

1. Fugitive dust as heavy haulage vehicles travel through the Central Main Road or the Eastern Main Road. Some fugitive dust can be expected after sites are cleared of vegetation for construction. Impacts associated with vehicular emissions are dealt with elsewhere.

2. Some traffic congestion due to heavy vehicles and slow moving equipment. Vegetation clearance and earthworks like grading and compaction may not be done until close to the scheduled construction time. Traffic outside of the main site along major site access routes is also expected to be impacted.
3. Noise from vehicular traffic along the main spines, and noise from construction within their own village if they buy into a village that is not completed in a single phase (e.g. Zone 6).
4. Visual intrusion of small construction sites within individual villages, if people buy into a village that is not completed in a single phase.
5. Safety and security. Construction sites are often the subject of larceny, and may attract thieves to the community. Also, if children are living in the area, unfenced construction sites represent a hazard.

CRITERIA	ASSESSMENT	Score
Scale:	On site and along main access corridor, and site access routes.	3
Affected Numbers:	Persons who buy into the development within the first 5 years and construction workers are likely to be affected. Pedestrians and motorists will be chiefly affected by nuisance dust and traffic along haulage routes.	4
Secondary Effects	▪ Reduced air quality depending on windiness. ▪ Delays in the case of traffic congestion. ▪ Wear and tear on the road surface from heavy vehicular traffic.	3
Resilience	Receptors (construction workers) are resilient if equipped with dust masks, ear muffs and other safety gear. Motorists should not be adversely affected as they will be inside vehicles.	1
Persistence:	Up to five years.	4
Reversibility:	Not reversible	5
Baseline change	Construction nuisances will be measurably different from pre-construction levels of noise, dust, visual intrusion and vehicular traffic.	4

Manageability	▪ Provision of dust masks and ear muffs to construction workers. ▪ Minimize work stoppage during earthworks. ▪ Suitable siting of the main staging area (construction camp). ▪ Ensuring that haulage contractors maintain their vehicles and have them suitably equipped to spread the axle loads to minimize effects of wear and tear on public roads. ▪ The loads of haulage trucks need to be securely covered. ▪ Haulage contractors need to observe community safe driving practices during later phases of the development. ▪ Constant wetting of stockpiles, unpaved surfaces and other dust-generating surfaces. ▪ Phasing of clearance and earthworks. ▪ Allow grass to re-establish as soon as possible after earthworks are completed. ▪ Placement of safety signs. ▪ Fencing off of construction sites. ▪ Security during all phases. ▪ Construction must be limited to normal working hours once people are living within a particular village that is under construction. ▪ Construction of Phase 5 (CDB and Zones 8, 9 and 11) must be done in a way that is sensitive to all the other residents.	1
Uncertainty	The actual rate of construction, and occupation of the units.	3
Acceptability:	Generally acceptable given the benefits.	1
Classification:	**MODERATE**	2.9

5.3.3.2 Increased Risk (Hazard Vulnerability)

Although the basic natural hazards (earthquakes, floods, hurricanes) affecting the site are unlikely to change significantly because of the development, the risk will increase because of the increased amount of investment in property at the site, and because of the higher density of people living there that can be impacted by the hazards.

CRITERIA	**ASSESSMENT**	**Score**
Scale:	On site	3
Affected Numbers:	The affected numbers are related to the effectiveness of the proposed mitigation measures. The risk to the population can be greatly reduced. The incidence of a hazard does not have to become a disaster.	3

Secondary Effects	▪ Disruption of daily life and livelihoods of persons in the area if roads and utilities are damaged after an event. ▪ Economic costs of recovery will be greater at a site with intense residential land use than in a poorly used agricultural area. ▪ Losses after a hazard has occurred can result in health, safety and quality of life issues. ▪ Relatively high homeowner insurance or disaster insurance.		3
Resilience	Very much dependent on the effectiveness of mitigation measures.		3
Persistence:	Long term (risk potential).		5
Reversibility:	Not reversible.		5
Baseline change	Major increase in "*at risk*" elements		5
Manageability	▪ Buildings should be constructed in accordance with national codes in respect of hurricane force winds and earthquakes. This should also include proper roofing and hurricane straps on houses. ▪ Preparation and implementation of an Emergency Response plan, which includes awareness programmes in communities and disaster committee, and shelter designation within each village or outside of the village as necessary. This should be approved by ODPEM. ▪ Insurance against earthquake and hurricane damage is recommended for homeowners in this area. ▪ Emergency power should be in place for the wastewater and water supply systems.		3
Uncertainty	The rate of recovery and costs of insurance are uncertain.		3
Acceptability:	This level of risk is acceptable to most homeowners provided that the mitigation measures are implemented. There are no regulatory controls in Jamaica governing hazard insurance. ODPEM is authorized by law as the main agency for emergency management and disaster preparedness, and it works with communities mainly through its parish extension offices.		3
Classification:	**MODERATE**		3.6

5.3.3.3 Infestation of Vectors and Pests

Dense residential settlements and commercial areas typically harbour pests such as rats, mice, roaches, flies, mosquitoes. Poor management of solid waste collection areas or food storage areas can result in major infestations, which can have serious public health consequences. In Jamaica, dengue fever and leptospirosis are two serious illnesses that are transmitted by vectors. In addition, there may be increased numbers of stray cats and dogs associated with residential developments.

CRITERIA	ASSESSMENT	Score
Scale:	Site specific	2
Affected Numbers:	Unknown; with mitigation it is expected to be less than 10% of the total population.	2
Secondary Effects	▪ Illness or mortality in human populations. ▪ Decline in visual aesthetics. ▪ Demands on public health inspectors and health care providers. ▪ Increase in feral cats which may in turn, increase predation of birds in adjacent hills on western side or wetlands to the south.	3
Resilience	Receptors are resilient once mitigation measures are implemented.	1
Persistence:	Short to medium term depending on the effectiveness of preventive measures rather than control measures.	1
Reversibility:	Can be reversed completely with proper measures in place	1
Baseline change	The area is already known to have many of these pests. However the population densities are expected to increase substantially.	2
Manageability	▪ Identifying and controlling pests of public significance. ▪ Proper and constant cleaning of storm water drains and possible vector breeding habitats. ▪ Ensuring proper storage of food, garbage and other insect attracting items. ▪ Development and implementation of a solid waste disposal plan. ▪ Encouragement of private solid waste collection agency. ▪ Dialogue between committee, the Public Health Department and the Ministry of Health on all matters pertaining to vector control in the area.	2
Uncertainty	See above.	2

Acceptability:	This impact is acceptable with implementation of mitigation measures.		2
Classification:	**MINOR**		1.8

5.3.3.4 The Municipal Carrying Capacity

The presence of a major residential development, mixed with commercial and agricultural uses can be expected to place high demands on municipal resources such as health and education services, urban burial capacity, solid waste disposal capacity, postal services and emergency services (police, fire etc.).

CRITERIA	**ASSESSMENT**		**Score**
Scale:	Related to site demand		2
Affected Numbers:	The main receptors will be the municipal service providers		2
Secondary Effects	Increased demands on resources and hence competition for scarce resources. Increased electricity consumption and carbon footprint for the parish.		2
Resilience	Receptors are resilient as they will be able to provide resources. To some extent, the move by the developers to facilitate provision of government schools, private health care etc. serves to help the service providers meet the demands.		3
Persistence:	Long term		5
Reversibility:	Not reversible		5
Baseline change	This effect will be cumulative with the 16+ other housing developments in the parish.		2
Manageability	▪ Policies to foster private health care and education facilities. ▪ Consideration of encouraging a private waste collection service (solid waste) particularly for the CBD. ▪ Site security and police should reduce the need for emergency policing.		2
Uncertainty	None		0
Acceptability:	Generally acceptable once mitigation measures are put in place		1
Classification:	**MODERATE**		2.4

5.3.3.5 Operational Phase Traffic Impact

During the operational phase, it is expected that there will be an impact on traffic in the area based on (a) the expected increases in number of vehicles accessing the site (b) proposed creation of a connecting main spine between the Colbeck Factory in the north and the Old Harbour Main Road on the south side of the property. Presently, there is no through road, and while few vehicles may enter the property on the south side, none presently exit on the north side. Most of the traffic using the north access is expected to come from or go towards Old Harbour (east). The southern access point off the Main Road at Bodles is expected to see the largest volume of traffic associated with the development due to its more direct connection with Highway 2000.

The developers are committed to working with the NWA to ensure that the development of these major community access points and their connections to the existing road networks will not create any traffic hazards or problems of peak hour congestion.

CRITERIA	ASSESSMENT	Score
Scale:	At site boundaries.	3
Affected Numbers:	Unknown. The number of affected users can be greatly limited by careful traffic planning.	3
Secondary Effects	▪ Exhaust emissions from vehicles, nuisance noise (horns, engines), and fugitive dust (discussed elsewhere) ▪ Increased potential for motor vehicle accidents arising from road hazards at access points if not properly planned. ▪ Increased demand for public transportation. ▪ Potential loss of productive time if there is congestion during peak hour traffic.	3
Resilience	The presence of two major east-west arteries south of the property supports the development of a community of this scale, without creating congestion or hazardous conditions.	2
Persistence:	Long term	2
Reversibility:	Reversible with planning of alternatives that could be recommended by the NWA after evaluation of the development proposal.	3
Baseline change	Significant – east and westbound peak hour flows (weekday) are presently below 500 cars per hour in either direction. Using worst case scenario assumptions, if there are 2671 householders plus another 32 farm lot owners, and half of these purchase vehicles, there could be ~1300 cars merging from or exiting to this area during peak hour. Assuming most are east bound in the morning hours (to Old Harbour, Spanish Town and Kingston), it is assumed that the traffic heading toward Old Harbour will remain on the main road, and the traffic heading	5

	further east will exit to Highway 2000, which can easily accommodate these flows. It must be emphasised that this scheme, unlike many others in the parish, will not contribute traffic flows from school traffic or shopper traffic as much of this will be contained within the site as both schools and a wide range of commercial amenities are being provided within the confines of the two access points at full build-out. Therefore the major contributions to traffic, particularly peak hour traffic are expected to come from commuter traffic.		
Manageability	▪ Installation of appropriate traffic signals and lights at site access points. ▪ Careful designs of exits to bypass and highways to foster efficient vehicle movement and good connections onto highways and connecting streets. ▪ Plans must take into account the needs for public transportation, particularly as this development aims at lower to middle income households. ▪ There must be continued dialogue with the NWA throughout the planning of the development to ensure consistence with its objectives. ▪ Traffic commuting between Old Harbour and the development should be routed mainly through the north access point to reduce congestion of commuter traffic seeking to cross the main road and connect to Highway 2000.		3
Uncertainty	See above		2
Acceptability:	Generally acceptable if mitigation measures are implemented.		2
Classification:	**MODERATE**		2.8

5.3.3.6 Crime

Although reported crime rates in the area are low, the police station in the area is considered under-staffed and under-equipped to the deal with the rapidly growing population of St. Catherine. Twenty-three percent of the survey respondents felt that this could be a possible social effect of the development, along with overcrowding and traffic congestion. Interestingly, 19% also felt that the development would increase security in the area. While it is agreed that any attempt to predict future crime rates depending on this development will be speculative at best, it can be said that the demographic of the target resident population is neither one that typically generates criminal elements nor attracts it.

By way of control of crimes in the area, the follow measures are regarded as preventive:

- Layout and social planning that fosters a sense of community. Small-scale village units are not expected to lead to social isolation that could lead to crime from within the youth of the community.

- There are only two motorable access points to the site, plus a major control point at the roundabout intersection between the CBD bypass and the entrance to the residential area. All other roads end in cul de sacs.
- Neighbourhood watch groups that work with the police will be established.

This potential negative impact is therefore regarded as negligible.

5.3.3.7 Improvement of Visual Aesthetics at Quarry Site

The proposed re-instatement of vegetation and creation of a community park at the present quarry site on the west end of the site is expected to greatly improve the visual intrusion of the present quarry operations. This will also have indirect effects of replacing lost hillside habitats for birds and other animals, controlling dust, increasing biomass etc. The quarry will provide any needed marl for the project, and will accommodate the main construction camp and stockpiles and will be the last area that is remediated. It is recommended that over-steepened slopes be graded to a 1:4 slope and covered with topsoil. Slopes that cannot be graded without intruding into the adjacent undisturbed forest area should be covered with a bio-engineering material that promotes vegetative growth. All depressions should also be filled with rubble and then covered with topsoil. **This is regarded as a minor positive impact of the project which will not occur in the first five years.**

Figure 28 Quarry

5.3.3.8 Development of Colbeck Castle Tour

Colbeck Castle is a central icon to the development. The developers have demonstrated a commitment to working with the JNHT to ensure that the property is appropriately conserved. In discussing heritage tourism, the Tourism Master Plan for Jamaica (page 98), supports a

strategy of "*creating vehicles for public-private partnerships so that the combined skills of both sectors can be harnessed in support of developing heritage products".* This is one such opportunity, where the developers of the site are willing to work with the constraints necessary for effective conservation of this site while allowing visitors and Jamaicans the opportunity to enjoy it and learn something about it in a safe and structured environment. The provision of shops and visitor amenities around the buffer area of the castle will serve to enhance the tourism product. This is considered a positive impact of the project.

CRITERIA	**ASSESSMENT**	**Score**
Scale:	Isolated on site.	1
Affected Numbers:	National heritage resource	4
Secondary Effects	▪ Greater appreciation for Jamaica's heritage and historical sites. ▪ Visitor satisfaction. ▪ Opportunities for tour related business. ▪ Reduction of the potential for vandalism and further degradation of the site.	3
Resilience	Immediate benefit.	4
Persistence:	Long term	4
Baseline change	Improvement to the recognition of Colbeck Castle its history, and the importance of its conservation	3
Uncertainty	-	4
Classification:	**MODERATE**	3.2

5.3.3.9 Change of land use

If permitted, there is expected to be a change in land use from neglected agricultural lands to a mixed-use dominated by residential usage. Although this change will result in removal of available lands from potential use for agricultural purposes, it must be emphasized that agriculture in this area is in decline for many reasons (many of which are economic), and the lands are likely not to be used for agricultural purposes in the short or medium term. This appears to be part of a natural process where the dominant land use around the Old Harbour area and its transportation network is transitioning from primary agricultural use to land uses that support a more urban base.

