Urban Environment Outlook 2009

GEO GEORGETOWN

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FOREWORD UNEP

The United Nations Environment Programme (UNEP) is pleased to present the urban environmental profile of the city of Georgetown - GEO Georgetown- which is the result of an initiative of the Mayor and City Council of Georgetown, implemented with the technical assistance of the School of Earth and Environmental Science of the University of Guyana and the UNEP.

The report was prepared using the DPSIR (Drivers–Pressure–State–Impact-Responses) conceptual framework of the Integrated Environmental Assessment methodology developed by UNEP, and applied for regional, sub-regional, national and city level assessments in Latin America and the Caribbean since 1995.

The GEO Georgetown report evaluates the interaction between the urban development and its impact on the environment. This report calls for action with regard to recognizing the nature, causes and impacts of the city's problems. It goes further, focusing on building a consensus and will to act to resolve these problems, considering specifically articulated scenarios.

At present, climate change is one of the main problems of coastal cities like Georgetown, located on a coastal plain where the geological and geomorphological characteristics of the soils, and the fact that the city is two meters below the sea level, exacerbate its vulnerability to flooding. Georgetown faces serious drainage systems problems increased by unplanned urban growth and the inland tidal effect that increases siltation along the coasts.

The report identifies the major sources of greenhouse gases such as the energy and agricultural sectors (from fossil fuels), landfill and household wastes, sugar cane burning, small and medium-size energy generators and motor vehicles, and highlights that greenhouse gases emissions are not monitored continuously.

Another problem confronting the city is related to the quality of natural water sources, soil contamination, and deforestation and degradation of mangroves affecting the marine and coastal ecosystems. Natural water sources are highly polluted, exceeding the standards of the World Health Organization. Improvements in sanitation, water quality and sewerage systems are needed to improve the living conditions of the population. The lack of access to drinking water and the deficiencies in sanitation in many settlements are responsible for the contamination of soils and water, as well as morbidity and mortality of the population of Georgetown. Some diseases like malaria, dengue, lymphatic filariasis are due to the main sanitation conditions.

GEO Georgetown presents scenarios on three selected themes, namely disaster preparedness, solid waste management and urbanization/migration, developing a vision with regard to framing policy, infrastructure, institutional capacity, citizen awareness and compliance. It recommends an intra and inter agency coordination to: promote and facilitate the orderly development of secondary towns; enhance public environmental awareness and education; build institutional capacity; enhance legislation and enforcement; and to prepare community and National Disaster Preparedness and Management Plans.

With the preparation of the GEO Georgetown report, UNEP hopes that local decision makers, university students, environmental consultants and all those working in fields related to sustainable development can use this valuable tool to improve the quality of life of the city residents.

Margarita Astrálaga
Director, Regional Office for Latin America and the Caribbean,
United Nations Environment Programme (UNEP)

FOREWORD Mayor and City Council

The city is the principal evidence of man's impact upon nature - concentrations of people covering an expanse of land in high-intensity use and high-intensity investment in the direct alteration of the environment. In modern societies, particularly the most developed, cities have become the supporters and organizers of the economy. So it is - Georgetown is the principal supporter and organizer of Guyana's economy.

This report demonstrates that the city is the vehicle of social, economic and cultural control and of administrative rule. It is the center of demand for the exchange of goods and the center for the accumulation and use of value and wealth. It is the center for the creation and support of cultural, educational and artistic institutions. As the center of control and culture, Georgetown is also the focus for passing on the traditions of Guyanese society.

Yet, the city is also the means for change in society – and can be the source of unrest, social ferment and even violence. It is also a forum for raising awareness of the damage that can be caused to the environment and to society, if care is not taken in managing the resources and controlling land use.

The foregoing realities of a city, suggest some of the challenges that confront the Mayor and City Council, in supporting the many roles, functions and activities of the citizens and their organisations.

The Mayor and City Council welcomes this report, first of all because it reminds us of the importance of the city and secondly because it highlights one aspect of the challenges facing Georgetown – how to occupy this small space on the coast of Guyana without compromising the ability of the natural and man-made environment to support the uses to which they are put. Through-out Georgetown's functional evolution: from military outpost, to port, to capital city, the natural environment has been "inhospitable". Inhospitable due to its swampy conditions and hence the adverse health conditions prone to mosquito bourne diseases; uncomfortable due to the high temperatures and humidity etc.

These conditions have not changed over the past 400 years, and yet people continue to occupy this stretch of land for business, pleasure, administration and education. They have invested and developed the city to provide it with a distinctive character, charm and even comfort. This is no easy feat, and the Mayor and City council endeavours to be actively involved in facilitating the efforts of citizens and ensuring the equitable enforcement of regulations that protect and preserve the environment of the city for the benefit of this and of succeeding generations.

This publication of the GEO Cities Report for Georgetown must be of interest to all citizens at home and abroad, since it should awake us to the social, economic and aesthetic value of our environment and hopefully, challenge us to play some meaningful part in enhancing our Capital.

Hamilton Green; JP
Mayor
Georgetown City Council
Guyana

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The team was assisted by Shane Singh. Editing was by Denise de Souza and Dr Bynoe was the principal editor. The work was carried out under the general direction of UNEP/ROLAC, including: the director - Margarita Astralaga, Kakuko Nagatani, Emilio Guzman, Patricia Miranda, Graciella Metternicht and Cinthia Soto.

Many others in and out of the stakeholder group provided helpful comments and contributions, including Dr Roger Luncheon and Mayor Hamilton Green. Institutions that were also helpful: Office of the President, Guyana, University of Guyana, Central Housing and Planning Authority, Georgetown Mayor and City Council, and the Environmental Protection Agency

Preparation of the Report was greatly aided by background papers and by contributions from participants in the consultation meetings.

