Table 5.2.5.1: Hydrostratigraphic Units in the Martha Brae Hydrologic Basin

Hydrostratigraphic Unit	Outcrop Area (km^2)	Percent
Alluvium Aquiclude	92	13
Coastal Aquifer	4	0.5
Coastal Aquiclude	4	0.5
Limestone Aquiclude	224	32
Limestone Aquifer	305	44
Basement Aquiclude	70	10
Total	**699**	**100**

(Source: Water Resources Inventory, 1985 UNDP/UWA)

Much of the site is underlain by the hard impermeable Montpelier limestone, which is classified as a limestone aquiclude. However, where the lithology comprises the massive chalky limestone, the permeability is likely to be greater.

5.2.5.2 Surface Drainage

Generally surface runoff predominates in the 3 km wide coastal strip, which drains directly into the sea, as this coastal strip is composed mainly of low permeability aquicludes. The Hydrological Modeling System (HEC-GeoHMS), an extension of ArcViewGis was used to delineate the drainage network based on a digital surface model. The software analyses flow direction and flow accumulation. Two major drainage basins were determined. (Figure 5.2.5.1).

The Boyce Gully flows along the western side of the proposed development. This gully has a catchment size of 2.9 km^2 and the proposed development occupies 19% or 138 acres of this catchment. The length of the catchment is approximately 3,360 m with an average slope of 1%. The Boyce Gully is mapped as a perennial stream. Its head is located approximately 400 m north of the Cornwall to Spot Valley road within the proposed development site and flows for approximately 2.5 km before under-passing the

North Coast Highway through a 2 m high x 4 m wide x 24 m long box culvert. It flows for an additional 300 m before entering the sea beside the Rose Hall Wyndham Resort.

The second stream is the Spot Valley River, which is located at the eastern side of the proposed development. This stream has a catchment size of approximately 4.9 km^2 and the proposed development occupies 4% or 51 acres of the catchment. The basin length is 3,800 m and the average slope 0.8 % (Figure 5.2.5.2). The head of the river is located approximately 950 m east of the Spot Valley community. This river is joined by a number of tributaries.

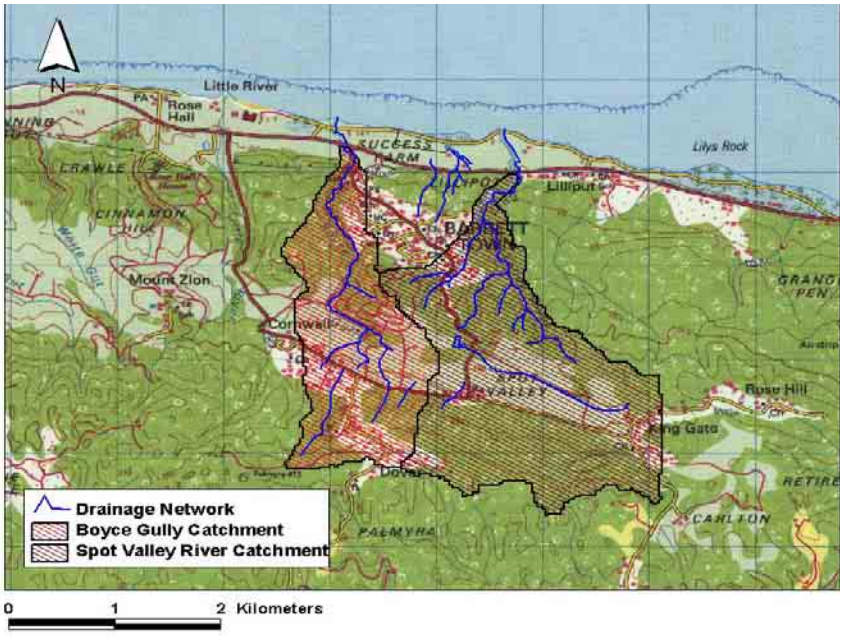


Figure 5.2.5.2: Drainage Basins

The river underpasses the North Coast Highway west of Lilliput community through a 3 m high x 4 m wide x 24 m deep box culvert (Plate 5.2.5.2c) after flowing for approximately 2.4 km. The river joins the marine environment after flowing for an additional 400 m. This river is mapped on the 1:12,500 topographic sheet as a seasonal

river. At the time of the field visit the river bed at the location where it underpasses the Highway was dry.

a) Boyce Gully Culvert

b) Spot Valley River Culvert

Plate 5.2.5.2 a and b: Box Culverts (viewing on the south side of the road)

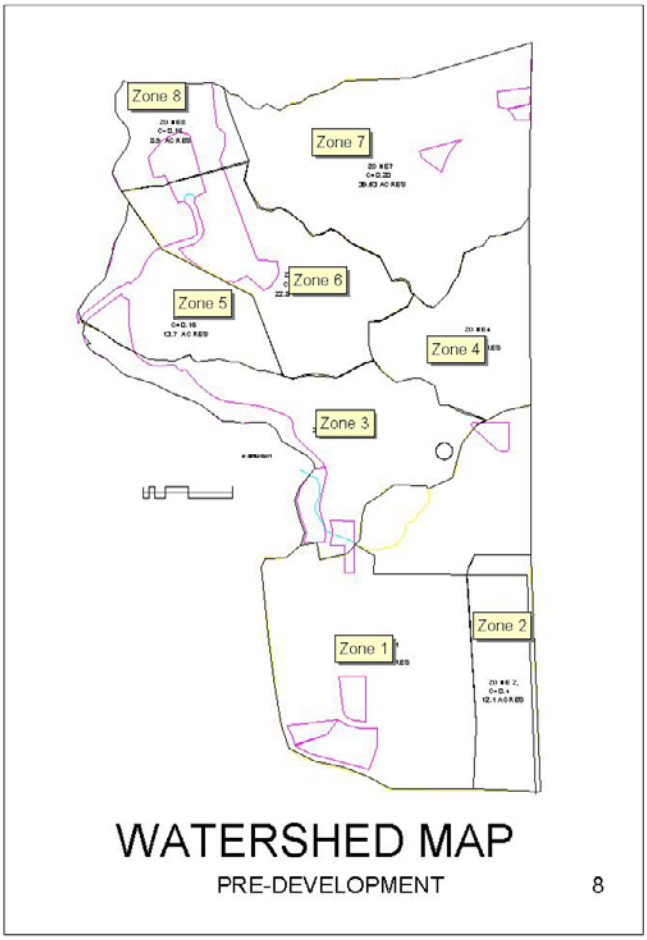
5.2.5.3 Peak Flow Determinations (Surface)

The proposed development can be divided into six main stormwater systems, of which five originate from within the site and one from outside the development site to confluence with Zone 1. Table 5.2.5.3a outlines the individual tributary zones.

Table 5.2.5.3a: Tributary Zones

System	Tributary Zones	Area (acres)	Outfall
1	Palmyra	160.0	Start of Boyce Gully
2	Zone 1	49.0	Start of Boyce Gully
2	Zone 2	12.1	Start of Boyce Gully
3	Zone 3	24.8	Overland flow, no defined system, Boyce Gully
4	Zone 4	15.9	Start of Eastern Gully
5	Zone 5	13.7	Boyce Gully by natural channel & overland flow
5	Zone 6	22.8	Boyce Gully by steep natural channel
5	Zone 8	8.9	Boyce Gully by overland flow
6	Zone 7	39.53	Overland mainly with gully flow in lower elevation to eastern gully

Figure 5.2.5.3a shows the individual tributary zones as determined by Westech Ltd. (2005a).