Overall, the change in use is regarded as a positive impact as it will:

1. Increase the availability of middle-income housing stock in an area that is prized for residential use because of its location in proximity to major urban centres and the recent development of the transportation network.

2. Convert the land from a low value use to a high value use. This includes 32 farm lots, which will cause 60 acres to be put into high value agrocultural use that is being encouraged by RADA.
3. Make adequate provision for drainage and open space requirements to minimize adverse physical effects.

CRITERIA	ASSESSMENT		Score
Scale:	Site specific		3
Affected Numbers:	12,000 to 18,000 persons are expected to directly benefit from the development, plus persons who obtain business opportunities in the commercial and agricultural areas.		5
Secondary Effects	▪ Creation of jobs and business opportunities for investors and community entrepreneurs particularly in the business zone, which would be made more attractive by the presence of the associated residential villages depending on its amenities. ▪ Creation of a commercial centre outside of Old Harbour may relieve congestion there. ▪ Improved quality of life (modern urban services) and improved planning. ▪ Removal of grazing animals and the potential negative effects on soils and water quality. ▪ Food production in the agricultural areas.		5
Resilience	Receptors will benefit directly from the change of use, particularly with the increased NHT loan amounts available to first time homeowners.		4
Persistence:	Long term		5
Baseline change	Major increase in the availability of housing stock		5
Classification:	**SIGNIFICANT**		4.5

5.3.3.10 Long term demographic changes

It is expected that the provision of 2671 middle income housing units will change the demographic of the St. Catherine and Old Harbour, if it is assumed that residents from outside the parish or from rural areas of the parish become attracted to the area. It is expected that the housing development will be particularly attractive to persons who have (a) to work in a major urban centre within one hour's commute of their home or (b) have families where working members work in different urban centres.

The changes in demographic of the area are seen as a positive impact, as there are many benefits to having a stable urban population. Although, these developments may represent a

loss of farm lands, there are several important advantages associated with trend towards more urban land use:

- They provide much needed middle income housing stock, for which there is a growing deficit. Developments like these take pressure off government in that they are driven by the private sector.
- These sub-urban settlements are fully supported by the road network that now exists, allowing for an easy commute between the major urban centres (Spanish Town, Old Harbour, May Pen and Kingston), and therefore relieves the demand for housing within the urban centres.
- It is easier and more cost-effective to provide municipal services to relatively dense, planned communities than low-density residential "rural areas", especially in terms of water supply, sewerage, storm water management, roads, communications, police and emergency services etc.

CRITERIA	ASSESSMENT	Score
Scale:	Regional	4
Affected Numbers:	Of the order of thousands.	4
Secondary Effects	It is expected that the demographic effect of the development may include: ▪ Contributions to the annual population growth in St. Catherine from in-migration. ▪ Many of the purchasers are expected to be part of nuclear families, with young upwardly mobile professionals where both spouses are working, and this investment is the first home purchased. This development caters to the needs of nuclear families in the provision of community amenities (schools, parks) and social-cultural facilities (church, shopping area, heritage site etc.) ▪ The two foregoing items have implications for the development of social capital and organization, as well as the electorate basis. ▪ There is also a potential that investors may purchase units for the purpose of renting, and having property that has good potential to increase in value. ▪ Improved quality of life to residents with the provision of centrally planned residential amenities, and village design that promotes community building.	4
Resilience	Receptors should be able to afford housing units with affordable loan programmes and mortgages	4
Persistence:	Long term.	4

Baseline change	At full build-out (with about 12,000 persons) the population of ED SW 73 will be greatly increased from a 2001 population of 537.		4
Uncertainty	There is a high demand for housing in this bracket, so there is a reasonable level of confidence that provision of such in a key location will be supported in the market.		4
Classification:	**SIGNIFICANT**		4.0

5.3.3.11 Ease of Congestion in Old Harbour

It is expected that the proposed development will ease congestion in Old Harbour in a two main of ways:

1. Persons now wishing to drive to the area north of the site (Colbeck, Planters Hall, Bannister,) from May Pen or Freetown must now travel through Old Harbour. The proposed dual carriage way through the Colbeck estate will serve effectively as a bypass road for Old Harbour.
2. Persons from surrounding areas (including other housing developments with no schools or business district provision) may now have the option of sharing facilities being created within this development. The layout of the Master Plan is such that persons not resident in the area can enter and use the school in Zone 4 or the commercial area without ever having cause to enter the main residential area.

This impact will be cumulative with the general improvement to transportation in the area with Highway 2000's effects on congestion reduction on the Old Harbour Main Road.

The effects can be further enhanced by the creation of a farmers' market place for produce and agricultural good (including gardening supplies) within the agricultural zone or commercial zone. Market congestion within Old Harbour on weekends can be thus alleviated.

CRITERIA	**ASSESSMENT**	**Score**
Scale:	Regional scale.	4
Affected Numbers:	Using the estimates provided in Table 27 of the regional population suggests this may be of the order of ~17,000, of which more than 10% are likely to benefit from the improved congestion in Old Harbour	5
Secondary Effects	▪ Shorter time between Freetown and Bannister. Positive effects on fuel consumption. ▪ Social amenities and convenience to nearby communities that were constructed without these. ▪ Less vehicular emissions and traffic impacts in Old Harbour. ▪ Opportunities for entry level small businesses. ▪ Off-set traffic impacts arising from increased vehicular traffic in the area.	4

Resilience	Drivers will not be restricted from entering or exiting the north-south spine.		4
Persistence:	Long term		5
Baseline change	Significant change is predicted.		4
Classification:	**SIGNIFICANT**		4.5

5.4 CONCLUSION

5.4.1 Summary

Minor or negligible impacts included infestation of vectors, effects on groundwater and potential ecological barriers and possible crime effects arising from the project implementation. Ten negative impacts were classified as moderate. Most of them were long term transitional or cumulative effects on the biophysical environment:

- Heat island effect.
- Vehicular emissions (air quality).
- Flood potential in the Bowers River System (from built surfaces).
- Flood potential in the Bowers Gully System (from curve flattening).
- Changes to surface water quality.
- Reduction in biomass.

Of those related to the human environment, one out of the four was considered short to medium term (construction nuisance), and the others were regarded as long term effects that were cumulative with other similar schemes in the area:

- Increased risk (hazard vulnerability)
- Demands on municipal services.
- Potential negative effects on traffic.

Six positive effects were assessed. These could be potentially compounded with many indirect effects, and are predicted to impact largely on the human environment. Three of these were determined to be significant by the criteria established in this EIA: change of land use, ease of congestion in Old Harbour, and the long term demographic changes in the region. Development of heritage tourism opportunity at Colbeck Castle was determined to potentially have moderate benefits, and the introduction of continuous effluent outfall into the ephemeral stream downstream of the property was determined to have the potential to have a negligible positive effect on the eco-system there. Visual improvement to the quarry area was considered to be a relatively minor positive impact, which is not likely to not occur within the first five years.

5.4.2 Finding

It is the finding of this EIA that there are no significant negative impacts on the environment that may reasonably be expected to arise from the implementation of this project. There are moderate negative effects, particularly on the biophysical environment that can be cost-effectively mitigated. There are significant opportunities for environmental enhancement in this project, and wider societal benefits.

6 ANALYSIS OF ALTERNATIVES

6.1 SECTION OVERVIEW

The purpose of this section of the EIA is to examine feasible alternatives to the project and, highlight the benefits of and general rationale for the project that need to be considered against any potential environmental cost. Feasible land use options shall be compared in terms of lowest costs and most benefits criteria: environmental impacts, social acceptability, economics (including productivity of land use) and engineering feasibility.

6.2 SITING CRITERIA

The location for the development represents the optimal siting as it meets the following required criteria for siting a residential development:

1. The physical conditions of the site are optimal for lower cost developments as the land requires little grading or excavation (flat terrain).
2. The site is well-drained with low potential for downstream flooding.
3. It is supported by a very good transportation network in relation to the major urban centres in the area.
4. Public facilities and services such electricity, police and fire services are available in proximity to the site.
5. The proposed land use is consistent with surrounding land uses.
6. There is sufficient acreage available to ensure adequate open space amenity, while having the housing densities necessary to make the scheme financially viable.

6.3 LAND USE OPTIONS

Feasible land use options are compared in terms of lowest costs and most benefits criteria: environmental impacts, social acceptability, economics (including productivity of land use) and engineering feasibility. The following land use options are considered: (1) leaving the land as is (status quo); (2) the proposed residential development; and (3) agricultural re-development/expansion. These options are detailed below.

6.3.1 Leaving the Land As Is (Status Quo)

The no action alternative or status quo would allow the 394 acre (159 ha) property to remain in its current unproductive state.

6.3.1.1 Costs

With the exception of Colbeck Castle, these resources were neither rare nor unique to this area, and should not impede the development. Based on current trends, the main costs of this option would be:

1. **Physical Aspects**
    - Equal level of exposure to natural hazards as with any other land use. Hurricane and earthquake prone.
    - Continued presence of the quarry.
    - Major contamination of surface water by TSS from overgrazed areas, nutrients and faecal coliforms from cattle.
2. **Ecological Aspects**
    - Increased risk of bush fires
    - Effects of grazing animals and historic agricultural uses on ecological resources.
    - Effects of feral species (rats, mongooses) on birds.
3. **Socio-economic Aspects**
    - Lack of development in the area as agriculture is not attractive to the owners.
    - Possible increase in squatting and praedial larceny on the property
    - Continued degradation of Colbeck Castle, and lack of investigation of the site for archaeological resources.
4. **Implementation Costs**
    - Opportunity cost to owners as there is a relatively low property value under present use.

6.3.1.2 Benefits

The current land use:

- Avoids sudden widespread impacts on the existing environmental resources (flora, fauna; heritage resources) on the site.
- Would preserve open space.
- Keeps the land in principle under agricultural land use, and does not contribute to the perception of the decline of agriculture through the loss of agricultural lands. NB. It is the contention here that this decline is not related to the unavailability of suitable lands.

6.3.2 The Proposed Mixed-Use Development

This option includes the development of a multi-use residential development as described in Section 1. This development is a permanent land use and will become a permanent part of the physical landscape. There will be both negative and positive environmental impacts associated with this option, which were detailed in Section 5 of this report.

6.3.2.1 Costs

1. Physical Aspects

- Heat island effect.
- Vehicular emissions (air quality).
- Flood potential in the Bowers River System (from built surfaces).
- Flood potential in the Bowers Gully System (from curve flattening).
- Changes to surface water quality.
- Consumption of groundwater resources.

2. Ecological Aspects

- Reduction in biomass and habitats (artificial pond).
- Vector infestation potential.
- Ecological barriers.

3. Socio-economic Aspects

- Construction nuisances.
- Increased risk (hazard vulnerability)
- Potential increase in traffic.
- Potential effects on crime.

4. Implementation Costs

- Engineering, design and construction cost of the proposed facilities.
- Environmental mitigation and monitoring costs.
- Consumption of government services and municipal resources.
- Maintenance: STP, drainage, park facilities etc.

6.3.2.2 Benefits

1. Physical Aspects

- Improvement of the visual aesthetic of the site, particularly near the quarry.
- Improved drainage infrastructure and capacity. This may include improvements to the Clarendon Gully crossing the parochial road on the southwestern side of the property.
- Elimination of the impacts of previous use: soil erosion, overgrazing, surface water contamination etc.

2. Ecological Aspects

- Improved management of existing natural resources.
- Inputs to the Bowers River from the STP, which would increase water and nutrient availability downstream.

3. Socio-economic Aspects

- Change in land use:
  - More affordable housing opportunities within the context of a well-planned structure.
  - Change of land use to a more productive land use;
  - Current land use proposal is consistent with proposed use under the Highway Corridor 2000 development plan.
  - Increased income earning opportunities because of the creation of a sub-urban market.
  - More cost-effective provision of services, and therefore improvements to quality of life.
  - Development of socially-integrated communities through modern urban planning.
- Ease of congestion in Old Harbour
  - Shorter time between Freetown and Bannister. Positive effects on fuel consumption.
  - Social amenities and convenience to nearby communities that were constructed without these.
  - Less vehicular emissions and traffic impacts in Old Harbour.
  - Opportunities for entry level small businesses.
  - Off-set traffic impacts arising from increased vehicular traffic in the area.
- Improvement and proper maintenance of the Colbeck Castle heritage site.

6.3.3 Agricultural Sub-Division

The hypothetical alternative is discussed theoretically only as a means of comparing the value of the proposed development in light of other feasible land uses. This alternative envisages that the whole area would be redeveloped for modern agriculture, inclusive of the types being suggested for Zone 1. The redevelopment efforts under this option could also see the implementation of cattle and sheep rearing, organic farming, aquaculture and export fruit crops (such as mangos). It is also recommended that bee-keeping for honey (logwood) be encouraged in this area.

Assuming 40% of the total acreage is reserved as passive use, this leaves ~236 acres. If another 36 acres are used for infrastructure (roads), and maybe a farmers' market and agro-processing area, that leaves ~200 acres, which can be sub-divided into 200 2-acre lots. Agricultural sub-division would require land clearance activities of the wooded areas and overgrown pasture, as well as development of the necessary infrastructure and services (including an extensive irrigation system), and the provision of 200 farmstead houses.

6.3.3.1 Costs

Costs associated with this scenario include:

1. **Physical Aspects**

   - Modification to existing drainage, which may affect flood potential.
   - Water and sediment quality (use of fertilisers and pesticides, pasture leachate, effluents from agro-processing and ponds). It is also likely that an STP would not be developed for this small demand so individual owners would have to put in small disposal systems.
   - Soil erosion (agricultural practices and methods).
   - Consumption of groundwater resources.

2. **Ecological Aspects**

   - Loss of ecological resources – habitats and biomass
   - Vector infestation potential – food and grain storage.
   - Ecological barriers – subdivision roads and drains, fences.