ACRONYMS AND INITIALS

CH&PA	-	Central Housing and Planning Authority
ECLAC	-	United Nations Economic Commission for Latin America and the Caribbean
EMC	-	Environmental Management Consultants
EPA	-	Environmental Protection Agency
GDP	-	Gross Domestic Product
GFC	-	Guyana Forestry Commission
GEO	-	Global Environmental Outlook
GFR	-	General Fertility Rate
Gg	-	Gigagram
GNBS	-	Guyana National Bureau of Standards
GWI	-	Guyana Water Incorporated
HDI	-	Human Development Index
IAST	-	Institute for Applied Science and Technology
IDB	-	Inter-American Development Bank
ILAC	-	Latin American and Caribbean Initiative for Sustainable Development
IMR	-	Infant Mortality Rate
IPPS	-	Industrial Pollution Projection System
ITCZ	-	Intertropical Convergence Zone
Kg	-	Kilogram
KWh	-	KiloWatt hour
M&CC	-	Mayor and City Council
NDIA	-	National Drainage and Irrigation Authority
NEAP	-	National Environmental Action Plan
NDS	-	National Development Strategy
NMVOC	-	Non-methane Volatile Organic Carbon Compounds
PAHs	-	Polycyclic Aromatic Hydrocarbons
PMTCT	-	Prevention of Mother to Child Transmission
PSIR	-	Pressure-State-Impact-Response
RDB	-	Regional Democratic Board
SEES	-	School of Earth and Environmental Sciences
SWM	-	Solid Waste Management
TFR	-	Total Fertility Rate
UNCCD	-	United Nations Convention to Combat Desertification
UNDP	-	United Nations Development Programme
UNEP/ROLAC	-	United Nations Environmental Programme/Regional Office for Latin America and The Caribbean
VOC	-	Volatile Organic Compound
VYC	-	Volunteer Youth Corps
WHO	-	World Health Organisation
WSSD	-	World Summit for Sustainable Development

EXECUTIVE SUMMARY

This Report seeks to link urban development to its impact on the environment, and goes on to initiate a call to action with regard to recognizing the nature, origins and consequences of the city's problems. It goes further, and focuses on building a consensus and will to act to resolve these problems around specifically articulated scenarios.

In **Chapter 1**, the geography of the city is presented. Located as it is on the northern coast of South America, roughly 6° north latitude, at the mouth of the Demerara River the city has a peculiar set of challenges and realities that have to be addressed, if not immediately then in the near term, such as floods, global warming and sea level rise, sustainable management of resources such as fresh water, and a wholesome physical environment, as well as its flora and fauna. The location of Georgetown also gives it a climate that requires specific responses in its infrastructure development and maintenance including its drainage, architecture and communications. The location and physical assets also present the city with certain roles and functions – as a port, as the capital city, and as the center of national administration, commercial and financial activity. As home to all these activities as well as to its citizens, the municipality faces a number of challenges.

The state of the city's environment – climatic, air quality, water, land and built - is reviewed in **Chapter 2**. Climatically, the city experiences a hot humid climate – with high but constant temperatures – 30 °C maximum and on average 24 °C at a minimum. Rainfall is also high, and shows an upward trend over the past decade, reaching a high of 3500 mm in 2008. There are nonetheless periods of drought which challenge the water management of the authorities. The hours of daylight are constant at about 7 hours and relative humidity is high at an average of 80 per cent.

Traditionally, monitoring of impacts has not been emphasized since the problems were seen to be minor in the past. Guyana as a whole is a net sink for carbon dioxide, – but this cannot be ascertained or suggested for the city. Findings show that the air quality is good, being largely uncontaminated by VOCs, and given the low level of industrial activities. However, from time to time, contamination occurs from combustion of fossil fuels by the Power company, solid waste by households and at the landfill sites, and sugar canes by GuySuCo - creating a high level of airborne particulate matter and obnoxious smoke.

Generally speaking, and for a number of reasons, not least of which is the 500 percent expansion of the city, over the past 100 years shortage of resources to address the consequential challenges, and low average incomes of its citizens, the city seems to have lost control of solid waste management, treatment and disposal of waste water, and production and distribution of safe potable water. Squatting and inner city decay as well continue to present an intractable set of problems.

The impact of the situation in the city on the natural ecosystems, the quality of life of the urban population, the built environment and economic activities is examined in **Chapter 3**. The build-up of refuse in the streets, clogged drains and canals and excessive flooding during the rains gives a general atmosphere of neglect and decay in the city. But worse than this, is the increased vulnerability of citizens to water and vector borne diseases, such as yellow fever, dengue fever, filariasis, hepatitis and various infectious intestinal and diarrheal diseases. There are also reports of high levels of respiratory difficulties in communities in close proximity to sources of air pollution such as the land fill site.

So far the environment seems to be able to absorb chemical pollutants without accumulations to dangerous levels. That said, there are signs that weak regulations and weak enforcement of regulations could inadvertently be leading to a growing problem, in which the actions of the irresponsible few can have a negative impact on significant numbers of citizens. The outcries of the victims, to the extent that these fall on deaf ears can lead to other complications, such as expanded illegal activities and possibly vigilante type responses. At the very least the demonstration effect of poor solid waste management elicits its

own response from the citizens. There is substantial evidence that the situation in the city has increased vulnerability to natural disasters including floods and inundation from sea waters; droughts and fires.

Even with the growing volume of vehicles and road traffic, little attention seems to have been given to the impact of noise. Noise is not simply a nuisance affecting quality of life; it also affects health and can damage physical structures. These challenges are touched on in the Chapter.

In just about every instance, the resolution of problems has been very much at the level of the individual household, company or the isolated community. This issue is examined in **Chapter 4** - which explores responses to the state of the environment. To guarantee themselves a continuous and reliable supply of potable water has meant considerable investments by citizens in tanks and pumps. Similarly to ensure a reliable supply of electrical power, large investments in generators and other standby systems had to be undertaken, particularly by manufacturing and commercial enterprises, creating another set of environmental impacts. The actions of both state and non-state actors are looked at, including the academic community and a few NGOs. Attention to the preparedness for flood events and other natural disasters is looked at as well.

Chapter 5 selects three themes: Disaster Preparedness, Solid Waste Management and Urbanisation/ Migration and formulates possible scenarios for the future. The chapter develops a vision of what is likely to be the worst case, a moderate case and a best case scenario for each of the themes with regard to framing policy, infrastructure, institutional capacity and citizen awareness and compliance.