Source: Westech Ltd. 2005

Figure 5.2.5.3a: Tributary zones (sub-basins)

Rainfall depths for the Boyce Gully Basin and the Spot Valley River Basin for various durations (ranging from 5 minutes to 24 hours) and frequencies (from 5-yr to 100-yr

return periods), are given in Tables 5.2.5.3 b and c. The locations of the rainfall stations are shown in Figure 5.2.5.3 b.

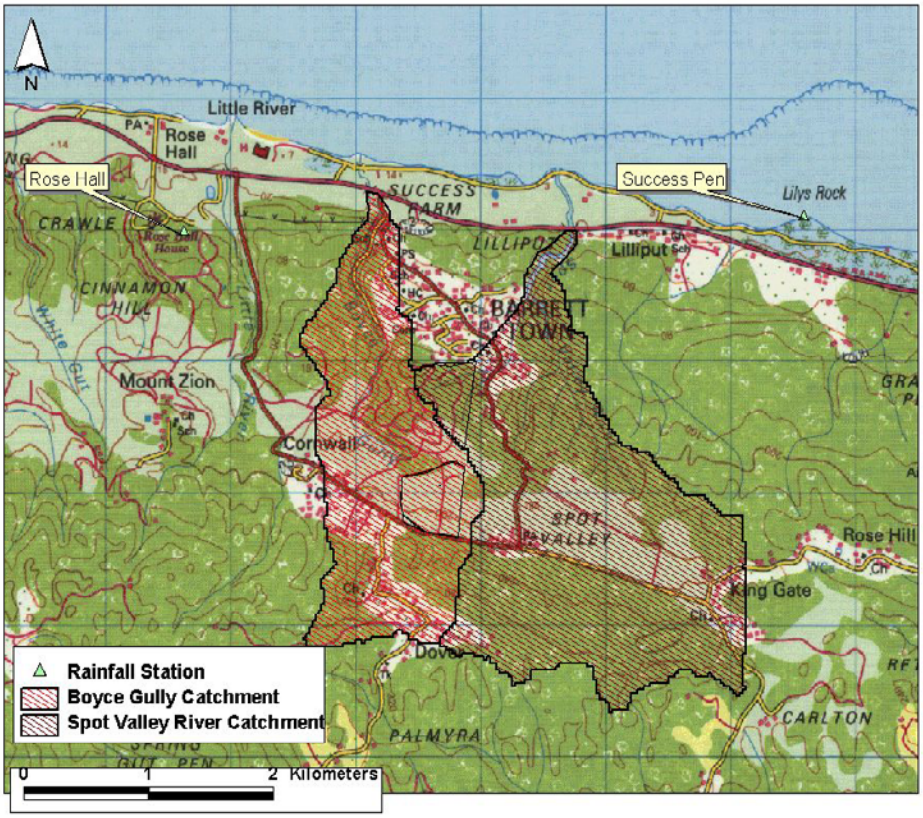


Figure 5.2.5.3 b: Location of Rainfall Stations

Table 5.2.5.3b: Rainfall Depths for Boyce Gully Basin for Various Durations and Frequencies

		Return Period				
Duration	Ratios	5	10	25	50	100
5 min	0.25	14	17	21	24	27
15 min	0.52	29	35	43	49	55
1 hour		56	68	84	95	107
2 hour	0.25	76	93	114	129	145
3 hour	0.343	83	102	125	142	159
6 hour	0.5	96	117	144	164	183
12 hour	0.69	111	136	167	190	212
24 hour		136	166	204	232	260

Table 5.2.5.3c: Rainfall Depths for Spot Valley River Basin for Various Durations and Frequencies

		Return Period				
Duration	Ratios	5	10	25	50	100
5 min	0.25	11	14	17	19	21
15 min	0.52	24	29	35	39	44
1 hour		46	55	67	75	84
2 hour	0.25	62	75	91	103	114
3 hour	0.343	68	82	100	113	126
6 hour	0.5	78	94	115	130	145
12 hour	0.69	91	109	133	150	168
24 hour		111	134	163	184	205

Figure 5.2.5.3c shows the model schematic for Boyce Gully and Spot Valley River. Peak flows from all small tributary zones in the proposed development were calculated using the 'rational method' approach. The hydraulic-hydrologic engineering report prepared by Westech can be found in the Appendix V.

Under the pre-development scenario it is expected that with a 50-year return period the basin outlet of the Boyce Gully at the coast road will receive a peak flow of 36 m^3/s of which the proposed development contributes a peak flow of 6.7 m^3/s and the basin outlet for the Spot Valley River at the North Coast Highway will receive a peak flow of 55 m^3/s with 2.7 m^2/s from the proposed development.

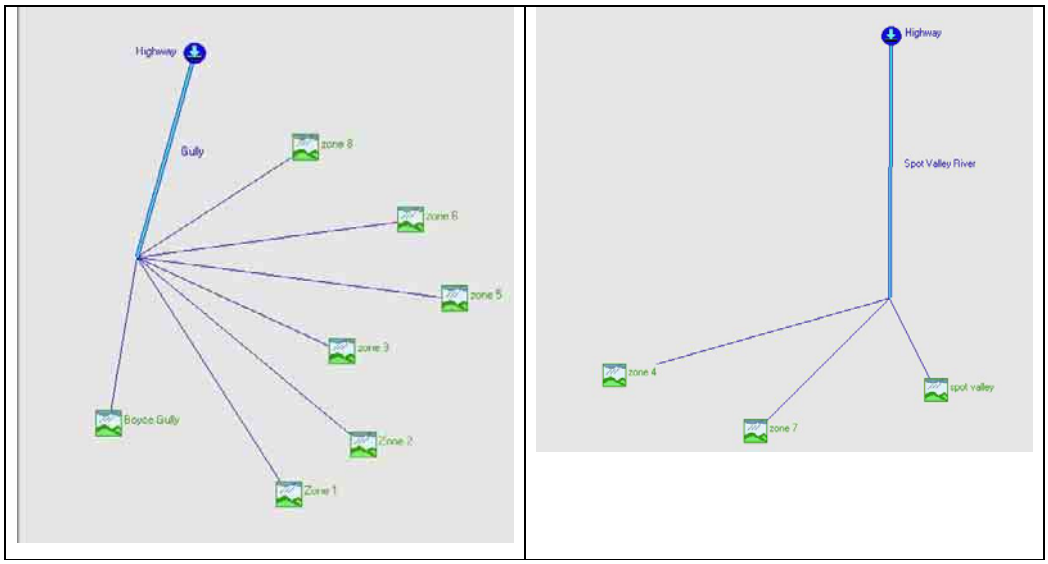


Figure 5.2.5.3c: Model Schematics for Boyce Gully and Spot Valley River

5.2.5.4: Groundwater

The site is underlain by the Montpelier Formation, which is considered a limestone aquiclude. The nearest wells are located at the southern edge of the development site and are owned by Rose Hall Development Ltd. (Figure 5.2.5.4).