3. **Socio-economic Aspects**

   - Some construction nuisances (much smaller scale)
   - Insufficient resources to justify the development of the Colbeck attraction.

4. Implementation Costs.

- Engineering, design and construction cost of the proposed facilities.
- Environmental mitigation and monitoring costs.
- Maintenance: drainage and communal areas.

6.3.3.2 Benefits

1. Physical Aspects

- Increased amounts of green space and maintenance of infiltration capacity;

2. Ecological Aspects

- Improved management of existing natural resources.
- Preservation of ecological resources

3. Socio-economic Aspects

- Increased production of subsistence and commercial crops.
- Economic effects: income and employment opportunities for farmers in the area;
- Attraction of agro-businesses and other new developments in the area
- Increased opportunity for agricultural diversification;
- This alternative would be consistent with the zoned land use for the area, as provided for in the National Physical Development Plan.

6.3.4 Least-Cost Most-Benefits Analysis

The land use options outlined above are compared in terms of potential benefits and costs using a range of factors or normative criteria. 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. Additionally, as it is a ranking system, each option is given a score of at least one, although two options could tie with the same rank. The best possible score would therefore be 10, and the worst would be 30.

Table 31 Comparison of Alternative Land Uses

Normative Criteria	SQ	PO	AS
Least physical costs	1	3	2
Least ecological costs	1	2	2
Lowest implementation costs	1	3	2
Least socio-economic costs	3	1	2
Least amount of environmental modification to suit design	1	2	2
Most physical or operational benefits	3	1	2
Most opportunities for resource conservation or enhancement	3	1	2
Most socio-economic benefits	3	1	2
Best aligned with regional development objectives and plans	2	3	1
Most economically viable for the landowners	3	1	2
Total	21	18	18

SQ = Status Quo PO = Proposed Option AS = Agricultural Sub-Division

Based on the simple unweighted ranking system, development would be preferred to the status quo for this particular site. Both development options ranked the same. However, this ranking is essentially unweighted, and the significant social benefits of the proposed developmnent over an agricultural sub-division are somewhat under-represented. Moreover, these landowners have tried agriculture in this location, and have previously incurred major losses due to the passage of a hurricane. The proposed option meets a major national need for middle-income housing, while providing basic community amenities at affordable rates.

7 ENVIRONMENTAL MANAGEMENT PLAN

7.1 SECTION OVERVIEW

In compliance with the TORs, this Environmental Management Plan (EMP) outlines:

1. Environmental performance objectives for the project based on the specific impacts identified during site preparation, construction and operational stages of the proposed development.
2. Proposed mitigation measures, identifying the best timing for implementation, responsibilities and any required commitments of resources. These may include general guidelines for activities during construction and operational phases of the project to improve the project's overall environmental performance (e.g., in respect of waste management, water and energy conservation, community development, etc.).
3. Requirements for post-permit plans and approvals.
4. An environmental monitoring plan.

The environmental permit will outline compliance requirements with respect to monitoring of sensitive environmental receptors and implementation of mitigation measures.

7.2 ENVIRONMENTAL MANAGEMENT OBJECTIVES

7.2.1 Construction Phase

6. To establish controls on contractors to ensure that the proposed mitigation measures are implemented in a timely and effective manner. This includes provisions for worker safety, road safety, waste and materials management.
7. To effectively minimize risks and negative environmental effects of natural disasters and hazards (hurricanes, fires, earthquakes, oil spills and accidental leaks).
8. To reduce and manage waste-streams predicted to occur.
9. To ensure that specific negative impacts on surface water quality from all aspects of construction
10. To minimize construction nuisances on other users and landowners throughout the development phase of the project.

7.2.2 Operational Phase

5. To develop and implement comprehensive environmental management plans, which clearly identify targets for environmental performance for the wastewater plant. This should involve some level of environmental education to all staff.

6. To conduct maintenance operations in a way that is compliant with environmental regulations and international best practices for pollution prevention, waste reduction, recovery and recycling wherever possible.
7. To maintain the project area in a manner that values adjacent eco-systems and its aesthetic appearance.
8. To work closely with the municipal service providers to ensure customer satisfaction and facilitation of the services.

7.3 MITIGATIONS

7.3.1 Recommended Design Modification

7.3.1.1 Bowers Gully

Although it is agreed that the deep hairpin curve can be eliminated to improve the lands in the Bowers Gully floodplain on the site (Zone 1), it is not entirely necessary to make the new alignment perfectly straight and smooth as this would accelerate flows. The alignment should have a high surface roughness and very low gradient to slow flows down. Creation of a detention basin along the alignment is not recommended as this would starve the downstream wetland of water during low flow periods and affect eco-systems downstream.

7.3.1.2 Storm water retention pond

It is recommended that the existing pond be integrated into the park/open space design for Zones 6 and 7 and part of the Zone 10, as a means of ensuring that the downstream flood potential is minimized. The engineer can determine the maximum capacity and determine the average depth for excavation based on the acreage the Master Planner wishes to allocate for this use. This water can be used for landscaping and irrigation.

7.3.1.3 Clarendon Gully

Although the drainage plan speaks to the matter of the Clarendon Gully joining the Bower River within the property boundary, there is no drainage reserve in the Master Plan for this, and no provision for crossing on the parochial road. It is recommended that the existing channel that runs south of the property boundary and road be maintained. Future breaches can be prevented by filling any channels leading to the road, and placing a berm on the south side of the road to protect the road and prevent storm flows from the Clarendon Gully sub-catchment from entering the property.

7.3.1.4 South boundary berm

There should be an earthen berm marking the southern boundary of the property to prevent sheet-wash leaving the site from further eroding the parochial road. This will also create a visual barrier.

7.3.1.5 Quarry restoration (Zone 11) in Phase 5.

Slopes should be graded to 1:4 and covered with topsoil. Slopes that cannot be graded without intruding into the adjacent undisturbed forest area should be covered with a bio-engineering material that promotes vegetative growth. All depressions should also be filled with rubble and then covered with topsoil. The area should be landscaped as determined by the Master Planner.

7.3.1.6 Farmers market and cooperative society.

It is recommended that a farmers market be developed to encourage the urban dwellers in the area to support the farms by purchasing produce. This is also expected to reduce the congestion in the Old Harbour Market, and promote homeowner gardening.

7.3.1.7 House Design and Residential Layout

The following suggestions are made for optimization of environmental performance:

1. Design houses that do not trap heat and allow for natural ventilation to minimize the need for air-conditioning systems.
2. Explore options for integration and promotion of solar power in the apartment complexes.
3. Use infiltration-promoting approaches for pavements and parking areas.
4. Create a homeowners development standards manual, which is part of the sales agreement. This should place restriction on the extent and style of expansion, limiting building units to a maximum ground floor footprint of 2000 square feet. Homeowners should also be restricted from establishing “garage businesses” such as mechanic or tyre shops in the residential areas. Buildings and extensions should be constructed in accordance with national codes in respect of hurricane force winds and earthquakes. This can also include proper roofing and hurricane straps implemented on houses.
5. There is a need for a central playfield or sports area. The central parks should be designed with the need for community sporting facilities (football and cricket) as well as schools and parks. In planning Zone 4, there could be some integration of a track, or sport arena.
6. In designing the CBD entertainment needs must also be met. A cinema in this area would be very financially lucrative. Restaurants and clubs could also be encouraged.

7. There should be provision of public transportation: e.g. bus terminal or bays, and taxi stands in the CBD.
8. Final designs of the north-south main road and its connections to the other major roads must be consistent with the requirements and recommendations of the NWA. This may involve requirements for installation of appropriate traffic signals and slip streams or lay bys at site access points. The final design should take into consideration the recommendation to route traffic commuting between Old Harbour and the development through the north access point to reduce congestion of commuter traffic seeking to cross the main road and connect to Highway 2000.
9. Organize farming areas so that aquaculture and animal pen outfalls can be used for irrigation of horticulture if possible and if supported by RADA.

7.3.2 Contractor Management

The following mitigation measures should be made mandatory for contractors.

7.3.2.1 Waste Management

- Maintain the vehicles and equipment properly throughout the construction phase.
- Avoid major earthworks during April-May and October-November in any given construction year, and phasing clearance and earthworks (i.e. do not clear entire site at once). Minimize work stoppage during earthworks and restore vegetation cover as early as possible. Allow grass to re-establish as soon as possible after earthworks are completed.
- Restrict concrete batching, equipment servicing and washing to the main construction staging area, which should have in place a washwater system. That system should be capable of removal of solids and oil and grease.
- Implement a construction site waste management plan to effectively manage and dispose of construction related wastes (including vegetation debris, packaging materials, additive containers construction camp wastes, oily rags etc.) This should also include provision for minimizing soil erosion on bared soils.
- Ensure that there is a construction phase Emergency Response Plan (ERP) for containing and cleaning up spills before they leave the site.

7.3.2.2 Material Management

- Wet stockpiles and unpaved access roads
- Cover haulage vehicles.
- Manage construction materials and stockpiles: covering, marshalling, bunding.
- Provide portable lavatories for construction workers.
- Ensure all solid waste generated on site is properly secured and routinely collected.
- All spills should be contained and cleaned up immediately.

7.3.2.3 Nuisance Minimization & Community Safety

- Haulage contractors should observe speed limits when driving in communities.
- Suitable siting of the main staging area (construction camp).
- Ensuring that haulage contractors maintain their vehicles and do not overload their vehicles.
- Haulage contractors need to observe community safe driving practices during later phases of the development.
- There should be safety signs.
- Construction sites should be fenced.
- There should be security during all phases.
- Construction must be limited to normal working hours once people are living within a particular village that is under construction.
- Construction of Phase 5 (CDB and Zones 8, 9 and 11) must be done in a way that is sensitive to all the other residents.

7.3.2.4 Worker Safety

- Ensure that all construction workers are provided with appropriate gear (dust masks and ear muffs, boots, hard hats) and insurance.
- Contractors should have an emergency response plan in place, with the necessary resources available to them to respond to any likely construction accident.

7.3.2.5 Resource Conservation

- If any archaeological artifacts are dredged up or unearthed during construction, a report should be made immediately to the JNHT for further evaluation.
- Topsoil should be carefully stockpiled for future use.
- Vegetation debris should be recycled as wood chips.

7.3.3 Committee Responsibilities

7.3.3.1 Maintenance & Security

It is recommended that the management committee oversee maintenance of:

- Riparian zones, reserve areas and parks as planned.
- Storm water drains including the Bowers River (Gully 1) through the Bodles Pen property.
- The proposed buffer zone for sewage outfalls in respect of the property line.
- Vector control. Dialogue between committee, the Public Health Department and the Ministry of Health on all matters pertaining to vector control in the area. The committee needs to ensure that the CBD owners have proper food storage, garbage

disposal facilities. There should be routine elimination of possible vector breeding habitats.
- Policies to foster private health care and education facilities.
- Consideration of encouraging a private waste collection service (solid waste) particularly for the CBD.
- Site security and police should reduce the need for emergency policing.

7.3.3.2 Environmental Awareness

There should be an environmental awareness committee, which specifically promotes:

- Waste recycling, reuse and reduction.
- Energy and fuel conservation – e.g. promotion of car pooling
- Water conservation particularly during droughts (e.g. no lawn irrigation)
- Vehicles older than 10 years should be voluntarily replaced.
- Community hygiene and best vector control practices.
- Disaster contingencies (loss prevention) and awareness: including insurance against earthquake and hurricane damage is recommended for homeowners in this area.
- Archaeological conservation and monitoring of activities at Colbeck Castle.

7.3.4 The Water Company

- Ensure that the STP is properly maintained, and that there is a secondary power system in place. The system should be designed to minimize impact or disruption of operations from hurricanes. Emergency power should be in place for the wastewater and water supply systems.
- Monitor STP effluent outfalls as required by law.
- If possible, the treated effluent should be beneficially reused within the development for irrigation. This will also reduce the demand for irrigation water.
- Advise the population downstream of the sewage effluent discharges.
- Monitor potable water quality and produce the necessary water safety plans.

7.3.5 Post-Permit Documentation Planning

1. **Planning Standards Guidance Document** for homeowners to ensure that the visual aesthetic is maintained. This should include an environmental management policy for commercial lot owners in respect of water conservation, energy conservation, paper-reduction and waste recycling.
2. **An emergency response plan (ERP)** which addresses contingencies for hurricanes, oil spills and fires, earthquakes. Preparation and implementation of an Emergency Response plan, which includes awareness programmes in communities and disaster committee, and shelter designation within each village or outside of the village as necessary.

3. **An attractions operational plan** for the proposed Colbeck Castle Heritage Site. This should be finalized in collaboration with JNHT, and the Ministry of Tourism (TPDCo)
4. Development and implementation of a **solid waste disposal plan**. Ensure that solid waste is properly managed in the residential, agricultural and commercial areas. Separate zone plans should be prepared. This should include encouragement of private solid waste collection agency.

7.4 MONITORING

7.4.1 Construction-Phase Monitoring

It is recommended that an independent third party be separately contracted to monitor the construction activities, and to submit Quarterly Reports to NEPA in respect of the following:

- Compliance with mandatory mitigation measures during construction.
- Occurrence of any accidents or environmental incidents.
- The occurrence of impacts not anticipated by this EIA.

7.4.2 Operational-Phase Monitoring

Water quality and sewage effluent monitoring as required by the standards is recommended.

7.5 FINAL RECOMMENDATION OF THE EIA

With implementation of the recommended mitigation measures and the management plan, it is recommended that this project be granted the relevant environmental permits to proceed with implementation.

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APPENDIX 1

APPROVED TERMS OF REFERENCE

JULY 4TH 2007

FINAL TERMS OF REFERENCE

July 4th 2007

FOR THE PREPARATION OF AN ENVIRONMENTAL IMPACT ASSESSMENT FOR THE VILLAGES OF COLBECK CASTLE DEVELOPMENT PROPOSED BY BCR INDUSTRIES CO. LTD.