In bringing together the assessments of various stakeholders with the prognostications from brainstorming sessions and creation of worst, moderate and best scenarios, a number of themes for action emerge in **Chapter 6**. In the deliberate judgment of the stakeholders, the city of Georgetown is at high risk due to the state of the infrastructure, and the lack of disaster preparedness, the poor institutional capacity, the inadequacy of the legal framework, and the low awareness levels of citizens. Moreover the city has not just lost its ability to manage but it is also the recipient of problems passed on by secondary towns and rural areas and the disfunctionalities of national politics.

The Chapter presents a set of proposals on seven priority Goals, with required actions, instruments and resources available to realize the goals. The Goals include: Building Institutional Capacity, Updating Legislation, Political Support and Will, Disaster Preparedness, Inter- and Intra- Agency Coordination, Public Awareness and Education and Development of Secondary Towns.

Given all the above it is expected that study and dissemination of the Report will lead to enhancement of local technical capacity and build consensus around a unified vision for the future of the city.

INTRODUCTION

Based on Decision 23/10 of the UNEP Governing Council, Decision 11 of the XIII and XIV Meetings of the Forum of Ministers of Environment of Latin America and the Caribbean, as well as the Latin American and Caribbean Initiative for Sustainable Development (ILAC), with its link to the Plan of Implementation of the World Summit on Sustainable Development (WSSD) of Johannesburg, the Mayor and City Council and the School of Earth and Environmental Sciences (SEES) of the University of Guyana, with support of UNEP, decided to conduct an Urban Environmental Assessment of Georgetown. While the project has been facilitated by the Office of the President, the technical partners are the Mayor and City Council and the University of Guyana, as shown in Figure 0-1 below. The UNEP facilitators at the workshop, however, stressed that the usefulness of the GEO City assessment depended on how much the city wants it to work.

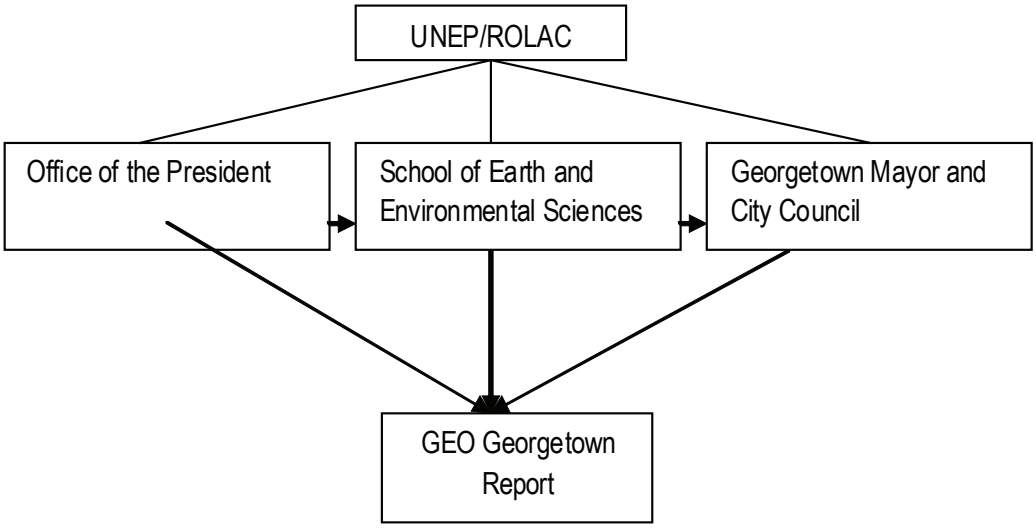


Figure 0-I: *GEO Georgetown Project: Stakeholders Relationship*

OBJECTIVES OF THE PROJECT

The objectives of the project were to:

- Recognize the links between environmental conditions and human activities, especially those related to urban development.
- Contribute to building local technical capacities that will permit integrated assessments to be made on the state of the urban environment.
- Guide consensus building on the most critical environmental problems in each city by encouraging all sectors of societies to engage in dialogue and participate in the decision-making-process.
- Make it possible to formulate and implement urban strategies and plans that will help cities improve urban environment management; and finally
- Encourage the creation of institutional networks in the city.

Conducting the assessment, as part of the process of preparing the GEO Georgetown, required that the GEO Cities Methodology, be closely followed. To this end, a workshop on the methodology was held on July 11 – 13, 2007 at the Ocean View International Hotel with the following objectives:

- To provide information to participants in this assessment on the GEO Cities Methodology;
- To identify the main problems that the city faces;

- To propose possible solutions, as well as to discuss the current governmental and municipal policies;
- To discuss the current institutional arrangements for urban management in Guyana; and
- To define indicators which will be used in the assessment, using as a reference the indicators in the GEO Cities Methodology, as well as of the ILAC.

A verification workshop was held on October 30, 2008. The purpose of which, was to provide an opportunity for representatives of different institutions to be apprised of what assessments had been done, what information had been provided, what were the gaps, how institutions could help to fill those gaps and put forward recommendations on what might be the best way to proceed.

BACKGROUND TO THE PROJECT

Since 1995, the United Nations Environmental Programme has been conducting an ambitious environmental assessment project known as Global Environment Outlook. GEO Cities Project was launched in 2001, responding to requests of the Forum of Ministers of Environment of Latin America and the Caribbean and to the activities related to the Johannesburg Summit. The project aims at promoting a better understanding of the dynamics of cities and their environs, providing local government, scientists, policy-makers, and the public in the region with reliable and up-to-date information about their cities.

GEO CITIES METHODOLOGY

In the methodology, the analysis focuses on the interaction between urban development and the environment, assessing it using the PSIR (Pressure-State-Impact-Response) Matrix (See Appendix 1). However, to make it more contextually relevant to Guyana, the GEO Matrix (in Appendix 2) provides a localized scenario.

CHAPTER ONE: BRIEF OVERVIEW OF GUYANA

1.1 Geography and Geomorphology

1.1.1 Location

Guyana is located spatially between 1° and 9° North latitude and 57° and 61° degrees West longitude. It lies along the north-eastern coast of South America and it is bounded to the southeast by Suriname, south and southwest Brazil; northwest Venezuela and north the Atlantic Ocean (Refer to Figure 1.1). The country occupies an area of 216,000 km^2 and has a coastline that is approximately 430 km long and a continental extent of about 724 km, according to the Integrated Coastal Zone Management Action Plan (2000). Guyana is divided into four geomorphologic regions namely: Coastal Plain, Sandy Rolling Land, Pakaraima Mountain Region, and Pre-Cambrian Lowlands; each with intriguing geomorphology, soil, geology and vegetation (Daniel, 2001).