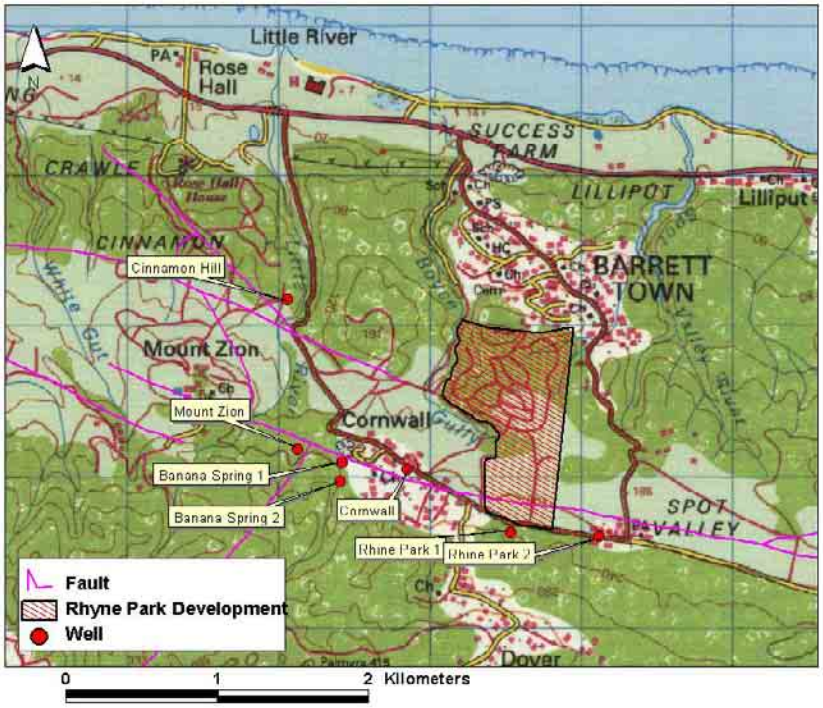


Figure 5.2.5.4: Well Locations *Source: WRA*

The following table gives some information on the wells, which was provided by the Water Resources Authority (WRA). The table indicates that the general depth to groundwater is in the region of 25 m below ground. The low permeability of this limestone formation is supported by the deep draw down as indicated in Table 5.2.5.4. The general groundwater flow direction is to the north. There are no wells to the north of the proposed development. In general, fault planes in brittle lithologies act as a preferential flow paths for groundwater as they create secondary porosities in the fault-brecciated zones. The groundwater flow direction could change along these planes.

Table 5.2.5.4: Well Data

Well	Status	Use	Depth (m below ground)		Drawdown
			Groundwater Level	Pumping Water Level	
Cornwall	Pump installed	Not known	-	73	
Rhine Park 2	Pumping	Domestic	27.43	-	25 m at 200 USGPM
Rhine Park 1	Not pumping	Domestic	-	-	54 m at 250 USGPM
Banana Spring 2	Abandoned (poor yield)	-	28.65	-	28 m at 1.5 USGPM
Banana Spring 1	Not pumping	-	25.6	-	
Cinnamon Hill	Unused hand dug well	-	-	-	
Mount Zion	pumping	Not known	-	-	

5.2.5.5 Water Supply

The National Water Commission (NWC) supplies the area from the Great River and Martha Brae River. The drinking water treatment plants have a combined output of 32 MGD[1] (121,133 cubic meters per day). The demand for the Greater Montego Bay Area has been projected in the 1990 Water Resources Development Master Plan with 29.2 MCM/yr or 80,000 m^3/d.

5.2.6 Air Quality

Particulate matter (PM) refers to discrete particles in ambient air that exist either as solid particles, or as liquid droplets. Respirable particulates are those particulates with size fraction less than 10 microns. In unoccupied areas PM enters the air from dirt roads, fields, and other open spaces as a result of wind, traffic, smoke from vegetation and wood burning vegetation clearing, excavations, and other surface activities. Ambient respirable particulate levels provide an indication of baseline levels which should be maintained during construction and operation of any proposed development(s).

The results of the respirable air quality sampling exercise conducted on January 26-27, 2006 are presented below.

[1] million gallons per day

Table 5.2.6 : Respirable Air Quality Data, Rhyne Park, St. James

Site	LOCATION	Results 24 hr monitoring /µg/m^3	NEPA 24 Hr Guide Line µg/m^3
A	North-eastern corner of project site adjacent to Barrett Town.	5.7	150
B	North-western corner of project site adjacent to Barrett Town.	8.7	
C	Centre of northern property project site adjacent to Barrett Town.	3.4	
D	Centre of western property boundary.	3.9	
E	South-eastern corner property boundary within the existing housing.	7.3	
F	Southern property boundary.	8.9	

Respirable particulate levels measured at all the sampling sites were well within the recommended national guideline of 150µg/m^3 per 24 hour period as well as the annual standard of 60 µg/m^3

5.2.7 Water Quality

5.2.7.1 Surface Water

There are several ground water upwellings and two major springs on the site. One of these springs is located on the project site and one on a neighboring property (cotton tree site). The waters from these groundwater systems flow overland and eventually merge to form a fairly large stream that drains to the Boyce Gully. The waters in the Boyce Gully discharge to the coastal zone in the Success Beach area. Another seasonal gully located to the north of the site also drains to the Boyce Gully. An artificial pond created as a result of the union of two chambers designed as a temporary holding area for sewage effluent forms the next significant 'surface water' system on the project site. The earthen walls and base of the holding chambers were lined, but onsite evidence suggests that the lining has been breached. The chambers have overflowed their banks forming a large