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Prepared by:

emc2 ENVIRONMENTAL MANAGEMENT CONSULTANTS (CARIBBEAN) LTD
61 Mansfield Meadows, Ocho Rios, St. Ann, Jamaica
Tel/Fax: (876) 974-7423 | Tel: (876) 974-9727 | Email: newbiz@eiacaribbean.com

1 INTRODUCTION

B.C.R. Industries Company Limited is seeking permission to undertake the proposed *Villages of Colbeck Castle* development on a 159 ha (394 acres) parcel of relatively flat land at Colbeck Pen. The site is located on the border between Clarendon and St. Catherine as shown in Figure 1. It is approximately 6.5 km north of Port Esquivel (Portland Bight) at an elevation of 38 m to 50 m above sea level. The Watershed Management Units map indicates that the proposed development falls mainly within the Rio Cobre Watershed. A portion of the development also falls within the Rio Minho Watershed.

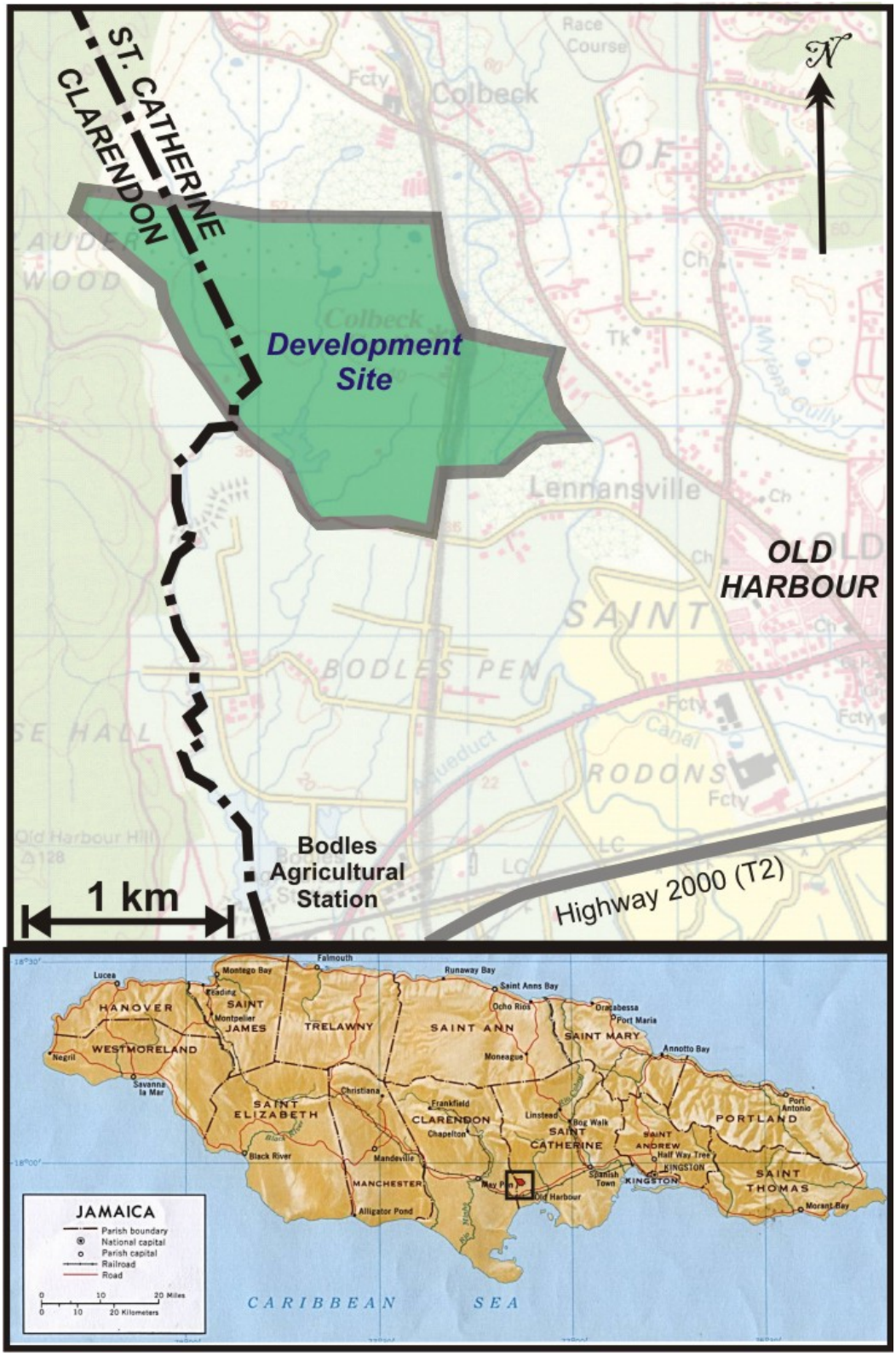
The western and southern boundaries are marked by a minor parochial road leading to a licensed quarry. The eastern boundary is in the southern part defined by an estate road (which continues on to the Colbeck Castle heritage site). The southeastern boundary is marked by a segment of the Plantain River. The northern boundary is not defined by any particular geographic feature. At the widest points, the northern boundary is ~1.2 km from the southern boundary, and the eastern boundary is 1.9 km from the western limit.

The site is situated approximately 36 km from the capital city of Kingston, 16 km from Spanish Town and 10 km from May Pen. The site is also situated within a few minutes drive of Old Harbour, which is situated ~2 km west of Colbeck Castle respectively. The Jamaican Agricultural Society (JAS) farmstead at Colbeck Pen and the Bodles Agricultural Research Station are located close to the site.

The *Villages of Colbeck Castle* will be essentially a multi-use residential development incorporating all the necessary attributes to support a desirable life quality for an anticipated population of between 12,000 and 16,000 inhabitants when completed. Although there is some reservation of agricultural land, the proposed development primarily includes urban land uses such as residential, infrastructure, commercial, educational, and recreational. There will also be provision for preservation of the Colbeck Castle heritage.

Pursuant to the Natural Resources Conservation Authority (NRCA) Act and prescribed schedule, the proposed development will require an environmental permit for the residential and commercial sub-division and housing development as well as an environmental license for the discharge of sewage effluent associated with the proposed sewage treatment plant. The National Environment and Planning Agency (NEPA) has requested that an Environmental Impact Assessment (EIA) be submitted in support of these applications.

Figure 1 Location of Proposed Development Site, Colbeck Castle, St. Catherine



2 OBJECTIVE OF THE DRAFT TOR

This document represents the Draft Terms of Reference (TOR) for the conduct of an Environmental Impact Assessment for the *Villages of Colbeck Castle* development proposal. The purpose of the TOR is to set the ground rules for the conduct of the EIA process, which includes the EIA report.

The legal defensibility of the environmental permit and the EIA rests upon:

1. The validity of the project and environmental information provided, in so far as they represent the actual building plans and the host environment;
2. The verifiability of the main scientific conclusions of the report; and
3. Adherence of the process to accepted norms that promote transparency.

Therefore the TOR shall:

- Be reviewed and accepted by all relevant parties as representative of the minimum requirements for an acceptable study;
- Indicate the process for such consultation;
- Provide sufficient information about the development proposal and the environment to allow for a preliminary scoping of environmental sensitivities;
- Outline the minimum requirements for the environmental baseline, specifically in terms of the parameters (Valued Environmental Components or VECs) to be investigated, the scale area of investigation for each parameter and the acceptable sources of information;
- Undertake primary surveys in accordance with the sampling regime described, having regard for international standard practice in EIA of studying environmental parameters in a *sphere of influence* of the project and not necessarily limited to the project site (the level of environmental investigation is commensurate with the level of concern that a receptor may be affected by the project);
- Outline the basic structure of the EIA Report, outlining the purpose of each of the sections as well as the minimum required scope/content; and
- Indicate any other information that is specifically required to facilitate the decision making process.

3 PLANNED DEVELOPMENT

The proposed Master Plan of the Development is given as Figure 2. The breakdown of land uses is given in Table 1 below.

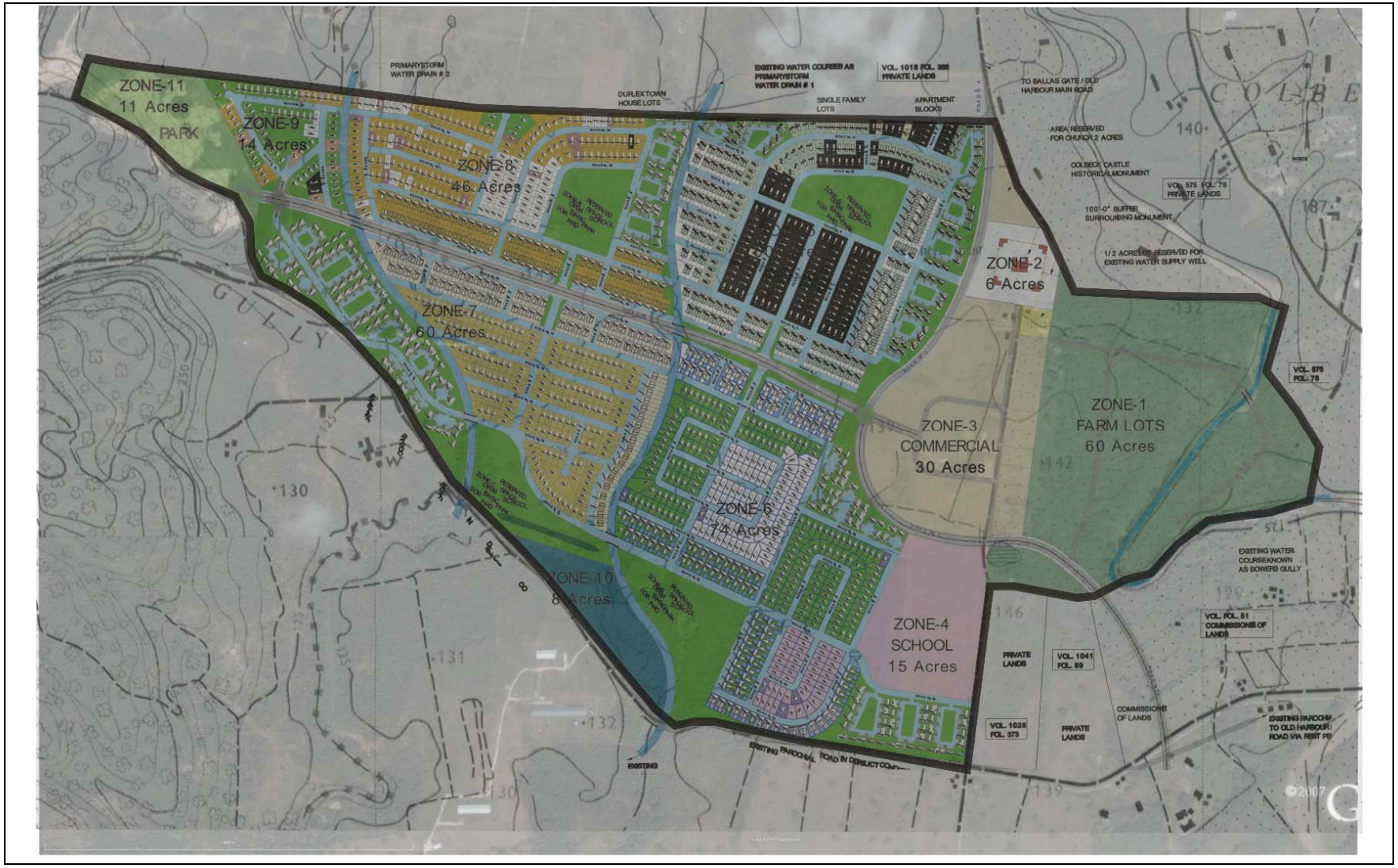
Table 1 Land Use Allocations

Zone	Land Use	Acres	Hectares
Zone 1	Agricultural sub-division	60	24.3
Zone 2	Colbeck Castle Heritage site	6	2.4
Zone 3	Commercial lots	30	12.1
Zone 4	School and playfield	15	6.1
Zone 5	Residential	60	24.3
Zone 6	Residential	74	29.9
Zone 7	Residential	60	24.3
Zone 8	Residential	46	18.6
Zone 9	Residential (Retirement village)	14	5.7
Zone 10	Sewage Treatment	8	3.2
Zone 11	Stand Alone Park	11	4.5
	Roads and drainage	10	4.0
	Total Acreage	**394**	**159.4**

3.1 Residential Land Use (Zones 5 to 9)

The development includes several zones or “villages” of variable housing densities (zones 5 to 9) as shown in Figure 2, with access to recreational community space, schools, and commercial area. A total of 2,722 housing solutions are planned, inclusive of 672 apartments, 1,028 townhouses and 1022 single family units. Approximately 65% (254 acres) of the total area will be allocated for this land use.

Figure 2 Master Plan, Villages of Colbeck Castle, St. Catherine



3.2 Agricultural and Open Areas

Approximately 37% of the total area (144.6 acres) will be left as open space. More than half of this will either be in agricultural lands (60 acres on the eastern side) or as the nature park (11 acres in the north western corner of the property). The agricultural allocation will be sub-divided into agricultural lots. The park will be landscaped and maintained (with public rest rooms) for community recreational use. The remaining open space reserves are distributed as given in Table 2 below.

Table 2 Open Space Allocations

	Land Use	Acreage	Hectares
Zone 1	Agricultural sub-division	60.0	24.3
Zone 2	Colbeck Castle Heritage site (buffer)	6.0	2.4
Zone 3	Commercial lots	0.0	0.0
Zone 4	School and playfield	15.0	6.1
Zone 5-9	Residential (school reserves)	44.6	18.0
Zone 10	Sewage Treatment	8.0	3.2
Zone 11	Stand Alone Park	11.0	4.5
		144.6 acres	**58.5 ha**

3.3 Community and Business District (Zone 2-4)

The main commercial space in the Central Business District (CBD) will be located in Zone 3 on the eastern side of the property, adjoining the farm lots (Zone 1), the main school allocation (Zone 4) and the heritage site (Zone 2). The CBD will include the following.

Table 3 Proposed Mixed Land Use in the CBD

Transport and Industrial	Shopping and Financial	Social Services and Amenities
Gas Station	Super-market	Health Clinic
Garage (mechanic)	Specialty Shops	Postal Agency
Transportation Hub	Personal Services	Church
Light Industrial/Tech Park	Bank Offices	Community Centre/Hall Craft Village

It is envisioned that the heritage site, shopping area and education zone will serve as a buffer between the farm lands and the residential lands, and will be a community focal point.