Figure 1.1: *Location of Guyana within South America*
Source: Environmental Protection Agency, Guyana

Georgetown, estimated population 134,497 (2002 Guyana Census), is the capital and largest city of Guyana, located in the Demerara-Mahaica region (Figure 1.2). It is situated on the Atlantic Ocean coast at the mouth of the Demerara River and it was nicknamed 'Garden City of the Caribbean.' Georgetown is located at 6°48'N Latitude, 58° 10' W Longitude.

Figure 1.2: *Location of Georgetown*
Source: http://countrystudies.us/guyana/21.htm

1.1.2 Topography

The effect of the forces of orogenesis, erosion, deposition, weathering, and denudation produce variations in the appearance and nature of the land surface (Bernard, 1999; Strahler and Strahler, 1994). Regarding the various land surfaces, known as landforms, Guyana can be divided into four types: Highlands, Central Peneplane, Sand Belt, and Coastal Lowlands as shown in Figure 1.3.

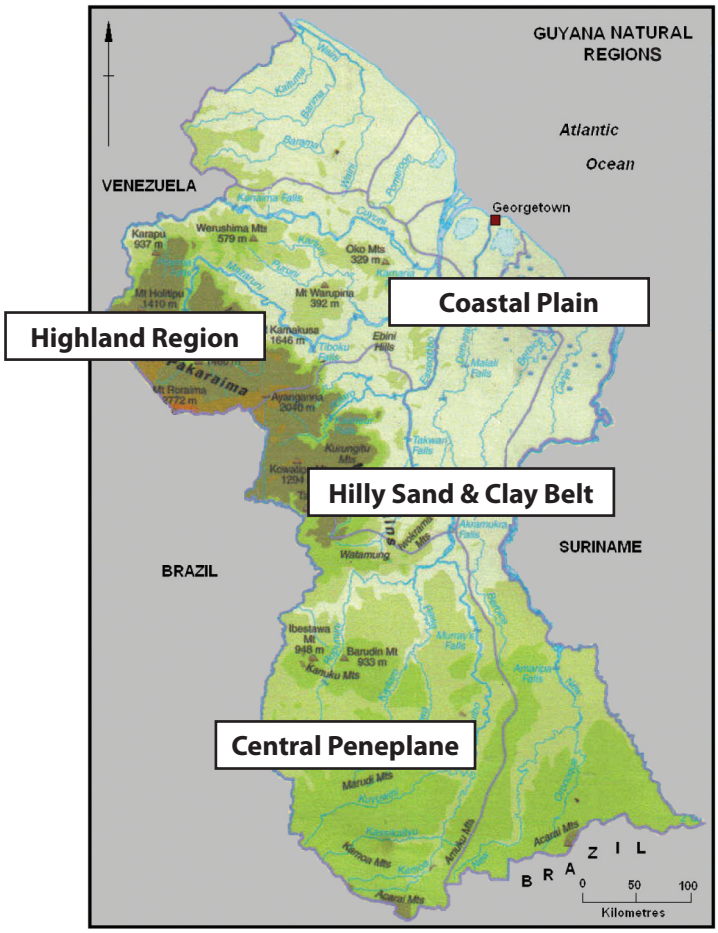


Figure 1.3: *Guyana's Natural Regions*
Courtesy: C. Foo, SEES, University of Guyana

The Highlands occupy the mid-western portion of Guyana and extend for 30,000 km^2 or 14 per cent of the surface area of 216,000km^2. They are part of a mountainous area which extends to Venezuela and Brazil called the Guiana Highlands. The portion of highlands which lies in Guyana is known as the Pakaraima mountain range. One of its peaks, Mt. Roraima, is the meeting point between Guyana, Venezuela and Brazil and at 2,773 metres is the highest point in Guyana. Landforms found in this region are plateaus, escarpments, gorges, waterfalls and rapids.

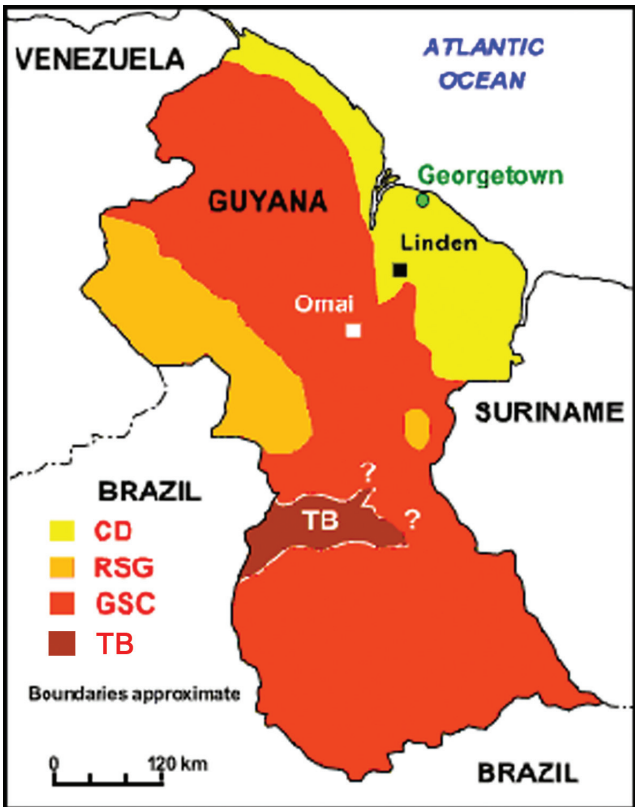
The Central Peneplane occupies more than half of the area of Guyana (143,520 km^2) and extends from the white sand belt to Guyana's southern boundaries. The land is 'gently rolling' rather than flat and it reaches 300 metres in the north and 900 metres in the south. In general, however, the land varies from 90 to 200 metres above mean sea level. Landforms found in this region are ridges, hills and rock outcrops, sills, dykes and inselbergs.

The Sand Belt extends from the coastal plain southwards to the central peneplane. It occupies 12 percent (25,800 km^2) of the country's surface area. The sand belt is more extensive on the eastern side of the country where it stretches for over 300 km from north to south; it is much less extensive at the western end of the country, disappearing altogether in the northwest. Landforms found in this region are ridges, flat hills and gently sloping hillsides.