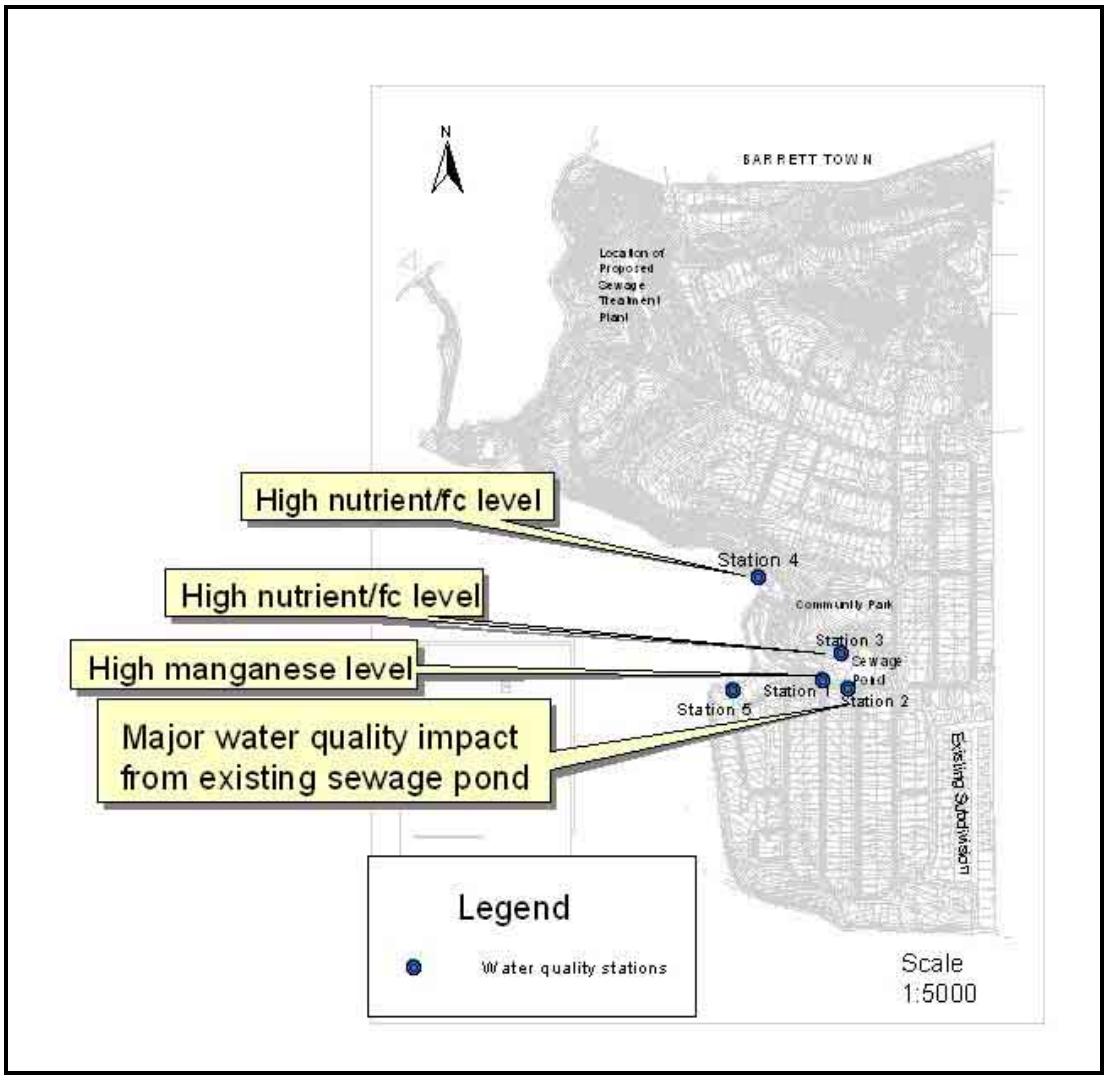
pond. This pond has been in existence for well over ten years receiving untreated sewage effluent from the existing VMBS Development. The effluent from the pond discharges directly and indirectly into the Boyce Gully.

A surface water quality survey was conducted over a three week period, January 26 through February 13, 2006. The major objectives of the water quality survey are summarised below:

- ◊ To provide critical data on the condition of the surface waters in the area.
- ◊ To assess coastal/land use practices prior to the construction of the Rhyne Park Housing Development.
- ◊ To determine the nature and extent of existing land use impacts,
- ◊ To determine the impact of the disposal of untreated sewage effluent from the existing Victoria Mutual Housing Development on surface water quality,
- ◊ To determine compliance with local and international water quality standards.

Five sampling stations were selected in Rhyne Park based on their location relative to their current or potential for impairment. The station locations are shown at Figure 5.2.7.1.

Figure 5.2.7.1: Water Quality Results



The results of the water quality survey are presented and discussed in the following sections.

The water quality data generated over the sampling period are presented at Tables 5.2.7.1 below.

Resulting from discussions with the Environmental Health Unit of the Ministry of Health, and the need for baseline data collection to be more extensive and representative of seasonal influences, the water quality sampling was conducted in triplicate for two stations. These two stations were the spring upstream of its confluence with the sewage pond discharge (Station 1) and the stream downstream of its confluence with the sewage pond discharge (Station 4). These two sites are the ones most likely to be influenced by seasonal changes.

Table 5.2.7.1: Water Quality Data for Rhyne Park, St. James, Jamaica.

PARAMETERS	January 24, 2006					February 03, 2006		February 14, 2006		NEPA Ambient Fresh Water Standards	NEPA Sewage Effluent Standards New Plants
	Station 1	*Station 2*	*Station 3*	*Station 4*	*Station 5*	*Station 1*	*Station 4*	*Station 1*	*Station 4*		
pH (units)	7.7	7.9	7.7	7.5	7.7	7.67	7.52	7.08	7.51	7.0-8.4	6-9
Temperature (^{0}C)	26.9	29.8	30.6	29.8	27.4	26.5	27.0	26.2	26.2	-	Ambient
Conductivity (uS/cm)	0.74	0.51	0.53	0.57	0.55	0.75	0.57	0.74	0.73	0.15-0.6 mS-	-
BOD (mg/L)	BDL	19.0	7.0	2.0	BDL	1.0	3.0	1.0	3.0	1.7	20 mg/l
TSS (mg/L)	8.0	68.7	1.5	22.3	3.3	4.0	8.0	5.7	9.3	30	20 mg/l
Dissolved Oxygen (mg/L)	4.8	4.0	2.8	3.8	6.0	4.82	3.78	3.61	4.25	>4	-
Nitrate (mg/L) Total Nitrogen	11.9	202.4	33.4	22.0	15.0	10.12	21.12	11.0	11.9	7.5	10 mg/l
Phosphate (mg/L)	0.31	10.2	4.1	1.3	0.33	0.34	2.00	0.04	0.11	0.8	4 mg/l
Oil & Grease (mg/L)	na	1.47	1.87	2.40	2.10	1.87	0.90	5.67	2.12	10.0	10.0
Total Coliform (MPN/100ml)	>2,400	>2,400	>2,400	450.0	<3.0	1,100	1,100	75.0	150.0	0.0	---
Faecal Coliform (MPN/100ml)	150.0	>2,400	150.0	240.0	<3.0	21.0	11.0	75.0	150.0	0.0	1000
Iron (µg/L)	64.0	54.0	117.0	53.0	23.0	42.1	31.2	36.6	51.1	300.0	-
Lead (µg/L)	<20.0	<20.0	<20.0	<20.0	<20.0	38.8	35.5	<20.0	<20.0	100.0	-
Manganese (µg/L)	92.0	150.0	581.0	27.0	<20.0	891.0	<20.0	44.8	<20.0	400.0	-
Copper (µg/L)	<10.0	<10.0	<10.0	<10.0	<10.0	12.7	13.4	<10.0	<10.0	100.0	-

BDL – Below detectable limits

The following discussion is based on data generated from three sampling exercises conducted over a three-week period. The current data is compared with the historical water quality data from the Rose Hall SEA (Environmental Solutions Ltd., 2004).

◊ **Conductivity**

Conductivity measurements at the sampling stations, Stations 1 -5, ranged between 0.5 and 0.74 mS. The conductivity recorded for Stations 2 through Station 5 are typical of freshwaters. Station 1 has elevated conductivities that indicate the presence of chemical constituents above normal levels.

◊ **Dissolved Oxygen (DO)**

Dissolved oxygen concentrations at Stations 3 and 4 are well below the recommended limit and indicate oxygen deficiency at these stations. The NWC pump station (Station 5) is the only station with good dissolved oxygen levels.

◊ **Biochemical Oxygen Demand (BOD_5)**

BOD levels in excess of 2.0 mg/l indicates elevated organic loading, which is a cause for concern. The BOD levels at Stations 1 and 5 were well within the required guideline. The BOD levels in the pond (Station 2) are elevated when compared with the ambient standard; however comparison with the sewage standard reveals that the levels are in compliance. Station 3 (beginning of Boyce Gully) has elevated BOD levels which decrease to within compliance levels at the downstream site (Station 4). The rapid flowrate in the Boyce Gully is primarily responsible for the re-oxygenation of the water considerably reducing the impact of the oxygen demand at Station 3.