In respect of the Colbeck Castle Historic Monument, there is on-going dialogue with the Jamaica National Heritage Trust (JNHT) to restore the site to facilitate some level of heritage tourism. The land that is reserved for schools will be developed by the Ministry of Education.

3.4 Infrastructure

3.4.1 Sewage System (Zone 10)

The Master Plan proposes the use of an oxidation ditch with facultative ponds for sewage treatment. The treatment works design capacity is 1.2 million gallons per day with an estimated flow from the development of 1 million gallons per day at the completion of the development.

Exactly 8 acres are reserved in Zone 10 of the sewage treatment plant (STP). The treatment ponds proposed will occupy approximately 4 acres. This is located in the lowest elevation of the site in proximity to the dam on the property. According to the Master Plan, the STP site will be buffered from the main residential zones by chain-link fences, grassed earth mounds, landscaping, and park reserves.

The preliminary design calls for a sewer drainage system with a four (4) lift pumping stations. The sewer system is designed to gravity drain to the pumping stations in the south of each zone, and be collected and delivered to the STP. The plant and pumping stations will be equipped with standby pumping capacity and standby power supply. Wastewater effluent from the plant will meet the standards for open surface discharge as prescribed by the NRCA wastewater standards.

3.4.2 Access Roads

As shown in Figure 2, the main access road to the site will be on the eastern side, off the existing parochial road to Old Harbour. This new access road will run through the Bodles Pen (lands not associated with the development) and along the western side of the CBD, northwards to the Old Harbour Main Road. The main sub-division road will run between the CBD (Zone 1) and the Nature Park (Zone 11). Smaller residential roads will serve the village communities.

3.4.3 Drainage System

There are 2 drainage systems associated with the site: Plantain River/Bowers Gully in the East and Clarendon Gully/Bowers River (western and central tributaries). The Clarendon Gully/Bowers River system transmits significant storm flows from upstream of the property to the wetlands on the Bodles Agricultural Estate. The drain in the centre of the property is a minor tributary which drains into the Bodles wetland before joining the Bowers River. The Bowers Gully system on the eastern side appears to be the major regional storm drain. These gullies presently transmit storm flows and are generally dry.

As far as possible channels traversing the site will be straightened/re-aligned, and for the most part, they will be left as earth drains along most of their course. Gabion baskets will be constructed as recommended by the storm water engineering design. Adequate floodplain reserves/riparian buffer zones required for public safety and efficient transmission of storm water will be included as part of the storm drain design. A summary of the engineering design report for storm water drainage will be included.

A sewer system of main collector drains combined with open curb and channel road-side drains with curb and grating inlets to the sewers is proposed for collection and disposal of storm water within the development. The main collector sewers will flow to the primary storm water drains.

3.4.4 Water Supply

A water abstraction license has been acquired for the use of the well located near Colbeck Castle on the eastern side of the property. This well was established in 1962. It is an 18-inch diameter well drilled to a depth of 68.3 m below ground level into the lower Rio Cobre Limestone aquifer. It has an estimated safe reliable yield of 600 m^3 per hour. The proponents plan to use water from this well to supply the development.

Water Resources Authority (WRA) has accepted a design minimum pumping water level elevation of 1.5 m above mean sea level (amsl) as a means of preventing saline up-coning (Hydrology Consultants Ltd, 2006[1]). The base of the well occurs 41 m above the saline groundwater. A license to abstract and use 7,703 m^3/day (2.04 MGD) of water has been issued by the WRA (March 2007). A maximum of 7,200 m^3/day (1.9 MGD) of water has been estimated as the demand for the development, inclusive of demands for both domestic water and irrigation water.

3.4.5 Solid Waste Collection and Disposal

Solid waste management for the development will be undertaken by North Eastern Parks and Markets Limited. An estimated total weight of 12 metric tons per day of solid waste will be generated. This was calculated assuming solid waste/capita/day of 2 lbs, and an estimated total population of 16,000.

3.4.6 Electricity

The JPSCo currently supplies the surrounding areas and is expected to provide electricity to the development. An estimate of the maximum power demand for the development will be given in the EIA.

3.4.7 Telecommunications

Telephone services will be land based and cellular telephone service to be provided by Cable and Wireless and Digicel. Cable and Wireless shall be asked to install the necessary telephone and internet infrastructure. In addition a suitable provider may be asked to provide cellular coverage. In the event that a cellular tower may be erected the approval of the Town and Country Planning Authority will have to be sought. An estimate of the maximum land line demand for the development will be given in the EIA.

[1] Hydrology Consultants Ltd. 2006. Evaluation Report. Colbeck Castle Well, St. Catherine. Project of BCR Industries Co. Ltd. 27 p

4 PRELIMINARY ENVIRONMENTAL SCOPING

4.1 Environmental Overview

4.1.1 Physical Environment

The site occurs at elevations between 38 m and 50 m above mean sea level, and is generally very gently sloping to the south (~1%). The eastern side of the site falls within the floodplain of the Bowers Gully. Other smaller gullies characterise the site west of the road to Colbeck Castle. With the exception of the central channel, these are generally dry and appear to only transmit storm flows. The central channel is a part of the Clarendon Gully system, and is a tributary of the Bowers River, as the system is called below Bodles. This tributary has been dammed near the southern boundary of the site, and consequently a relatively large pond has developed.

The underlying bedrock is the Newport Formation (White Limestone). White limestone hills occur to the west of the site, where a small quarry has been established. The potential effect of the established quarry on the proposed development will be addressed in the EIA. Older rocks (Walderston Formation and Yellow limestones) outcrop to the north. The soils in the area are generally loamy alluvial soils with compact clayey layers at 15 to 25 cm.

4.1.2 Ground Cover and Ecology

The area is presently classified as agricultural lands[2], and has been historically used for cattle rearing and mariculture. Consequently, the vegetative cover at the site is very disturbed, comprising mainly shrubs and acacia trees on neglected farm lands. Forest vegetation occurs along gully courses. The dominant species include logwood, acacia, guango (*Samaan*), and *Ziziphus Mauritonian.*

Forty-two bird species were found on the property in a baseline survey. Of these only eleven were endemic, most of which were found along the forested gully courses. A typical avifaunal association (with disturbance) was found in a previous baseline study, including: Antillean Grackle, Smooth Billed-Ani, Common Ground Dove, White Wing Dove, American Kestrel, Black Faced Grassquit, Jamaica Euphonia and the Jamaica Oriole. In a previous baseline study of the property, water birds were observed in association with the abandoned fish ponds. These included Common Moorhen, Little Blue Heron, Cattle Egret, Great Egret and the Yellow-Crowned Night Heron. It is likely that other water birds would be associated with waterlogged areas and the dam site (central gully). The site occurs relatively close to the Bodles Wetlands, and bird populations are expected to range to this small area.

Twenty five species of butterflies were identified on the site, along with other invertebrate species. Of these, only two were endemic (*Mestra dorcas* and *Leptotes cassius theonus*). These are widespread across Jamaica. The large pond on the property (dammed channel) contains a large population of shrimp (*Macrobrachium* sp.), small fish (*Gambusia punticulate*), various insects and snails. No rare or protected species or species of ecological or taxonomic importance were found on the site. The faunal diversity was also found to be very low because of the previous land uses.

[2] An application has been made for a change of use.

4.1.3 Human Environment

The site itself is privately owned farmland, with no informal occupation. Colbeck Castle is a major heritage site located on the eastern side of the property. This is a massive stone ruin with walls standing at their original height. The Castle was built in 1680 by the English, who had occupied the island from about 1655. The developers have reserved 2 acres of lands associated with the ruins.

4.2 Environmental Sensitivities

The following is a preliminary list of environmental concerns that have been identified for more exhaustive assessment in the EIA process:

1. Environmental effects arising from the proposed physical changes and design footprint of the proposed development:
    a. Concrete batching and construction of the residential units;
    b. Changes to hydrological conditions and flood potential arising from the proposed drainage modifications and site run-offs;
    c. Modification of existing habitats including potential effects of replacement of large dammed pond by facultative ponds;
    d. Effects of tertiary effluent discharges on downstream water quality in the Bodles area, and the Bowers River system;
    e. The potential contribution to salinization over the coastal aquifer by the operation of the Colbeck well;
    f. The effects associated with the operation of the farm plots on the eastern side;
    g. Micro-climate effects; and
    h. The effects of change of land use and proposed landscaping.
2. Potential impacts on the human environment:
    a. Potential nuisances in both construction and operational phases: dust, noise, heavy traffic.
    b. Creation of the CBD;
    c. Heritage site at Colbeck Castle;
    d. The creation of a major access road, and effects on traffic flows; and
    e. Development of a major sub-urban community, including effects on:
        i. Increased availability of affordable housing stock in proximity to a major arterial road.
        ii. Demographic and socio-economic profile of the communities.
        iii. Vulnerability to natural hazards (flooding, earthquakes, hurricanes); Based on the size of the proposed development and the limitations of the natural surface water drainage systems, a flood impact assessment using the 2, 5, 10, 25, 50 and 100 year return period rainfall, shall be conducted to evaluate the impact of the development on the environs and any impact on the development caused by flood levels in nearby man made/natural channels or ponds.

iv. The municipal carrying capacity: health care, education, urban burial capacity, solid waste disposal capacity, postal services and emergency services (police, fire etc.);
v. Public health management and vector control; and
vi. Increased demands for electricity.

3. The EIA shall also describe off-site and on-site effects on the environment arising from the implementation of this project.

This preliminary list of impacts shall be supplemented after stakeholder consultation, technical evaluation of the host environment and the project, and a review of the effects of similar projects in this type of environment.

4.3 Stakeholders

The following stakeholders shall be apprised of the proposed development, and included in the EIA consultative process:

1. Relevant government agencies:
    - National Environment and Planning Agency (NEPA);
    - Water Resources Authority (WRA);
    - National Works Agency (NWA);
    - National Water Commission;
    - Office of Utilities Regulation;
    - Jamaica National Heritage Trust;
    - Ministry of Local Government and Environment;
    - Office of Disaster Preparedness and Emergency Management (ODPEM);
    - Environmental Health Unit (EHU) of the Ministry of Health;
    - National Solid Waste Management Authority (NSWMA);
    - Parish Councils: St. Catherine and Clarendon; and
    - Ministry of Agriculture and Lands.
2. Non-Governmental Organizations and community based organizations with an interest in the area;
3. Occupiers/Owners of adjacent lands; and
4. Communities around the site.

4.4 EIA Preparation Team

Based on the fact that in depth hydrological and ecological assessments were conducted in 2006, it is proposed that the EIA team will be comprised of an Environmental Impact Assessment specialist, a social impact specialist and a geographer. The firm of Environmental Management Consultants (Caribbean) Ltd. has been retained by the developers to assist with the preparation of the EIA.

5 MINIMUM SCOPE OF WORK (TASKS TO BE COMPLETED)

5.1 Task 1 Conduct of a valid EIA Process

The EIA process shall be conducted as follows:

Submission of the Draft TOR for the EIA to NEPA.	May 8th 2007
Posting of the 1st Public Notice of the availability of the Draft TOR for public review.	May 11th 2007
Finalization of the TOR based on comments received.	May 30th 2007
Conduct of the EIA as prescribed in the TOR.	April to June 2007
Submission of 11 copies of the EIA Report to NEPA for review.	June 15th 2007 *(subject to change)*
Posting of the 2nd Public Notice advising on (1) the availability of the EIA for public review and (2) the venue and time for the public meeting.	Upon submission of the EIA.
Conduct of the Public Meeting	Within 3 weeks of the 2nd Public Notice.
Submission to NEPA of the Town Meeting Report	Within 7 days of the meeting.
Close of the public review period	One month after the public meeting,
Review of the project application in light of the EIA by NEPA's Internal Review Committee (IRC) and the inter-agency review panel, the Technical Review Committee (TRC).	
Collation of review comments and submission of these to the Consultant by NEPA.	Further to the IRC and TRC reviews.
Submission of an Addendum Report addressing review comments by the Consultant	Within 1 week of receiving the review comments.
Review and acceptance of the review comments by specific reviewers.	
Further response by the Consultant if necessary.	
Recommendation of a decision by NEPA to the Board of the NRCA.	
Notice to the Applicant of the Board's decision.	

All EIA documentation may be placed online (nrca.org and eiacaribbean.com/Colbeck) to facilitate the review process).

After the submission of the EIA for review, neither the applicant nor consultant shall contact NEPA before the review report has been submitted to the consultant.

5.2 Task 2 Conduct of a Valid Stakeholder Consultation Process

The Environmental Impact Assessment (EIA) will include, among other things, the methodology utilized to consult with stakeholders, the type of information to be provided and the various stakeholder target groups. It will indicate the public input that has been incorporated into the proposed project design. 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. These opportunities will include, but not be limited to, those which follow.

1. Direct written communication from the EIA consultant to relevant public agencies, NGOs and adjacent land owners/occupiers, will advise them of the project, and seek their concerns about potential environmental impacts.
2. Survey of the communities in proximity to the site will elicit comment on the following issues.
    a. General acceptability of the proposed project, including consideration of the community-based stakeholders' willingness to make trade-offs, if potential benefits to the local and national economies are perceived.
    b. Fears and expectations about the specific project, including any anticipated social conflict and crime.
    c. Perceptions and attitudes of present community-based resource users.
    d. General health, safety and environmental concerns related to the project.
3. A Public Meeting after the EIA is made available for review. This meeting shall include presentations outlining the project, its possible environmental impacts, and proposed mitigations.
4. EIA documents will be made available for public review, inclusive of: (1) Terms of Reference; (2) the EIA report and 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).

5.3 Task 3 Preparation of a TOR Compliant EIA Report

The following scope and content shall be satisfied by the EIA report. This scope of work shall be accomplished by the following sub-tasks.

5.3.1 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. This shall involve the use of maps at appropriate scales, site plans, aerial photographs and other graphic aids and images, as appropriate.