The Coastal Plain occupies a mere 7.5 percent (16,125 km^2) of the country. It is wider to the east of the country where it is approximately 77 km in width, whereas it is only 26 km wide at the western end. The land is generally 2.5 metres below mean high tide sea level. Landforms found in this region are sand ridges/ cheniers, mudflats and sandbanks.

1.1.3 Rock Formation

In Guyana, the rock types vary from crystalline basement complex rock of the Pre-Cambrian era to the unconsolidated sediments formed during recent times. The Pre-Cambrian rocks made up of varied formations of sedimentary and igneous origin underlying much of Guyana, dip in a northerly direction and extend below the continental shelf. They have been subjected to metamorphism, tectonics and sub-aerial processes of weathering and erosion throughout the geologic history. Slightly metamorphosed sedimentary rocks known as the Roraima Formation probably dating back to the late Pre-Cambrian era overlie the basement complex rocks in the mid-south western part of the country (Refer to Figure 1.4). The unconsolidated sediments laid down in comparatively recent periods overlie the basement complex on the coastal and near inland areas. The Roraima formation consists of pink, yellow and white sandstones, red quartzites, green, black and red shales, conglomerates and boulder beds (Funk, 2004). Elsewhere the basement complex is buried beneath a thick mantle of weathered materials except on riverbeds and steep slopes where the bedrock is exposed (Daniels, 2001).



Legend

CD - Coastal Deposits (Cretaceous - Recent)
TB - Rocks of the Takutu Basin (Jurassic - Cretaceous)
GSC - Rocks of the Guiana Shield Complex
RSG - Roraima Super group (Precambrian)

Figure 1.4: *Location of the Dominant Rock Formations*
Source: www.guianashield.org/joomla/index

The Demerara Formation section of the Coastal Plain, on which Georgetown lies, is covered mainly by soft blue clays of the young Coastal Plain dating from the Pleistocene Period to the Holocene Period and the old Coastal Plain by mottled and leached clay of the Coropina Formation of the Pleistocene Period (Daniel, 2001) (See Figure 1.5 below). The surface water drainage in Georgetown is hampered by underlying, impervious clay soils and a resultant flat topography and elevation at about or below mean high water level. The unconsolidated sedimentary rocks were laid down during different phases of geologic history. The young Coastal Plain does not rise more that 2.5 m above the mean sea level and in areas where Georgetown is located it is approximately 1.5 m below mean high tide sea level.

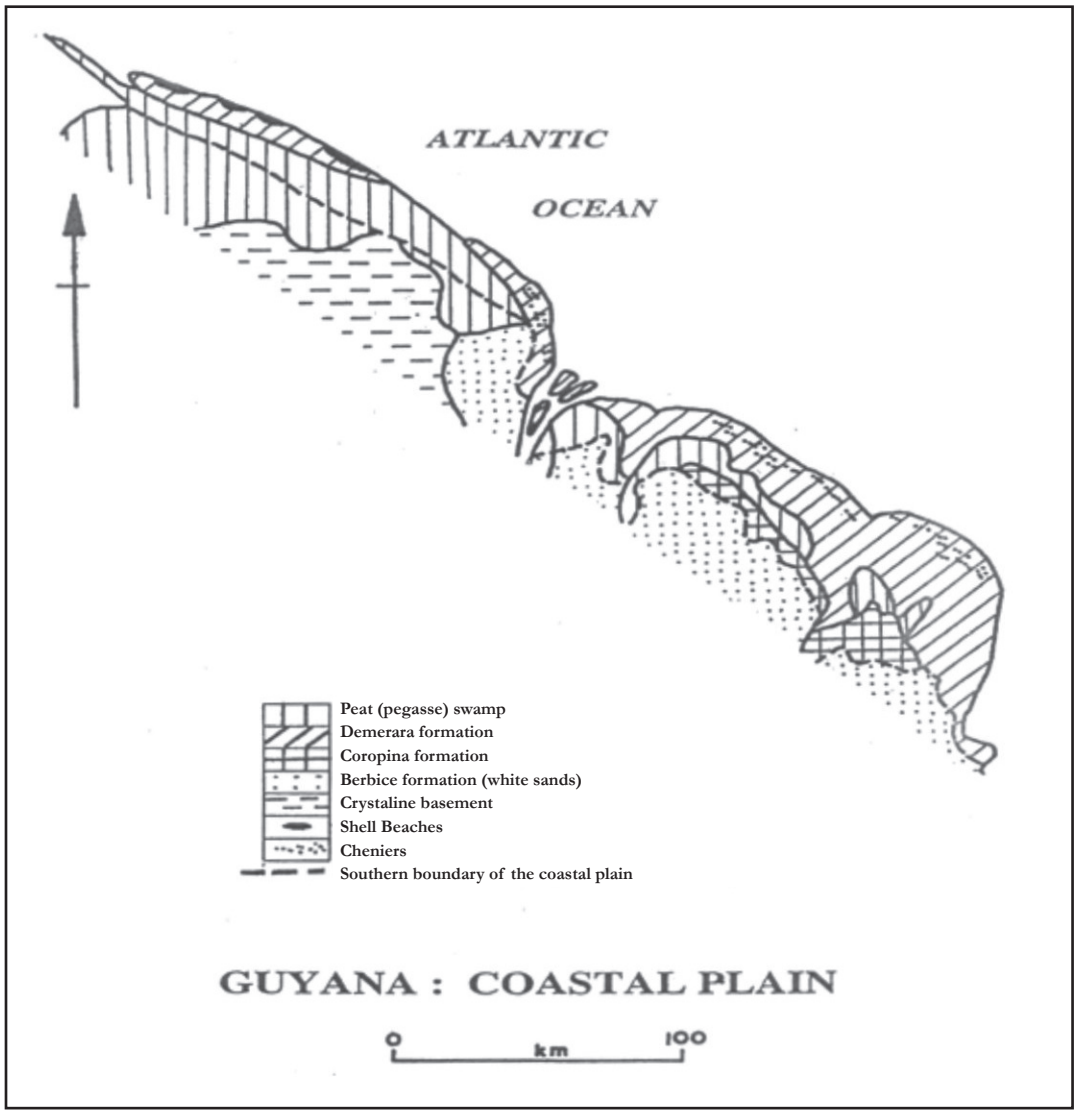


Figure 1.5: *Geomorphology of the Guyana Coast*
Source: Daniel 2001

The geologic and geomorphologic characteristics of the coast make Georgetown vulnerable to flooding. Firstly, the area is below mean high tide sea level and becomes submerged during periods of heavy rainfall or when there are sea defence breaches during high tide. Secondly, clay soil drains poorly and allows water to accumulate much quicker and remain on the land much longer thereby giving rise to flooding. Thirdly, the gradient of the land slopes from the more elevated old Coastal Plain in the south to the Atlantic Ocean where the built up sea defence structures exist. This creates a slight depression that allows flood waters from the backlands to move northwards and to accumulate in the housing areas in Georgetown.