Historical data shows that the mouth of the Boyce Gully (May 2004) had elevated BOD levels. This suggests that despite the lowered BOD readings at Station 4, the organic loading in the Boyce Gully can be an issue and should therefore be carefully monitored to prevent deleterious downstream effects in the coastal zone.

◊ **Oil and Grease**

The oil and grease levels recorded for each station were all within acceptable levels less than or equal to 2 mg/l.

◊ **Total and Faecal Coliform**

Total Coliform bacteria can be found widely in air, soil and water. The presence of these bacteria in large numbers means the water is of poor quality. Fluctuations in the number of bacteria are likely dependent on how recently the contamination occurred. These bacteria do not indicate a high probability of pathogens (disease-causing organisms) as is the case with faecal coliforms.

Total Coliform levels were very high at four of the five sampling stations on the first sampling exercise. The levels were somewhat lower on subsequent trips, but still above the NEPA guideline.

Faecal Coliform bacteria originate in the gut of humans and other warm blooded animals and are used as an indication of the presence of pathogenic organisms. Faecal Coliform levels were above the NEPA ambient standard at all stations except Station 5 (NWC pupm station) on the first sampling exercise. The faecal bacterial levels were significantly lower on subsequent trips.

Managing the bacterial load in the surface waters draining to the Boyce Gully is very important as these waters discharge into the coastal zone and presents a serious health risk to the users of these recreational waters.

◊ **Total Suspended Solids**

The total suspended solids (TSS) concentration recorded at Station 2 (the pond) and Station 3 were elevated, Station 2 being considerably elevated. The suspended solids loading at Station 2 is approximately three times the threshold recommended in the national sewage regulations. Although the TSS levels decline going downstream, the fact that the suspended materials are from a septic origin present a significant cause for concern.

In May 2004 (Environmental Solutions Ltd., 2004) significant suspended solids levels were recorded for the coastal end of the Boyce Gully and in Success Beach. Management of the suspended solids discharged into the Boyce Gully will be an important component of the environmental monitoring programme during the construction phase of the Rhyne Park Development, as well as during operations phase if sewage effluent is to be discharged (directly or indirectly) to this gully.

◊ **Nitrates**

Nitrate levels are also used as an indicator of contamination by wastewater from sewage and/or fertilisers from agriculture. Nitrate levels in excess of 7.5 mg/l NO_3 indicate nutrient enrichment from one or both sources.

Nitrate concentrations were considerably elevated at the pond (202.4 mg/l) and significantly elevated at the other stations, ranging between 10 and 33 mg/l NO_3. Station 3 is the most impacted as a result of its proximity to the pond. Nitrate levels at Station 4 are also well above the standard and is a cause for serious concern as the waters from the Boyce Gully discharge into the Bay and will contribute to the nutrient enrichment of the coastal waters.

◊ **Phosphates**

Phosphate concentrations were similarly elevated at Stations 1-4. The impact of phosphate rich effluent from the sewage pond is clearly seen in the recorded levels for Stations 2, 3 and 4. The fact that Station 4 has elevated phosphate levels underscores the point that waters discharged from the Boyce Gully may cause nutrient enrichment of the coastal zone.

◊ **Metals**

Four metals were analysed on each sample. These were iron, lead, copper and manganese. The concentration of iron, lead and copper were within the recommended NEPA guideline for these elements. Manganese levels on two occasions were

considerably elevated at 891µg/L and 581µg/L at Stations 3 and Station 1, respectively. High manganese can occur from natural as well as anthropogenic sources, the fact however that these levels were not recorded at Station 2 suggest that they are naturally occurring and likely associated with the spring. The high conductivity readings recorded for Station 1 would confirm this inference.

◊ **Summary**

The surface water quality survey shows the significant impact of the sewage pond on surface water quality in the project area. The freshwater upwellings along Boyce Gully, as well as the inputs from the two springs (one located on the Rhyne Park site and one on an adjoining property) has resulted in the dilution of the nutrient, bacterial and suspended solids loading resulting from the discharge of sewage effluent.

Historical data (Environmental Solutions Ltd., 2004) shows that nutrient and suspended solids levels can be quite elevated at the mouth of Boyce Gully and in Success Beach. The proposed development will provide a designed sewage treatment system that will incorporate the existing load going to the pond. This will positively impact the surface waters in the project area as well as the coastal zone.

5.2.8 Natural Hazards

5.2.8.1 Flooding

The main north coast road, now being upgraded under the Northern Coastal Highway Improvement Project (NCHiP), has been flooded on several occasions over the last few years, severely hampering vehicular traffic and causing widespread economic damage to tourism facilities and the road network. The section of highway between the Ritz Carlton and Wyndham-Rose Hall resorts has received significant damage. The last major event occurred in April 27, 2005 forcing the Ritz-Carlton to cease operations for an extended period. There is no single reason for flood events to occur. However it appears that inadequate maintenance of drainage channels and the blocking of culverts with debris (rock material, vegetative matter) reduces the capacity of the drainage infrastructure to adequately convey storm water under the coastal road. Plate 5.2.8.1 shows the typical

aggradation of coarse sediment (White Limestone boulders) in gullies near culverts. When comparing the peak flows modeled with the cross sectional area of the two box culverts flooding is likely to occur even with return periods of less than 50 years.

Plate 5.2.8.1: Sediment Build-up (south of culvert, Spot Valley River)

5.2.8.2 Hurricanes

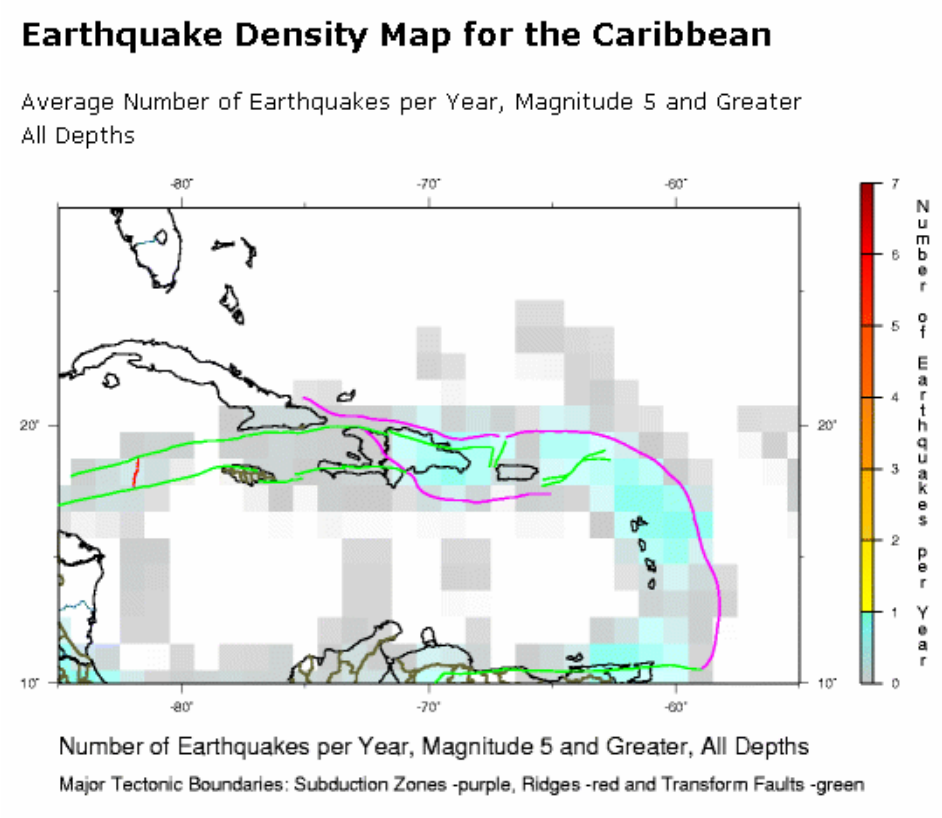
Jamaica is prone to hurricanes during the period June to November. The north coast of Jamaica is particularly vulnerable to cyclonic systems passing north of the island. The major hurricane systems that have affected Jamaica in the past 17 years (1988 to 2005) include five September events (Ivan in 2004), Lilli and Isadore in 2002, Tropical Storm Helene in 2000 and Hurricane Gilbert in 1988. Other cyclonic events affecting the island occurred in July (Claudette in 2003), August (Tropical Storm Charley in 2004), October (Michelle and Iris in 2001) and Gordon in November 1994. Statistically, hurricanes have affected Jamaica later in the season (between September and November). The 2005 Atlantic hurricane season saw a record number of hurricanes and tropical storms with a combined total of 30, none of which passed over Jamaica directly, but the island was severely impacted by heavy rains and flooding during Hurricanes Dennis (May), Emily