The minimum requirements of this section are:

1. Project overview (main design elements), justification (objectives) and implementation schedule (phasing);
2. Definition of the Project area, including all lands subject to direct disturbance from the Project and associated infrastructure, including access and utility corridors; and a map showing the area proposed to be disturbed in relation to existing topographic features, major urban areas, other residential developments, ecosystems such as wetlands,

watercourses, water bodies, geo-physical features, protected areas as well as sites designated under International Conventions;

3. Footprint Plan showing property boundaries, project footprint, areas to be landscaped or conserved, location of access roads, sewage treatment, storm water drainage and any other infrastructure;

4. A Site Plan that identifies the site boundaries, housing densities, locations of all proposed development activities, and set backs;

5. Design and planning specifications showing scale and capacity of proposed operations, design concepts and proposed technologies, details of spatial allotments for various proposed land uses, and design specifications for earthworks and drainage modification;

6. Describe the governance systems or management agreements that will be implemented and provisions for management and maintenance of central infrastructure once construction is completed.

7. Evaluation of impact-causing aspects of activities during routine and upset conditions for all phases of the project.

    - Activities and equipment usage.
    - Resource usage: water, power, land space, labour etc.
    - Waste streams: air emissions, noise emissions, calculated site run-offs and discharges, solid waste generation.

If a permit is issued, it shall be tied to what is disclosed here so the information about the project shall be as close to final-stage as possible. **Where design or technology options are still being considered, the discussion of these shall be done under the "*Analysis of Alternatives*" Section.**

5.3.2 Analysis of Alternatives

The purpose of this section of the EIA is to examine feasible alternatives to the project and, shall highlight the benefits of and general rationale for the project that need to be considered against any potential environmental cost. It shall outline, in a balanced way, the wider societal benefits of the development proposal that could arise if the environmental permit is granted.

Alternatives shall be examined in terms of their location, scale, layout, and technology. Feasible land use options shall be compared in terms of lowest costs and most benefits criteria: environmental impacts, social acceptability, economics (including productivity of land use) and engineering feasibility. The following land use options shall be considered: (1) leaving the land as is (*status quo*); (2) the proposed residential development; and (3) agricultural re-development/expansion

5.3.3 Legal and Institutional Framework

The objective of this task is to provide an outline of the relevant environmental regulations, policies and standards/guidelines governing the construction and operation of a residential subdivision as proposed. Relevant international guidelines, conventions and protocols shall be described. This shall include regulatory controls and institutional frameworks with jurisdiction over the following main areas as they relate specifically to this site and project:

1. National Planning Context

    - Water Resources Master Plan
    - National Physical Plan
    - Plans for road and infrastructural development
    - Other planned development projects for the area
    - Agricultural development plans

2. Development & Operational Control

    - Permitting: environmental permits, effluent discharge licences, water abstraction licensing (and provision of potable water), planning permission and other operational permits.
    - Construction: building codes, site management controls, and subsidiary inputs such as concrete, lumber, etc.
    - Public safety and vulnerability to natural disasters.

3. Environmental Conservation

    - Forestry, flora and fauna, and biodiversity
    - Endangered, endemic, threatened and introduced species
    - Water resources (freshwater)
    - Heritage and cultural resources
    - Location relative to areas declared protected under the Natural Resources Conservation Authority, Wild Life Protection, Watersheds Protection Act (1963), Draft Watershed Policy (2006), Forestry and the Jamaica National Heritage Trust Acts.

4. Waste Management air quality, noise, water quality (wastewater effluent, irrigation, and potable), solid waste, public health issues and storm water management.

In all cases the roles of agencies with responsibility for implementing legal mechanisms will be described. Where Jamaican standards or policy are insufficient, international standards and policies will be outlined. This section shall summarize, thematically, 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 the relative significance of environmental impacts.

5.3.4 Description of the Environment (Baseline)

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.

Table 4 Scope of the Baseline Section

VEC	SCALE/AREA	DATA SOURCES/METHODS/OUTPUT
PHYSICAL BASELINE		
Climate	Regional (Old Harbour)	**Literature Review**: Existing Meteorological Office data. This shall be described in terms of prevailing winds, temperature and humidity, and rainfall (mean annual distributions).
Hydrology	Site specific and regional	**Literature Review and Field Observations:** Interpreted from existing reports (including the well evaluation report), rainfall and geology. This shall include descriptions of (a) the water management unit in which the area falls, as well as a map showing the location of the development site in relation to the watershed boundaries (b) the hydro-geological classification of the bedrock under the site (c) the likely depth to groundwater (d) surface drainage features
Topography	Site specific	**Literature Review and Field Observations:** Description of the site based on an interpretation of contour information on the Ordnance Survey (OS) maps and satellite imagery as well as site inspection. A geomorphic map with the classified landforms/processes and elevations at the site shall be included
Geology	Site specific and regional	**Literature Review and Field Observations:** Published reports/maps, remote sensing and any available geotechnical reports. Descriptions of regional geological setting, inclusive of stratigraphy and structure shall be presented.
Soils	Regional	**Literature Review:** Review of available soils literature and data, and reference to the Rural Physical Planning Soils Classification. Soils shall be discussed in terms of their genesis, texture, internal drainage, pH and colour as well as capability and erosion hazard
Natural hazards:	Regional	**Literature Review:** Existing data and other available literature shall be reviewed to describe the historic occurrence (magnitude, frequency and likely effects) and remedial actions previously taken in respect of (a) earthquakes (b) hurricane winds (c) flooding from intense rainfall. In each case recommendations shall be given to minimize loss, including reference to the applicable standard practices and codes.
POLLUTANT BASELINE		
Water Quality:	Site Specific	**Primary Survey:** 3 stations with 3 replicates, sampled at the start of the wet season (May). Samples will be collected and tested according to standard methodologies. Descriptions of the average values compared to ambient concentrations and criteria shall be included for each of the following: nitrates, phosphates, faecal coliform and total suspended solids. One station shall be located in the large pond, and one shall be located upstream of this feature. Other locations to be determined. Existing water quality data for the well will also be reviewed. The analytical methods applied will be as recommended by Standard Methods for the analysis of Water and Waste Water 19th Edition upwards.
Fluvial sediments	Site Specific	**Primary Survey:** 2 stations sampled at the start of the wet season (for screening purposes).Heavy metals (mercury, copper, lead, nickel, zinc) concentration levels shall be described from samples taken from the pond and river course.

Air Quality	Site Specific	**Field Observations:** Description of sources of pollution
Ambient Noise Levels	Regional	**Literature Review and Field Observations:** Description of sources of pollution
BIOLOGICAL BASELINE		
Vegetative cover	Site specific	**Primary survey**. Types described in terms of relative species abundances and identification of important species (protected/endangered, rare, endemic, commercially or ecologically important) and their ecological functions.
Faunas	Site specific	**Primary survey** to describe the invertebrate and avifauna populations in terms of important ecologically species (protected/endangered, rare, endemic, commercially or ecologically important) that have the potential to occur in this geographic area, and ecological dependencies (habitat, food, breeding, environmental sensitivities etc.). Migratory and invasive alien species will also be described.
SOCIO-ECONOMIC BASELINE		
Socio-economic setting	Site specific and regional (Old Harbour)	**Literature Review and Field Observations:** Identification of the project's area of influence in terms of its potential social, economic and cultural impacts. This must include major communities around Colbeck Castle that may be affected by the project. Attention shall also be given to identifying specific resource users within the study area, such as owners of adjacent lands (including the highway), squatters on the property, persons who traditionally use the lands.
Demographic Profile:	St. Catherine	**Literature Review**: Census data available from Statistical Institute (STATIN) for the Enumeration Districts of the communities identified above. Parameters shall include: population size and growth trends, age distribution of the population, male to female ratios, workforce (dependency ratio), income, education levels, and employment levels.
Municipal resources:	Regional	**Survey**: interviews with agencies and a literature review shall inform a description of the present availability and scope for expansion of resources such as utilities (telecommunications power, water supply), solid waste disposal capacity, and facilities (public transportation, housing stock, and emergency response services such as fire, medical, protective, disaster relief).
Land use	Regional	**Literature review, satellite image interpretation and site observations** Published OS maps, remote sensing and site investigation. A map showing the cover by various categories shall be included. Historic and present use of surrounding lands, e.g., recreational/open space, agriculture, urban etc. shall be described Existing traffic data shall be reviewed.
Heritage resources:	Site specific	**Literature Review:** This shall include a description of the potential for archaeological resources to occur on the site and any cultural aspects of the site including Colbeck Castle.
Traffic	Near to site	**Existing NWA traffic survey data for Old Harbour as well as an independent primary traffic survey**

5.3.5 Summary of the Stakeholder Consultation Process

This section shall summarize the key environmental concerns arising during the stakeholder consultations done prior to submission of the EIA. The degree of public concern with specific issues (and general acceptability of the impact given proposed mitigation) is a key criterion used in determining the relative significance of environmental impacts.

A field survey of 100 household heads in the surrounding EDs shall be conducted. The sampling regime for administration of the questionnaire shall also be described. The following information shall be determined from the population survey:

- Basic demographic profile: age, sex, income, education, land tenure, quality of life indicators;
- Social capital: membership in voluntary organizations, churches, clubs and linkages outside of the community;
- The values that the local communities place on the area; existing nuisances and complaints about the area and services; and
- Awareness, perceived problems or fears; expectations or perceived benefits of the development proposal.

5.3.6 Assessment of Impacts and Mitigation Measures

The purpose of this task is to identify the major environmental and public health issues of concern and indicate their relative importance to the design of the project and the intended activities. Both positive and negative project impacts are identified using the following methods.

1. Stakeholder consultation.
2. Technical inputs from environmental specialists on the EIA team.
3. Review of the possible impact-causing aspects of the project.
4. Review of impact assessments done for similar projects.
5. Regulatory criteria governing aspects of the environment likely to be impacted.
6. The sensitivity of valued environmental components (VECs) likely to be impacted by the project.
7. Review of the risks arising from the project and the range of environmental consequences that could arise under upset conditions.

Each identified impact is classified according to the assessed effect level (no impact, minor, moderate or major). Each identified impact shall be assessed using the following criteria:

1. Scale: magnitude of the adverse effect in terms of the geographic extent of influence arising from frequency and magnitude of the causative action.

2. Affected Numbers: numbers of individuals (organisms, people etc.) from a valued population that stand to be impacted.

3. Secondary Effects: This parameter looks at the impact as a trigger mechanism for other effects, particularly those manifesting downstream of a pathway emanating from a project component, latent effects that could occur in the future, such as bioaccumulation of heavy metals in the food chain, or effects on future generations.

4. Resilience: Ecological resilience/sensitivity (ability of a population to cope with effect). Existing stresses and variability of sensitivity (spatial or seasonal) shall be considered.
5. Persistence: frequency and duration of effects in the environment. In general, chronic (persistent) or acute (short-term but severe) effects are regarded as more significant.
6. Reversibility: the extent to which an affected receptor can be returned to its pre-project state.
7. Baseline change: This relates to any model or prediction of the extent of change that can be expected. This shall compare predicted levels of change with normal fluctuations as well as trends in the parameter without the effect of the project.
8. Manageability: This addresses the feasibility (ease of implementation and cost-effectiveness) of measures to prevent or reduce environmental costs. It shall also consider the benefits or moderating circumstances given these environmental costs.
9. Uncertainty: This allows for disclosure of the level of scientific confidence in the predicted outcomes, and the general reliability of the data and models used to predict impacts.
10. Acceptability: This examines the willingness to make trade-offs and the degree of objection, given potential benefits of the project. This also includes planning constraints and scientific criteria (maximum allowable limits).

Using these criteria, **a significant negative environmental impact** is defined as one that:

- Is located in proximity to any sensitive or protected areas and has been determined to impact negatively on these;
- Is extensive over space or time (scales must be appropriately defined);
- Is intensive in concentration (i.e. exceeding recommended criteria) or in relation to assimilative capacity (as appropriated to the affected receptor);
- Is not consistent with national plans for the general use of the area;
- Contributes to the endangerment of threatened species;
- Reduces the stocks of commercially important species;
- Permanently damages habitat quality or creates ecological barriers;
- Threatens cultural or heritage resources;
- Alters community lifestyles or requires long-term adjustments of local people in respect of traditional values and resource use; and
- Represents a long-term nuisance or significant safety risk to other users.

Where the project contributes to a pre-existing environmental stress (arising from non-project related external activities), the additive or cumulative effects are taken into account in the examination of the baseline as a shifting baseline, as well as divergence from the baseline that might be expected to arise from project implementation.

Internal aggregations of impacts on specific VECs that may individually be assessed as having a “minor” effect, but may collectively have a significant combined effect. The net cumulative effects are evaluated where multiple project activities contribute to the same effect.

This section must conclude with the consultant's statement on whether, based on the various investigations and assessments that were done as part of the EIA process, there is a Finding of No Negative Significant Impacts (FONSI). If the study finds that the project has the potential to result in significant negative environmental impacts that cannot be cost effectively mitigated, and which require project modification (in terms of design, site, technology use or scale/footprint), this must be clearly disclosed.

5.3.7 Environmental Management Plan

The Environmental Management Plan (EMP) shall include, at a minimum:

- A description of the most appropriate environmental performance objectives for the project based on the specific impacts identified during site preparation, construction and operational stages of the proposed development.
- A summary of proposed mitigation measures, identifying the best timing for implementation, responsibilities and any required commitments of resources.
- The sites to be monitored (including a control site), the frequency of monitoring and how these will be reported.
- General guidelines for activities during construction and operational phases of the project to improve the project's overall environmental performance (e.g., in respect of waste management, water and energy conservation, heritage conservation, community development, etc.).
- Recommended requirements for post-permit plans and approvals.
- An outline of a monitoring plan, which shall cover monitoring of implementation of mitigation measures and the enforcement of the permit conditions, as well as any recommended monitoring of environmental parameters that can allow for assessment of the *actual* environmental effect level compared to the baseline condition and the *predicted* effect level.