1.1.4 Vegetation

The natural vegetation of Guyana can be divided in seven major classes – rain forest, seasonal, dry evergreen, montane, marsh and swamp forests; and savannah as illustrated in Figure 1.6. Much of Guyana is covered with tropical rainforest, a continuation of the Amazon forest. This type of vegetation extends from the lower slopes of the Pakaraima Mountains to the coastal belt in the north-western part of the country. It also occurs in the areas drained by the upper Demerara and Middle Essequibo Rivers. Seasonal forests are located on well drained sites and areas with long dry seasons for example, the intermediate savannahs in the mid- eastern section of the country. Dry evergreen forest grows in areas where rainfall is high but the soil is excessively well drained such as the southern part of the White Sands area and some areas in the south-eastern part of the country (Daniel, 2001 & Bernard, 1999).

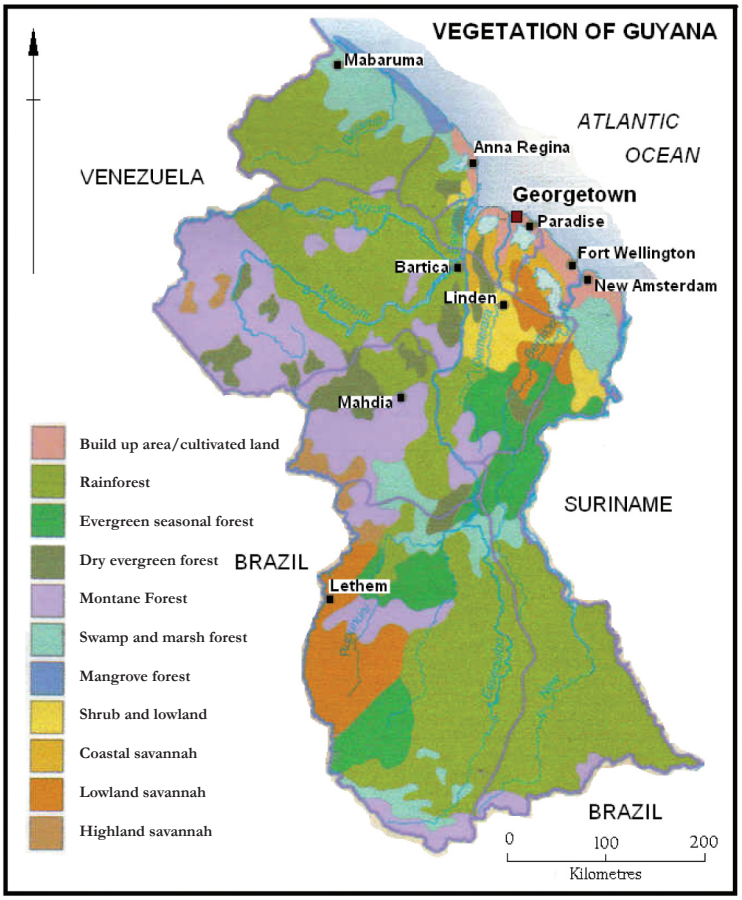


Figure 1.6: *Vegetation of Guyana*
Courtesy: C. Foo, SEES, University of Guyana

The montane forest is found on the Pakaraima and Kanuku Mountains. These forests are affected by both the high altitude and high rainfall, and also the poor soil conditions. Marsh forest grows where the soil is very wet or flooded for part of the year and very dry at other times. This type of forest is found extensively on pegasse swamps and under other wet conditions, they are found mainly on the northern and southern sections of the coastal region. Swamp forests are found where the soil is usually waterlogged and rarely dry. Examples include the mora forest found in wet conditions and the mangrove forests growing on the coast and in the brackish waters of the major rivers. Savannah vegetation is found where there are long annual dry seasons and poor soils such as the Rupununi and the intermediate savannahs (Bernard, 1999).

Georgetown is virtually void of natural vegetation. The prevalent vegetation found in Georgetown is cultivated flora, trees that line many streets and only few scattered remnants of mangroves remain north

of the sea defence structures and along major drainage canals. Residents continue to plant cash crops (mainly vegetables) for subsistence and/or commercial use and flowering trees and shrubs to beautify the environment.

1.1.5 Climate

Guyana has a tropical climate with almost uniformly high temperatures and humidity, and much rainfall. The country experiences a mean temperature of 26.8 °C in coastal locations and 27 °C in the Rupununi Savannahs. Coastal locations are generally 2 - 4 °C cooler than hinterland areas due to the influence of the Atlantic Ocean (Bernard, 1999).

Rainfall is heaviest in the north-west and lightest in the south-east and interior. Annual averages on the coast near the Venezuelan border are near 250 cm, farther east at New Amsterdam 200 cm; and 150 cm in the Rupununi Savannah in the south. Areas on the north-east sides of mountains that face the trade winds average as much as 350 cm of precipitation annually (Guyana's climate, www.hydromet.gov.gy/climate).

Unlike the temperature, seasonal variability is the dominant characteristic of rainfall in coastal Guyana, with two distinct wet seasons and two dry seasons in general. The bimodal annual rainfall distribution pattern experienced along the coast, where Georgetown is located, is a result of the annual meridional migration of the Inter-tropical Convergence Zone (ITCZ). The northward movement of the ITCZ generally brings heavy rainfall between mid April and ending of July, with a major peak of rainfall in June. This is referred to as the primary wet season. During the southward migration the ITCZ, a second wet season is observed between mid November and the end of January, with peak rainfall in December.