(June) and Wilma (October). In this area hurricanes may produce destructive winds, flooding and landslides.

5.2.8.3 Earthquakes

Figure 5.2.8.3 below shows the earthquake density map for the Caribbean, reproduced from the USGS website (http://earthquake.usgs.gov/regional/world/caribbean/density.php), which shows the average number of earthquakes with a magnitude 5 and greater in the region (for all depths).

Figure 5.2.8.3: Earthquake Density Map for the Caribbean



Northern Jamaica is affected by the presence of a major transform boundary (green line). Jamaica as a whole is falls within a zone receiving less than 1 earthquake of magnitude 5 per year. However, some lower magnitude earthquakes can be felt depending on the depth and ground type (acceleration).

The 1957 earthquake affecting Kempshot and environs disrupted a pipeline and resulted in a felt intensity of VIII (on the Modified Mercalli Scale). The site occurs close enough to the (possibly active) Duanvale fault to be in moderately-high seismic risk zone (Dr. M. Wiggins-Grandison, Earthquake Unit, UWI,Mona, Pers. Com)).

5.2.8.4 Landslides & Erosion

The major forms of erosion noted at the site include:

1. Rock falls associated with overhanging slopes of the bedded Montpelier lithology. In general the Montpelier is very stable except where the bedding dips out of the slope. The lithology tends to cleave in blocks along joint/bedding planes, producing boulder-sized rocks.

2. Minor slumping in the massive white lithology. In this situation, loading of the slope can lead to failure. Trees on the slopes can also act as levers to pull sections of the slope away from the main slope.

3. Rill development and gully development along flat or depressed surfaces in the limestone. This can be seen along secondary roads on the property, which serve as preferred pathways in the absence of a storm water drainage system. These rills are essentially first order streams that connect to the major gully systems that drain the property.

Plate 5.2.8.4 a, and b: Erosion at Rhyne Park

5.2.10.4 a

5.2.10.4b

5.3 Biological Environment

The project site is located in what was formerly dry lowland limestone forest. It has a long history of habitat modification and at present only a small fraction superficially resembles the natural state of the habitat. Four distinct habitat types were discernable on the site.

5.3.1 Flora and Habitats

1. Abandoned pasture

The majority of the site is dominated by abandoned pasture with scattered mature trees and shrubs. The dominant grass is Seymour Grass *Cynodon dactylon* and there are also patches of the invasive Piano Grass *Themeda arguens*. The most abundant trees are Pimento *Pimenta dioica* and Naseberry *Manilkara zapota*. There are also several other abundant shrubs species including White Night shade *Thunbergia fragrans* and Wild

Hops *Moghania strobilifera*. There are also patches of thorny or poisonous shrubs (unpalatable to grazing animals) that are typical of arid limestone habitats including Wild Sage *Lantana camara*, Bitter Bush, Belly-ache Bush *Jatropha gossypiifolia*, Rosemary *Croton linearis* and strong back *Morinda royoc*. These plants are all common weeds and are of no special conservation value. The pasture is maintained by informal grazing by an undermined number of goats and cows. There are also a few longstanding puddles probably supported by springs or leaking pipes that support a few sedges and water loving plants.

A few small areas showed signs of having been cultivated fairly recently, crops such as tobacco *Nicotiana tabacum* and various ornamental shrubs were present at such sites.

A list of the tree species identified is given in Appendix XI.

Plate 5.3.1 a: North easterly view across the property and existing VMBS houses

2. Recently Cleared Woodland

Several steep slopes to the north of the site have recently been almost totally cleared of vegetation and are presently being regenerated by weeds. As a consequence these slopes are showing signs of severe soil erosion. The limestone scree has been colonized extensively by Moses in the Cradle *Rhoeo spathacea*, several grasses and other weeds.

3. Riparian Woodland

The largest trees on the site are found on the steep banks of the stream that cuts across the southwestern margin of the site. There are very large Guango trees (*Samanea saman)*, Roseapples (*Syzygium jambos)*, and Mangoes (*Mangifera indica).* The relatively stable history of this area is reflected by the size of the trees as well as the presence of epiphytes on the trees including the orchid *Broughtonia sanguinea* (an endemic species) and several species of Tillandsia epiphytes. Royal Palms (*Roystonea altissima)* were common. The banks are thickly covered with ferns including Maidenhair and Polypodium, and the trees with vines and these contribute to a potentially attractive site for a nature walk as proposed on the plan, once garbage has been removed. The height of the deposits of detritus on the vegetation on the banks indicated that floodwaters can reach 3-4 feet above current levels, reinforcing the importance of leaving a buffer of natural vegetation in the gully at least 10 m on either side of the stream.

No rooted aquatic plants were found in the stream bed, it is unclear whether this is normally the case, or whether they were scoured by a recent flood event.

Plate 5.3.1 b: Stream vegetation

4. Secondary Dry Limestone Woodland

The dry limestone woodland on the steep slopes of the site is dominated by natives such as Red Birch (*Bursera simarub),* Burn Wood (*Metopium brownii)* and various other species that are typical of this type of habitat such as introduced Logwood (*Haematoxylum campechianum)*. The average canopy height was six metres on the slopes and ten metres in the gullies. Few endemic or mature hardwood species were observed in this area suggesting that such species were selectively harvested for fuel and lumber although some ornamentals such as the attractive endemic Jamaica Fuchsia (*Lisianthus longifolius)* and orchids *Broughtonia sanguinea* were present. Large piles of stones indicated that much of the area had probably been cleared in the past for agriculture. The absence of large emergent trees suggested selective extraction of timber trees such as W.I. Mahogany (*Sweetenia mahagoni)* over a long period. Some of the slopes had a dense ground cover of ferns.

Plate 5.3.1c : The Red Birch tree *Bursera simarouba,* typical of dry limestone habitats

5.3.2 Fauna

Forty seven species of birds were observed on the site in two days of observation. There were several other resident species that are expected to occur there but were not detected in the survey because of various factors such as variation in seasonal abundance, naturally low density, and low detectability during survey times. A list of the birds identified is given in Appendix XI.