5.4 Additional Information

The EIA preparer shall observe the following guidelines:

- Professional opinions shall not be presented as statement of fact, and shall be avoided unless they can be substantiated by published references as is the norm in technical scientific writing.
- All bibliographic references used to substantiate statements in the report shall be listed.
- The report shall include appendices with items such as the approved TOR; raw data; and Water Quality Lab Certificates, maps, site plans, photographs, and other relevant information.
- A list of EIA preparers (including analytical facilities) and their credentials must be included.

APPENDIX 2
AMENDMENT TO THE TERMS OF REFERENCE

Ref: 2007-14017-EP00004

August 28, 2007

Dr. Ravidya Burrowes
Managing Director
Environmental Management Consultants (Caribbean) Limited
61 Mansfield Meadows
Ocho Rios
St. Ann

Dear Dr. Burrowes,

Re: Application for a Permit under Section 9 of the Natural Resources Conservation Authority Act, 1991, in respect of the Colbeck Castle Estate Development at Old Harbour, St. Catherine

Please be advised that the Agency has just received additional comments on the draft Terms of Reference. These comments have been deemed critical and as such information concerning these areas should be addressed and embodied in the Environmental Impact Assessment. The major areas of concern which have been highlighted are as follows:

- A full analysis of the watershed must be conducted highlighting the effects on the following as its salient points:
    - The summary of predevelopment flows in the watershed area and the effect that the proposed subdivision will have on the post development flows.
    - These shall be for:
        I. The proposed site (to determine the potential of flooding of the site from peak flows within the gully)
        II. The National Works Agency's main road and bridges crossing the Bowers gully
        III. The Highway 2000

    (I and II are existing facilities and the study should therefore determine any mitigation measures which may be required as a result of post development flows on them)

- It should be noted that straightening the gully (gully training) is not a recommended course of gully management and any such proposal should include an analysis of the potential scour effects this will have on downstream facilities.

- With respect to the Traffic Impact Study (TIS) requested, the study should determine the specific infrastructure needed to mitigate the impact of the proposed development on the local transportation network and establish the site design features needed to support the system-wide transportation objectives. The TIS should be prepared in consultation with the Planning and Research Directorate of the National Works Agency.

The Agency sincerely apologizes for any inconvenience that may be caused by this late inclusion of comments. If you have any question(s) or require further clarification please do not hesitate to contact the undersigned or Ms. Aisha Bedasse at 754-7540 or email abedasse@nepa.gov.jm. The above reference number should be quoted.

Yours sincerely

_____
Marc Rammelaere
for Chief Executive Officer/ Government Town Planner

cc: Mr. Michael Mintz, Chief Executive Officer, BCR Industries Company Limited
Ms. Frances Blair, Manager, Applications Secretariat Branch, NEPA

MR/ab

APPENDIX 3
ENGINEERING SPECIFICATIONS
FOR SUB-DIVISION DRAINAGE

Lots and Streets: The drainage plan proposes the drainage of lots and sidewalk areas to the serving roadway as far as practicable. Curb flow for roads in general was based on design criteria: Frequency of return = 5 years

- Duration = 10 minutes
- 24-hour rainfall = 140 mm
- Rainfall intensity = 150 mm/hr.
- Run-off coefficient = 0.7
- Average depth at curb = 100 mm

The Rational Method along with the manning hydraulic flow equation was used to estimate curb flow and the inlet spacing required to satisfy the proposed depth of flow service limitations.

Inlet Spacing: The requirements of curb flow inlet spacing and inlet capacities for roads of various longitudinal slopes are indicated by Table No. 1 of the Engineering Design Report. Design calculations are shown in Appendix No. 1 of that Report.

Drainage Inlets: The size and capacity of different types of inlets, whether curb or grating type, for varying road longitudinal slopes are provided in tables No. 2 and No. 3. The placement of inlets as indicated on the proposed drainage plans represent capacity estimates of inlets of a combination of both types of inlets mentioned referred to as a "curb and grating" inlet.

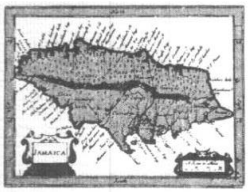
Storm Drainage Sewers: Drainage sewer diameters required to adequately convey flow from the inlets were determined using the Manning flow equation for free surface flow in pipes. The sewer diameters indicated on the drainage plan provided are for the use of reinforced concrete pipes as drainage sewers applying a Manning Coefficient of n = 0.15. Suitable alternative pipes for sewers include H.D.P.E. pipes with Manning Coefficient of n = 0.13. The choice of pipes will be determined by economy at the time of installation. H.D.P.E. pipes are more economical to install as they are much less in weight and can be handled in longer lengths with less jointing works. The cost of reinforced concrete pipes can be subjected to many variables which are not easily determined at this time. Sewers were laid to minimum slopes as indicated by the JIE Guidelines in order to satisfy the minimum flow velocity in sewer lines of 1.0 m/s in order to prevent the deposit of debris. A minimum pipe diameter of 450 mm was used in accordance with the JIE Guidelines to facilitate maintenance of the sewer lines. The capacity of pipes of varying diameters at different slopes as applied to the drainage plans provided are provided in Table No. 4 of the report.

Run-off to Main Drains: Main drainage sewers have been laid to deliver their flows to the main drains as soon as practicable from sub-catchments for the best economy. Where sub-catchments are relatively large (approaching the size of a development block) the main sewers are designed for a storm of ten (10 No.) years frequency, applying the Rational formula for the sub-catchment.

APPENDIX 4
LETTER OF NO OBJECTION FROM JNHT

JAMAICA NATIONAL HERITAGE TRUST

79 DUKE STREET,
HEADQUARTERS HOUSE,
KINGSTON,
P.O. BOX 8934, KINGSTON C.S.O.,
JAMAICA, W.I.



TELE: (876) 922-1287-8
(876) 922-3990
FAX: (876) 967-1703

Colbeck Castle Development Site
Archaeological Evaluation Summary

On October 26, 2006 The Jamaica National Heritage Trust (JNHT) received a letter from Edward Young Associates re the development proposal of area around the Historic Monument of Colbeck Castle, Colbeck, St Catherine.

The area that encompasses Colbeck is historically rich as it was settled by the Taino, the Spanish and the English. According to the JNHT's Sites and Monument Records there is a Taino site located within Zone 1 of the proposed development. John Colbeck, a member of the invading English army in 1655, received a grant of 1,340 acres on which an estate was subsequently established. It is believed that the area was also used for military purposes.

On February 13 & 19, 2007 a team of archaeologists from the JNHT conducted an archaeological evaluation of the site. The proposed development area is divided into 11 Zones by developer; Edward Young Associates, (See Master Plan).

The archaeological evaluation revealed several areas of archaeological interest. In Zone 6 an area of artefact assemblage was identified namely, Area 1 (See extract Master Plan). In Area 1 the types of artefacts found included ceramics, earthenware, and olive green glass, all dating between the 18th and 19th century. In Zone 7 an artefact assemblage including Taino, Spanish and Afro-Jamaican earthenware sherds was found (Area 2). In addition there were red and white clay smoking pipes fragments.

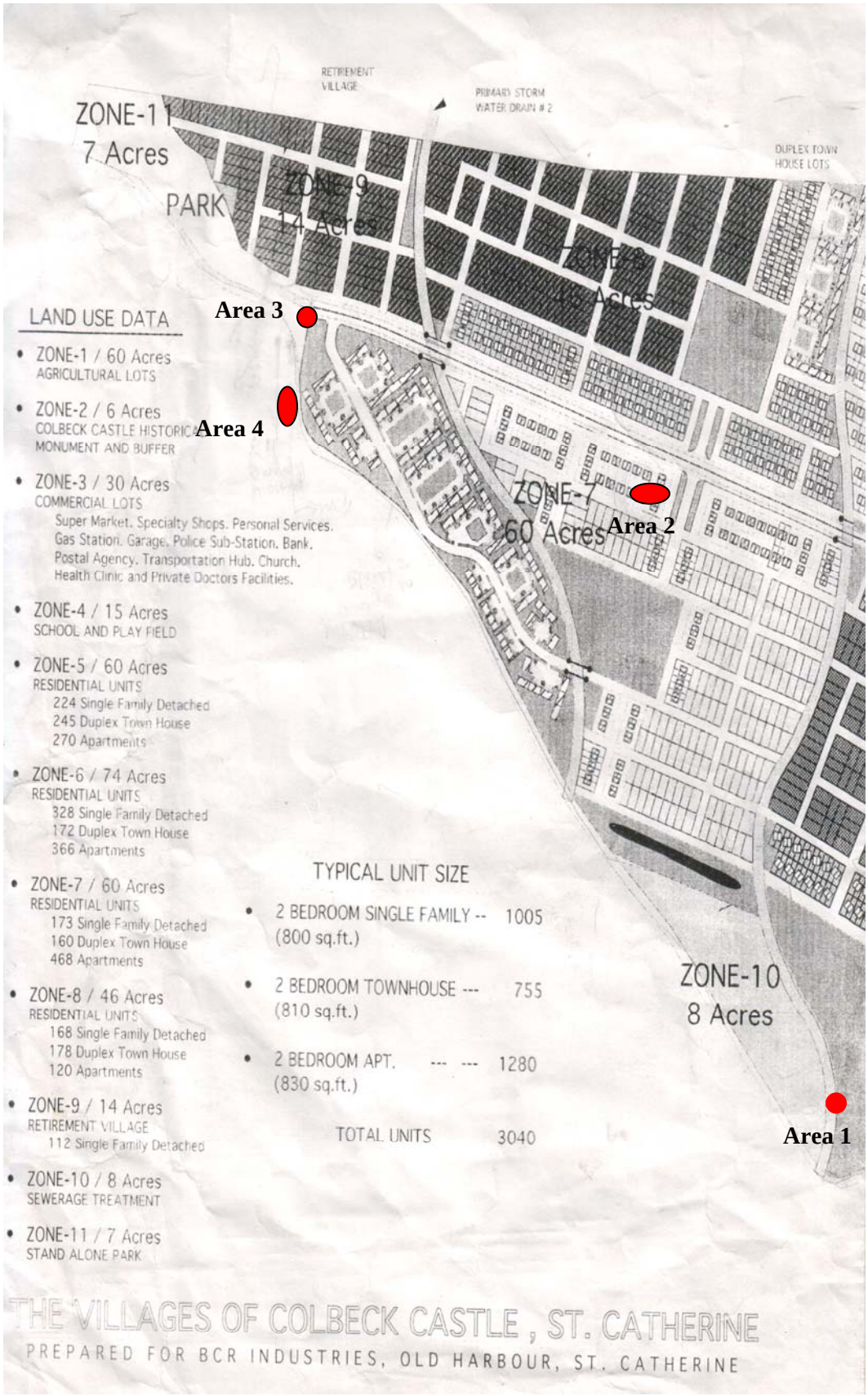
A seasonal fresh water spring is located immediately east of the assemblages. In Zone 11 a Well and the remnants of building foundations were found. Fragments of Spanish jars were also observed in Zone 9 (See extract of Master Plan Area 4). The evaluation process was hindered by the dense vegetation cover in some areas and a large bush fire in the western portion of Zone 7.

Conclusion and Recommendation.

Based on the archaeological evidence available to us at this time, the value of archaeological features and artefact assemblages observed are not significant to the point that will hamper the development of the area. However by the virtue of their presence we need to proceed with caution when carrying out ground work in these areas. **The JNHT has no objection against the proposed development providing that an archaeological watching brief is conducted during the infrastructural excavation phase of the development.**

Dorrick Gray
Deputy Technical Director of Archaeology
Jamaica National Heritage Trust

March 9,2007



Extract the Master Plan showing Zones 7 to 11

APPENDIX 3

SAFFIR-SIMPSON HURRICANE SCALE

Category	Wind Speeds km/hr	Storm Surge (m)	Possible Damage on the North Coast
One	119-153	1.5	Tree limbs and signs affected. Landslides and some flooding. No real damage to building structures.
Two	154-177	2.5	Roofs, doors, window damage. Small trees and shrubs. High tension wires and overhead cables blown down. Some flooding.
Three	178-209	3.6	Minor structural damage. Large trees. Coastal roads flooded.
Four	210-249	5.5	More extensive structural damage, doors and windows; loss of roofs. Vegetation and signs blown down. Low-lying terrain and roads flooded. Major beach erosion.
Five	>249	>5.5	Some complete building failures. All vegetation and signs blown down. Severe damage to windows doors and roofs.