Guyana is subjected to winds which blow from the sub-tropical high pressure zone. As the North East Trades approach the Equator, they assume a more easterly direction and reach Guyana from the east-northeast. This accounts for 60 percent of the winds that affect Guyana and is occasionally accompanied by winds from the north and southeast. Average wind speed ranges from 12.2 kph (kilometres per hour) in Georgetown (coast) to 1.3 kph in the Pakaraimas (Bernard, 1999).

For the year 2009, average annual temperature was constant with a maximum of 27.5 °C in August and a minimum of 26.4 °C in June as shown in Figure 1.7(a). The highest temperatures ever recorded for Georgetown were usually in July. Seasonal variations in temperature are slight in Georgetown. January and August were recorded as the wettest and driest months respectively, with averages of more than 450 mm and less than 50 mm rainfall (Refer to Figure 1.7 (b)).

Figure 1.7 (a) *Mean Monthly Temperature for Georgetown (2009)*

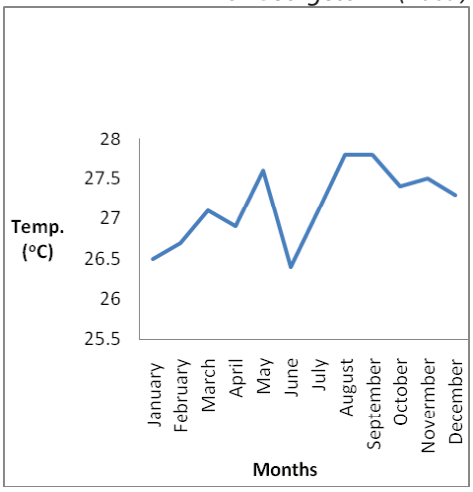
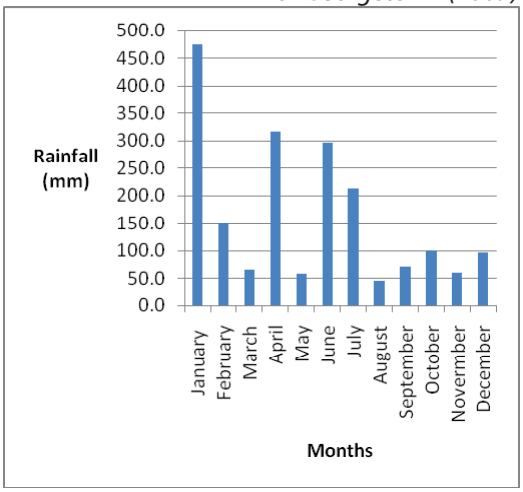


Figure1. 7 (b) *Mean Monthly Rainfall for Georgetown (2009)*



Source: Data from Hydrometeorological Office, Botanical Gardens

1.1.6 Marine and Tidal Effects

Guyana's coastal zone consists of a low-lying system of marine and riverine deposits which formerly comprised an extensive network of tidal deltas. The origin of the coastal sediments includes discharge from local river systems and a large sediment load that is transported from the Amazon River northward along the northern coast of South America by the Guiana current. Much of the land now in use in the coastal zone is below the mean high tide level which is around 16.6 m (54 ft) Guyana Datum (GD). This land was reclaimed from tidal areas and is protected by an intricate network of seawalls, dykes, polders and drainage structures (Westmaas, 2005; Daniel, 1991). The coastline along Georgetown is relatively straight with a marked absence of beaches, headlands, bays and inlets.

The coast experiences wave heights above 3.5 m about 2 percent of the time. More usual wave heights of 2 m occur from December to June and between 1 m – 1.5 m from July to November. Wave energy is considerably reduced on the coast because of the continental shelf width that extends for an average of 140 km. According to Daniel (2001), the tide is semi-diurnal and averages about 2 m near Georgetown. However, between the months of November and February when higher than average spring tides occur due to atmospheric conditions, the tidal effects are felt as far as 80 km to 100 km inland in the Demerara River. The combined effects of low wave energy and the inland tidal effects increase siltation along the coast and in the estuary of the rivers such as Demerara River where Georgetown is located. This has the effect of reducing both the capacity and rate of flow of the drainage systems, especially during periods of heavy rainfall giving rise to flood waters overtopping levees and escaping into inhabited and cultivated areas. In an attempt to off-set this problem, very expensive high-powered drainage pumps, as indicated in Plate 1.1 below, are installed to dispel flood waters beyond the concrete sea defence structures.

Plate 1.1: Example of Drainage Pumps Installed Along the Coast
Source: www.bryanmaxx.netfirms.com

1.1.7 Drainage System and Vulnerability

The drainage system of Region Four, in which Georgetown is located (see Section 1.3 Administration and Social Overview for more information on the administrative structure of Guyana), is dominated by two major

rivers, the Demerara and the Mahaica which form the western and eastern boundaries of the region and the tributaries that are linked to them. The southern part of the region is fairly hilly and comprises white sands which allow for good drainage. The northern part of the region, on the other hand, is made up of pegasse and has poor drainage. The drainage system in this part of the region is interrupted by a number of man-made structures to facilitate drainage during periods of heavy rainfall and for the irrigation of crops as well as the provision of water supply for domestic and industrial use during periods of drought.

Impervious areas within Georgetown increased by 50 per cent between 1963 and 1993, raising the volume of run-off channeled through Georgetown's drainage system. At the same time, drainage capacity has been reduced due to the infilling of canals and drains, inadequate maintenance of the existing network, the use of drains for informal/illegal refuse disposal and the use of drainage reserves for informal housing and petty-agriculture. Since 1989 uncontrolled urban expansion into un-serviced areas has similarly increased city vulnerability to flooding from high rainfall events (Halcrow, 1994a). Sea-level rise will further reduce the efficiency of the city's gravity drainage (Camacho, 1994; Swedeplan, 1995) and may induce a rise in ground-water level. Climate change adds further uncertainty to hydraulic systems, with global warming being associated with increased precipitation (Fowler and Hennessy, 1999). The city is currently protected from riverine and coastal flooding by defensive walls but regularly experiences widespread flooding following biannual, seasonal rains.