Plate 5.3.2 a: Black necked stilts on the lining of the Sewage Pond

5.3.2.1 Endemic Species

Ten of Jamaica's 28 species of endemic land birds were observed - including the Jamaican Woodpecker (*Melanerpes radiolatus),* Sad Flycatcher (*Myarchus barbirostris*) and Jamaican Tody (*Todus todus).* These species are typical of this type of habitat and are common in both forested and secondary woodlands throughout the island. None of the uncommon or forest dependent endemics were present.

5.3.2.2 Migrants

Migrant warblers are typically common in lowland woodlands of this type and should be particularly common in this area given its location on the north coast of the island as this is the first point of contact for birds approaching from the north. The site also has a combination of open areas, closed forest and riparian woods that should also appeal to a wide variety of specialist species. Common species included American Redstart (*Setophaga ruticilla),* Prairie Warbler (*Dendroica discolor)* and Palm Warbler

(*Dendroica palmarum)*. A migrant duck species, the Blue-winged Teal *Anas discors* was observed in the sewage pond near to the houses. The Rose-breasted Grossbeak (*Pheucticus ludovicianus)* is a very attractive and uncommonly observed migratory species and its presence there suggests that several other uncommon migrants should occur in the woodlands.

5.3.2.3 Aquatic birds

The small sewage pond supported a small number of waterbirds, including Least Grebes (*Tachybaptus dominicus)* (3), Black-necked Stilts (*Himantopus mexicanus)* (3), Common Moorhen (*Gallinula chloropus)* (1), Spotted Sandpiper (*Actitis macularia)* (1) and the aforementioned migratory Blue-winged Teal (1). The Northern Waterthrush (*Seiurus noveboracensis)* is a migratory warbler common in Jamaica particularly in coastal wetland areas and was found along the banks of the stream. The Jamaican Tody although not strictly an aquatic bird was found mainly in the riparian area as it is known to regularly nest in holes in earthen embankments particularly near water.

5.3.2.4 Butterflies

Twenty three species of butterfly were identified. Several species were full endemic or sub-species. All the species were common and most were typical of disturbed open habitats. The Jamaican Goatweed butterfly *Anaea troglodyta portia* was observed in unusually high numbers but this may be because of the recent land clearing. None are known to be range restricted or threatened. A list of the butterflies is given in Appendix XI.

5.3.2.5 Reptiles

A Pond Turtle *Pseudemys terrapen* was found in the sewage pond. A few species of Lizards were uncommon but a few specimens were seen.

5.3.2.6 Mammals

A small Indian Mongoose (*Herpestes javanicus)* was observed on the site. Bats such as the frugivorous *Artibeus jamaicensis* (which frequently feeds on naseberries) were

probably present, but not observed . Domestic goats and cows were observed occasionally in the pasture areas.

5.3.3 Endangered Species

No rare, threatened or endangered species were observed on the project site.

5.3.4 Parks and Protected Areas

The Rhyne Park property does not fall within any Park or Protected Area. However it should be noted that the property is on what was part of the Rose Hall lands and as such is on lands that are of significant archaeological and cultural interest.

The Montego Bay Marine Park is located several miles to the west of the property in the city of Montego Bay and should not be impacted by the development if the recommended mitigation measures are instituted.

5.4 Socio-economic Environment

The Rhyne Park property was previously owned by Rose Hall Developments Limited, and is slated for middle- income housing in the Rose Hall Development Master Plan. The property is an existing housing subdivision, originally planned and approved in 1974, put on hold, reinstated in 1993 with the construction of 58 lots by Victoria Mutual Building Society, and then discontinued again.

Gore Developments Limited purchased the property and proposes its expansion by building 908 new lots: including 755 lots with houses and 145 service lots. This is in keeping with the vision of the property in the Rose Hall Master Plan for providing two-bedroom middle-income housing solutions. Completion of the housing development is proposed for 2008/2009.

The socio-economic characteristics of the site are largely determined by the regional setting and characteristics of the immediate surrounding communities.

5.4.1 Regional Setting

The site of the proposed Rhyne Park Village is located in the Rose Hall area approximately 10 km east of Montego Bay, with the nearest significant urban centre being Coral Gardens. The sprawling communities of Barrett Town and Lilliput are located along the northern periphery of the property. Cornwall Community situated in a southwestern direction and the Spot Valley Community to the east. These communities are in close proximity to the site and could be considered part of the sphere of influence of the project (Figure 5.4.1).

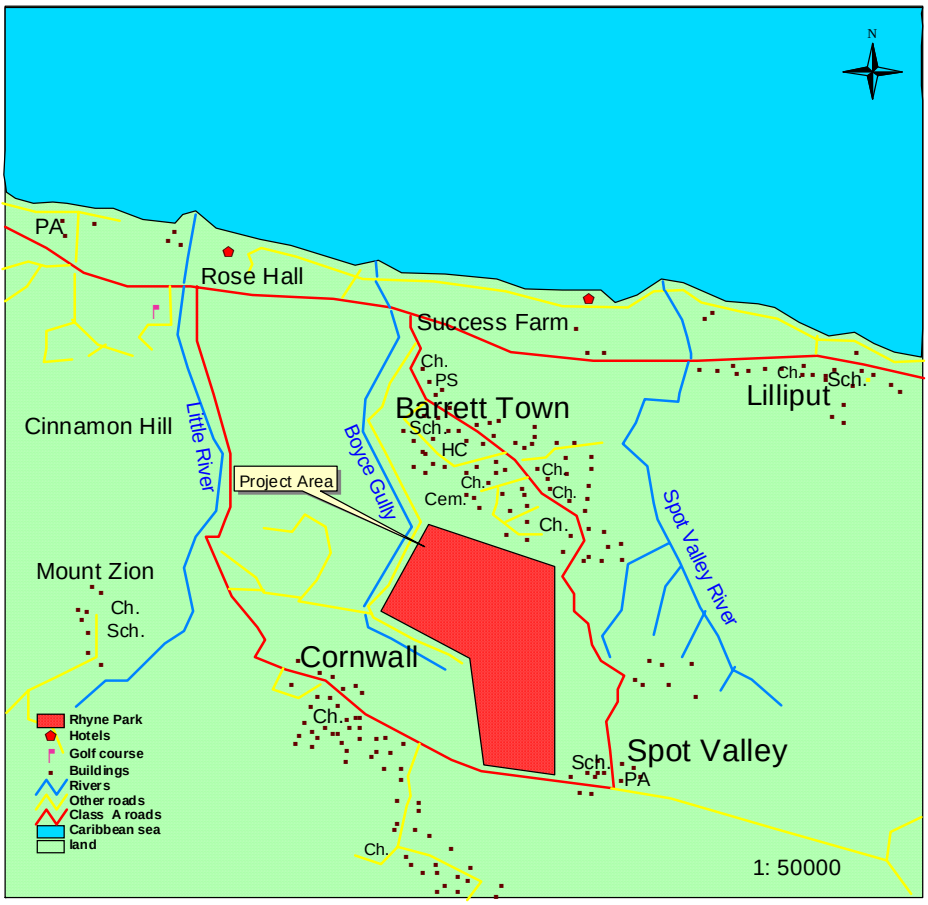


Figure 5.4.1: Regional Setting of Rhyne Park

The site is also located within an area that is key for tourism development, which extends from Montego Bay through Falmouth and ultimately to Ocho Rios. The main tourism related enterprises within the sphere of influence include the Wyndham Rose Hall Hotel and the Ritz Carlton, both of which are located to the north of the property on the coastal land.