APPENDIX 6

GROUNDWATER TEST DATA:

NON PRIORITY POLLUTANTS

(Non-Priority Pollutants)

Parameter	Sample 1	Sample 2	WHO (mg/l)	USEPA mg/l
Alkalinity (total)	302	298		
Colour	2	2	15	
Iron	0.023	<.02	0.3	0.3
Manganese	<.02	<.02	0.4	0.05
Nitrate	10	10	50	10
pH	6.9	6.9	6.5 to 8.5	5 to 9
Total Dissolved Solids	387	391		250

(General Parameters)

Parameters	Sample 1	Sample 2	WHO DW (mg/l)
Aluminum	<0.0002	<0.0002	0.2
Calcium	118	116	
Chloride	32.4	31.7	250
Fluoride	<.5	<.5	1.5
Hardness (total)	305	322	500
Magnesium	28.5	28.7	
Phosphate	<0.1	<0.1	
Potassium	1.1	1.16	
Sodium	23	27.9	200
Specific Conductivity	688	701	
Sulphate	13.3	14.1	400
Suspended Solids	1	<1	
Turbidity NTU	<1	<1	5

APPENDIX 7

VEGETATION ASSESSMENT USING THE POINT-CENTRED QUARTER METHOD

Point	Tree Height Min-Max (m)	Average Tree Height (m)	DBH (cm)	Dominant Tree Species	Other Tree Species	Notes
V1	2.0 – 3.1	2.6	21 - 100	Logwood	*Acacia sp.*	Logwood dominant
V2	2.7 – 3.2	2.9	25 - 40	*Ziziphus mauritiana*	*Acacia sp.* Guango	Open pasture with sedge like grass and two old fish ponds
V3	3.6 – 2.8	3.2	30 - 46	*Acacia sp.*		Overgrown pasture
V4	2.6 – 4.0	3.3	21 - 150	Logwood	*Acacia sp.* Guango Logwood Cactus	Overgrown pasture
V5	4.2 – 3.6	3.9	80 -170	*Acacia sp*	Guinep Guango	Open pasture with sedge like grass and 2 old fish ponds
V6	2.9 -4.1	3.5	36 - 115	*Acacia sp.*	Pickle Yellow God Okra Wild Pine	Overgrown pasture
V7	2.2 – 3.9	3.2	45 - 125	*Acacia sp.*	*Ziziphus mauritiana*	Open pasture
V8	4.0 – 7.2	2.4	40 - 72	*Ziziphus mauritiana*	Logwood *Acacia sp.*	Overgrown pasture
V9	2.5 – 3.2	2.9	30 - 48	Logwood *Acacia sp.*		Open pasture
V10	1.5 – 2.6	2.1	20 – 115	*Acacia sp.*	Prickly Yellow Logwood	Open pasture

					Dranko Bead Tamarind	
V11	2.9 – 4.2	3.7	120 - 320	Guango	Guinep *Acacia sp.*	Open pasture dominated by sedge like grass
V12	1.5 – 2.6	2.1	20 -320	*Acacia sp.*	Logwood	Overgrown pasture
V13	1.4 – 3.0	2.3	15 - 36	*Acacia sp.*		Open pasture
V14	.8 – 2.9	2.2	20 - 920	Ackee Logwood	Guinep Guango Cherry *Acacia sp.* Bahmia Grass (carpet grass)	Near old farm building with over grown acacia plants
V15	1.9 – 3.1	2.6	20 -40	*Acacia sp.*	Lignum Vitae Guinep	Pasture land
V16	1.5 – 2.3	1.9	20 -34	*Acacia sp.*		Acacia woodland dominated by Bahmia Grass (carpet grass)
V17	2.3 -3.1	2.8	32 - 65	*Ziziphus mauritiana*	Logwood *Acacia sp.*	Pasture with large acacia trees and cactus
V18	3.0 3.2	3.1	25 - 55	Guinep	*Prickly Yellow Guinep*	Gully habitat
V19	2.8 – 3.1	3.0	45 - 70	*Acacia sp.* *Ziziphus*		Acacia woodland

				mauritiana		dominated by a sedge like grass
V20	1.7 – 3.1	2.3	20 - 40	Guinep	*Ziziphus mauritiana*	Gully habitat
V21	2.8 – 3.9	2.5	20 - 80	*Acacia sp.*		Acacia woodland

APPENDIX 8

TREE AND PLANT SPECIES LIST

Common Name	Botanic Name	Status	Life Form
John Crow Bead	Abrus precatorium	Native	Climber
	Abutilon trisucatum	Native	Herb
Park Nut	Acacia macracantha	Native	tree
Deveil's Horse whip	Achyranthus indica	Native	Herb
Wild Callaloo	Amaranthus virdis	Native	herb
Sweet Sop	Annona squamosa	Introduced	Tree
Coralista	Antigonan leptopus	Native	Climber
Yellow Thistle	Argemone mexicana	Native	Herb
Bull Hoof	Bauhinia divaricata	Native	Tree
Ackee	Blighia sapida	Introduced	tree
Ping Wing	Bromelia penguin	Native	Shrub / bromeliad
Mustard Shrub	Capparis ferruginea	Native	Shrub
	Cassia emarginata	Native	Shrub
	Chloris barbata	Native	Herb / grass
Soldier with	Cissus sicyoides	Native	Climber
Wild Cala	Cleome viscose	Native	Herb
Maiden Plum	Comocladia pinnatifolia	Native	Shrub
Clammy Cherry	Cordial collococca	Native	tree
Coconut	Cozos nucifera	Tintroduced	Tree
Calabash	Crescentia cujete	Native	Tree
West Indian Gherkin	Cucumus anguria	Native	Herb
Bastard Cherry	Ehretia tinifolia	Native	tree
	Eleocharis sp.	Native	Herb
Redwood	Eugenia axillaris	Native	Shrub
	Gossypium sp.	Native	Shrub
Bastard Cedar	Guazuma ulmifolia	Native	tree
Logwood	Haematoxylum campechianum	Introduced	tree
Torchwood Dildo	Harrisia gracilis	Native	Shrub / cactus

	Heliotropium sp.	Native	Herb
God Okra	Hylocereuss triangularis	Endemic	Runner / Shrub
Christmas Candlestick	Leonotis neptifolia	Native	herb
Lead Tree	Leucaena leucocephala	Native	Tree
	Ludwigia erecta	Native	Herb
Mango	Mangifera indica	Introduced	tree
Wild Raspberry	Manilkara sp.	native	Tree
Guinep	Melicocus bjugatus	native	Climber
	Merremia umbrellata	Native	Climber
Guaco	Mikania micrantha	Native	climber
Strong Back	Morinda royoc	Native	Shrub
Cowitch	Mucuna pruriens	Native	Climber
Parsley	Ocimum micranthium	Native	Herb
Tuna	Opunata tuna	Native	Shrub / Cactus
Guinea Grass	Panicum maximum	Native	Herb
Wild Plumbago	Plumbago scandens	Native	Herb
Pussley	Porulaca oleracea	Native	Herb
Cashaw	Prosopis juliflora	Naturalized	Shrub
Castor Oil	Ricinus comunis	Introduced	shrub
Duppy Gun	Ruella tuberosa	Native	herb
Guango	Samanea saman	Introduced	tree
Bowstring Hemp	Sansevieria metallica	Native	herb
Broom Weed	Sida acuta	Native	Herb
	Sporobulus sp.	Native	Herb / Grass
Vervine	Stachytarpheta jamaicensis	Native	herb
Five Finger	Syringonium auritium	Native	climber
	Teramnus labialis	Native	herb
Wild Mahogany	Trichilia hirta	Native	Tree
Basket with	Trichostigma octanfrum	native	climber
Rauchie	Waltheria indicum	Native	Herb
Coolie Plum	Ziziphus mauritiana	Introduced	tree

Prickly Yellow	Zanthoxylum martinicense	Native	Tree
Grass	Lasiacis divaricata	Native	Herb / Grass
Barbados Cherry	Malpighia punicfolia	Introduced	Shrub
Lignum Vitae	Gulalacum offinale	Introduced	Tree
Tamarind	Tamarindus indica	Introduced	Tree
Red Birch	Bursera simaruba	native	Tree
Orange	Citrus sp.	Native	Tree
Bromeliad	Bromelia sp.	Native	Shrub

APPENDIX 9

LIST OF INVERTEBRATES DOCUMENTED AT COLBECK

MAY 2006

Unk. Sp. = unidentified; sp. = species unknown (but Genus identified).

NB. More than one species may have the same common name.

Most species do not have common names.

ORDER	FAMILY	SPECIES	COMMON NAME	NOTE
		HEXAPODA (Insects)		
COLEOPTERA (Beetles)	Platypodidae	*Unk.Sp.*		
	Cerambycidae	*Eburia postica*	Longhorn Beetles	
		Metriona flavolineda		
		Diabritica balteata		
	Chrysomelidae	*Colemegilla cubensis*		
		Altica sp. 1	Flea beetle (large)	Frequent
		Alticinae species 2	Flea beetle (small)	Abundant
	Lampyridae	*Unk. Sp. 1*		
		Unk. Sp. 2	Fireflies/Blinkies	
	Coccinellidae	*Hyperaspis connectris*	Ladybird Beetles	
		Cycloneda sanguinea	Ladybird Beetles	
	Gyrinidae			
DIPTERA (Flies)	Syrphidae	*Osmia sp.*	Green Hoverflies	
		Ordina obesa	Hoverflies / flowerflies	
		Pseudodoras clavatus	Hoverflies / flowerflies	
		Toxomerus muculatus	Hoverflies / flowerflies	
	Asilidae	*Efteria haloesus*	Robberflies	
	Bombyliidae	*Lucifera sp.*	Bee Fly	
	Muscidae	*Musa domestica*	House Fly	
	Tabanidae	*Tabanus sp.*	Horse Fly	
HEMITERA (True Bugs)	Pyrrchoridae	*Chariestrus gracilicornis*		
		Dystercus andrea	Love Bug	
		Oncopelius pictus		
	Tingidae	*Ukn. Sp. 2*	Lace bugs	
		Coxa viridus	Green Stink Bug	
	Pentatomidae	*Nezara viridula*	Green Stink Bug	
		Ukn. Sp.	Brown Stink Bug	
	Coreidae	*Phthia picta*		
	Issidae	*Unk. Sp.*		
	Aphididae	*Hysteroneura setariae*	Rusty Plum Aphid / Grass Aphid	
	Coccidae (Scale Insects)	*Icerya purchasi*	Cottony Cushiony Scale Insect	Abundant
		Unk. Sp.	Oval Brown	
	Flatidae (Planthoppers)	*Unk. Sp.*		
	Dictyophoridae	*Unk. Sp.*		
	Kinnaridae	*Unk. Sp.*		
	Delphacidae	*Poregrinus maidis*	Planthoppers	
	Cixiidae	*Unk. Sp. 1*		
		Unk. Sp. 2	Planthoppers	
	Cicadellidae	*Hortensus similes*	Leafhoppers	Abundant
		Tylozygus fasciatus	Leafhoppers	Abundant
HYMENOPTERA (Bees, Wasps, Ants)	Formicidae	*Crematogaster sp.*	Cop Cop	
		Companotus sp.	Red / Carpenter Ants	
		Phediole	Running Ants	
	Aphidae	*Apis melifera*	Honey Bees	Abundant
	Megachilidae	*Megachile poyei*	Leafcutter Bee	
		Megachilie consigna	Leafcutter Bee	

	Halicitidae	*Exomolapsis sp.*	Sweat Bee	Abundant
	Ichneumonidae	*Ichneumonus sp.*	Black Ichneumonid Night Wasp Red Ichneumonid	
	Sphecidae	*Prionyx thomae* *Trypoxylon texense*	Thread-waisted wasp	
	Polistinae	*Polistes crinitus* *Polistes hunteri*	Red Wasp Red Wasp	
	Vespidae	*Pachodynerus jamaicensis* *Pachodynerus nasidens*		
NEUROTERA	Chrysopidae	*Chrysopa bicarnea*	Lacewing	
	Myrmeliontidae		Doodle Bugs, antlions	Larva frequent
ORTHOPTERA (Crickets & Grasshoppers)	Gryllidae	*Halpithus sp.*	Cricket	
	Tettigonidae	*Neoconocephalus pipulus*	Grasshopper, (large, brown)	
		Unk. Sp. 1	Grasshopper (small, green)	
	Acrididae	*Schistocers niterus*	Grasshopper	
		Orphutella punctata	Grasshopper	
LEPIDOPTERA (Butterflies & Moths)	Nymphalidae	*Mestra dorcas*	Dorcas	Endemic
		Precis evarete zonalis	West Indian Buckeye	
		Euptoieta hegesia hegesia	Tropical Fritillary	
		Anartia jatrophae jamaicensis	Jamaican White	Endemic sub-species
		Siproeta stelenes stelenes	Peacock Antillean Malachite	
		Hemiargus hanno ceraunus	Hanno Blue	
	Lycaenidae	*Strymon columella cybira*	Hewitson's Hairstreak	
		Leptotes cassius theonus	Cassius Blue	Endemic, dominant
	Pieridae	*Ascia monuste eubotea*	Antillean Great White / Cabbage Butterfly	
		Anteos maerula maerula	Maerula	
		Kricogonia lyside	Lignumvitae Butterfly / Lyside	
		Phoebis sennae sennae	Cloudless Sulphur	Frequent
		Phoebis agarithe antilla	Cloudless Orange	
		Eurema lisa euterpe	Lisa / Little Sulphur	
		Eurema nise nise	Cramer's Little Sulphur	
		Eurema daira palmira	Small Sulphur	
	Hesperidae	*Phygus oileus*	Syrichtus / Checkered Skipper	
		Panoquina sylvicola woodruffi	Watson's Cane Skipper	
	Heliconiidae	*Heliconius charitonius jamaicensis*	Zebra	Endemic subspecies
		Dione vanillae	Tropical Silverspot	
		Dryas Julia delia	Julia	
	Papilionidae	*Papilio andraemon*	Orange Dog / Cuban Swallowtail	Introduced
	Danaidae	*Danaus eresimus eresimus*	Eresimus	
		Danaus gilippus jamaicensis	Queen / Gilippus	Endemic subspecies
	Pyralidae	*Diaphania indica*	Pumpkin Moth	

	Noctuidae	*Loxomorpha sp.* *Unk. Sp. 1 – 15* *Melipotis perpendicularis* *Melipotis ochrodes* *Melipotis evelina* *Argyromamma verruca* *Acontia tetragonal* *Unk. Sp. 1 – 10*		
	Sphingidae	*Unk. Sp.*	Sphinx Moth	Larva frequent
ISOPTERA (Termites)	Nasutitermitinae	*Nasutitermes nigriceps*	Duckants, white ants, termites	Arboreal
ODONATA (Dragonflies & Damselflies	Libellulidae	*Erythremis plebeja* *Erythrodiplax berenice naeva* *Macroatplax balteata* *Tramea binotata* *Lepthemis vesiculosa* *Species 1*	Needle Case / Dragonfly Needle Case / Dragonfly Needle Case / Dragonfly Needle Case / Dragonfly Needle Case / Damselfly Needle Case	Abundant
	Aeschnidae	*Aeschna sp.*	Small Needle Case	
DIPLOPODA (Millipedes)				
JULIDA		*Unk. Sp.*	Black with Yellow	
ARACHNIDA				
ARANAE (Spiders)		*Species 1 -3*		
ACARINAE (Mites & Ticks)	Ixodidae	*Dermacentor sp.*		
MOLLUSCA (Snails & Slugs) GASTROPODA				
STYLOMMATOPHORA	Bulimulidae	*Orthalicus undatus jamacacensis*		Native
		Bulumus diaphanous		Introduced
		Pleurodonte invalida		Endemic
		Pleurodonte lucerna		Endemic
		Hemitrochus graminicola		Endemic