The project is within the Greater Montego Bay Area (GMBA), for which development plans to the year 2014 were drafted and eventually promulgated by the Greater Montego Bay Redevelopment Co. (GMRC) in 1997. The GMBA is the residential and economic core of St. James and covers an area of 52,168 acres extending over a radius of 19 kilometres from Montego Bay to include over 38 residential districts in 42 planning areas. The 2001 Census of Jamaica refers to the Montego Bay "*Special Area*", which essentially incorporates the GMBA. The area has been zoned for "*mixed resort commercial/residential use*".

5.4.2 Demographics and Livelihoods

Adjacent to the project are 58 residential homes, all located at the south-eastern tip of the property, described as the existing subdivision of Rhyne Park. There is also a home on the property, west of the existing subdivision, in which the former caretaker for the property lived when it was a sugar estate. The family of the former caretaker still lives on the property in that house. The remaining land consists of undulating uplands and limestone forest. The existing site has very limited social and civic infrastructure, and as such, the residents mainly use social infrastructure and amenities from the GMBA.

The current population of Rhyne Park is estimated at 200 persons, consisting of a fairly young population, mainly of a 25 - 39 age cohort. The majority of these persons are part of the labour force of the GMBA occupying middle-income level jobs in the tourism, banking and government sector.

The city of Montego Bay continues to be rapidly growing urban centre. The Population Census 2001, Jamaica (STATIN, 2003) indicated a population of 175,127 for the parish

of St. James and 55 percent (or 96,476 persons) located in Montego Bay its immediate environs (referred to collectively as the Montego Bay Special Area). The population of the GMBA was estimated at 98, 000 in 1995 with an annual growth rate of 2.5 percent, therefore an estimation of 128,584 in 2006.

Several informal communities characterize the GMBA, and contribute to the significant population movement over the past 15 years. In the Montego Bay Special Area, persons between the ages of 0–39 years account for 73 % of the population, and those in the 15-39 age cohort account for 40% (Environmental Solution Ltd, 2004). Community based interviews, confirm that this age distribution is also representative of the project area. The project will therefore be located adjacent to, and impact, a predominantly young population, with a high demand for social support systems including educational institutions, recreational facilities, day care centres and housing, which are very limited in the GMBA.

The male female ratio for the Montego Bay Special Area is 0.92. This compares with 0.959 for the entire parish of St. James and 0.958 for Jamaica (Environmental Solutions Ltd., 2004). Females outnumber males and the significance in employment and purchasing power may have some influence on affordability of the proposed housing units.

About 80,000 workers are estimated to commute and work within the GMBA on a daily basis, and population numbers rise with the introduction of cruise ship and stop-over visitors. Unemployment is a major problem in the GMBA. The Montego Bay Special Area experiences a 17 % average unemployment rate, which is 2 % above the national average. In the informal communities the figure increases to a high of 30 %. Tourism is the main economic base of Montego Bay, which has been described as an urban resort. Small family type businesses also play a major role in the economic base of Montego Bay and are vulnerable to high interest rates, corporate competition and inflationary impact. (Greater Montego Redevelopment Company, 1997).

5.4.2.1 Surrounding Communities

Rapid appraisal techniques and windscreen observations were used in 3 communities that are in close proximity to Rhyne Park. The communities observed were Barrrett Town, Spot Valley and Cornwall. The main characteristics of the surrounding communities are discussed in the following sections.

Barrett Town

Barrett Town is a low to lower middle, income community. The population of Barrett Town is in the order of 1,441 (STATIN, 2001) having grown by 20% over the last 10 years. About 360 dwellings and 47 small business establishments are found in Barrett Town. Barrett Town is largely a residential community with limited small scale trading activities mainly in food retail ad household services. The main occupations of the residents are based on domestic and artisan skills supplied to the tourism sector outside of the community. The community is served by a health clinic, a police station, a playing field, an all age school and a primary school.

The town receives metered piped water from the National Water Commission (NWC) and is supplied by an eight inch main. Several wells lie upland of the community, none of which is currently a source of water to NWC. Run off pits (30%) and pit latrines (70%) are the main sanitary conveniences used. Garbage disposal and collection is undertaken WPM Waste Management Ltd. Unauthorised dumping of garbage also takes place in the Boyce Gully (the main storm water discharge route to the sea). The main mode of public transportation for community members is by route taxis.

Spot Valley

Spot Valley is a low income unplanned community with informal residences of about 55 dwellings and 5 small shops that is part of the old Spot Valley estate lands. The population of Spot Valley is about 531 with a high proportion under age 35. Land use is mainly residential. Some small-scale back yard gardening is in evidence. Small business are mainly in food retail and household services. Main occupations involve domestic and artisan skills supplying services outside of the community.

The community is served by a church, a postal agency, a basic school and a sports field. The NWC provides metered water to the community. Run off toilets and pit latrines are the main sanitary conveniences used. Garbage is collected by WPM Waste Management Ltd. The main mode of transportation for community members is by route taxis.

Two large middle and upper income housing scheme developments are currently underway. One referred to as the Spot Valley Development will comprise 600 two-bedroom single units. It is also designed with a shopping arcade, fire brigade station, police post, taxi stand, bus station and a public park (incorporating the ruins of an old sugar factory). A further 500 individual houses and 700 town house and apartment units are also to be built as part of this development. West Indies Home Contractors, who are currently building a school in the community, are also planning a 500-600 two–bedroom lower middle income-housing scheme. These developments will significantly impact the growth and economic prospects of Spot Valley.

Cornwall

Cornwall is a low to lower middle income, unplanned community with about 200 residents, about 35 dwellings and 8 business establishments, mainly small food retail and other household services. No schools clinics or churches are present but there is a playing field.

The community is largely limited by small-scale trading activities, the most significant of which is a small hotel and guesthouse, catering to the tourist and local market. Water is supplied by the NWC. Run off toilets and pit latrines are the main sanitary conveniences used. Household garbage is mainly disposed of though burning and burying although the MPM collects garbage infrequently. The main mode of public transportation for community members is by route taxis.

5.4.3 Housing

Housing demand is highly influenced by the demographics and livelihoods in the GMBA. The growth of informal settlements has resulted from an inadequate supply of formal and planned housing and the need for available housing stocks, including low and middle income housing units. Town houses, single-family units, multi-family units and cluster housing are in short supply, and the provision of these categories will help to meet demand as well as rationalize the use of land in the urban area. It is estimated that the total housing need is 25,701 with a yearly requirement of 1285 units (Greater Montego Redevelopment Company, 1997).

The property is situated in close proximity to several low and middle-income communities. A number of squatter settlements are located outside the property to the north, namely in Barrett Town and Lilliput.

A similar housing development is underway in Spot Valley by West Indies Home Contractors (WHICON), providing 492 low to middle-income level housing solutions. Construction work began in 2005 and the proposed date for completion is in 2008 (Judith Bruce, Pers. Com.).

Relocation of the family of the former caretaker from the house on the property, has been identified as a key issue, and will be facilitated based on agreements between Rose Hall Development and Gore Developments Ltd.