1.2 History

1.2.1 Evolution and characteristics of the city

The evolution of the capital city began on December 10, 1781 by way of proclamation from the British Governor Lieutenant/Colonel Robert Kingston after the Dutch surrendered Demerara to the English. Lieutenant/Colonel Robert Kingston was responsible for erecting Fort St. George near the mouth of the River on the Company Path – approximately the present location of the Museum. It was also decided that the seat of Government should be located there and an office was erected that same year.

However, on January 31, 1782, a squadron of French men-of-war (allies of the Dutch) demolished Fort St. George and the English occupiers were forced to surrender. The French Commander then issued a proclamation on February 22, 1782 stating that it was "... considered necessary to establish a Capital that would become a business centre." Thus, two canals were dug running eastwards. They were the North Canal (Croal Street) and the South Canal (Hadfield Street). These canals formed two lines looking onto a Middle Dam between them with 13 lots on either side. This Dam was called Rue Royal (Brickdam). There were no cross streets. The Capital was called La Nouvelle Ville or Long Camps.

The colonies of Demerara and Essequibo were restored to the Dutch in 1784 and the Dutch West India Company by way of resolution on September 14, 1784, named the new town Stabroek. This was after the president of the company – Nicolas Geevink, Lord of Castriaiam, Brickum and Stabroek. On May 5, 1812, when Demerara, Essequibo and Berbice were finally passed to the English, it was ordained, "... that the town formerly called Stabroek (small town) be named George Town ...", after the then reigning Sovereign George III. On March 1, 1837 an Ordinance was passed abolishing the board of Police of Georgetown and providing for the appointment of a Mayor and Town Council, which consisted of eleven elected Councillors, one for each ward.

Georgetown was raised to the rank of a city with the colony being declared a Bishop's See by Queen Victoria on August 21, 1843. At the beginning of the 19th century, Georgetown consisted of three areas: Stabroek, Werk-en-Rust and Robbstown-Newtown. In 1852, Lacytown was incorporated into the City. The residential areas were extended to former plantations Vlissengen and Bourda before the 1880's. By 1970, the city had grown to approximately 6.5 km^2 (2.5 sq. miles) due to urban development. On April 29, 1970, under the

Municipal and Districts Councils Act, Chapter, 28:01, Greater Georgetown came into being. This extended the City from 6.5 km^2 (2.5 sq. miles) to 39 km^2 (15.0 sq. miles) encompassing Cummings Lodge on the East Coast of Demerara and Agricola on the East Bank of Demerara (Greater Georgetown Development Plan, CH&PA, 2001).

1.2.2 Planning for Georgetown

Evidence suggests that physical planning was done as early as the 18th century for Georgetown, by the Dutch initially and later executed by the British. Since all efforts in planning were directly related to the physical development of the city, the other aspects, such as demographic, social and economic planning, and addressing future development needs, were given limited consideration. Piecemeal expansion of the city was done wherever this was physically possible.

In the early 20th century, plans for Georgetown were made by the city engineer and there was no planning legislation in existence. Sanitary and fire regulations were the main focus of plans. It was only in the mid 1940s, following the outbreak of diseases and disastrous fires highlighting the importance of these matters, that serious thought was given to urban planning laws. With the Town and Country Planning Ordinance enacted for Georgetown in 1945 and in 1948, a conscious effort was made to control land use and building development in Guyana. In Georgetown special acts for better regulations were passed after the fire in 1945 destroyed Newtown. Increased widths of the streets and distance between buildings made of bricks were encouraged.

In 1950 a plan for Georgetown was made and, as in the past, physical planning was emphasized with regard to issues such as traffic problems and urban design. In the 1970s however, a comprehensive approach to planning was attempted in Georgetown when recommendations were made for the future development of the city, taking into account land utilization and zoning, communications, civic development and amenities.

Today, under the Greater Georgetown Development Plan, which was approved in 2004, changes have been made in the land use-zoning classification. No longer are there strict zoning regulations and detailed descriptive documents, but there are more general statements and planning principles that are used to interpret and manage development, providing some flexibility in the type of development that can occur.

1.2.3 Land use

At its birth in 1781, the main function of Georgetown was mainly to house the headquarters that linked the colony to Europe. It later developed into a meeting and business centre for the colonists who traded with ships that entered the port. This activity led the colonists and traders to acquire land space to build warehouses north of Stabroek along the right bank of the Demerara River.

The river bank south of Stabroek, from Werk-en-Rust to River View, Alexander Village was (and still is) utilized for industrial and manufacturing activities. The Houston-Agricola area, after 1970, was incorporated into Georgetown. This area was utilized for residential, commercial and industrial activities. Also, with the acquisition of new lands, the Industrial Site was developed to cluster industrial activities so that benefits could be derived from agglomeration, to accommodate new industrial developments and to protect other parts of the city from noise, air, and water pollution.

Like industrial and manufacturing activities, commerce evolved and developed over time, centralizing within and around Water Street. Gradually commercial strips evolved and these areas included Werk-en-Rust, Robbstown, Bourda and to a lesser extent Cummingsburg and Kingston.

The Central Business District (C.B.D.) is concentrated along major roadways such as Regent Street, Water

Street, High Street and Camp Street refer to Figure 1.8 following). In these areas, land space is utilized to almost its maximum limit by a cluster of diverse commercial activities which can easily be identified as the economic heart of the town. Almost every building is put into maximum use in these areas including stores and offices. The vertical zoning system found there (Harris 1945), utilizes the ground floor for retailing while upper floors are used for residential purposes.

A number of areas were utilized for recreational purposes. The southern part of Parade Ground was used by the Georgetown Cricket Club which was founded in 1885, and was later abandoned when a new cricket ground was established at Bourda. The new cricket ground still remains the Georgetown Cricket Club ground. The southern part of the old Parade ground was renamed Independence Park in 1966. The northern portion of the old parade ground was converted, along with other lots near New Market Street into the present Promenade Gardens. The land for the Botanic Gardens was purchased, and trees were planted in 1879 to beautify the area.

Thomas Lands, Non Pariel, a former plantation was deeded to the city, by the owner, on condition that it is used only for recreational and institutional purposes. In fact the site known as Camp Ayangana now occupied by the Guyana Defence Force headquarters, was once a golf club.

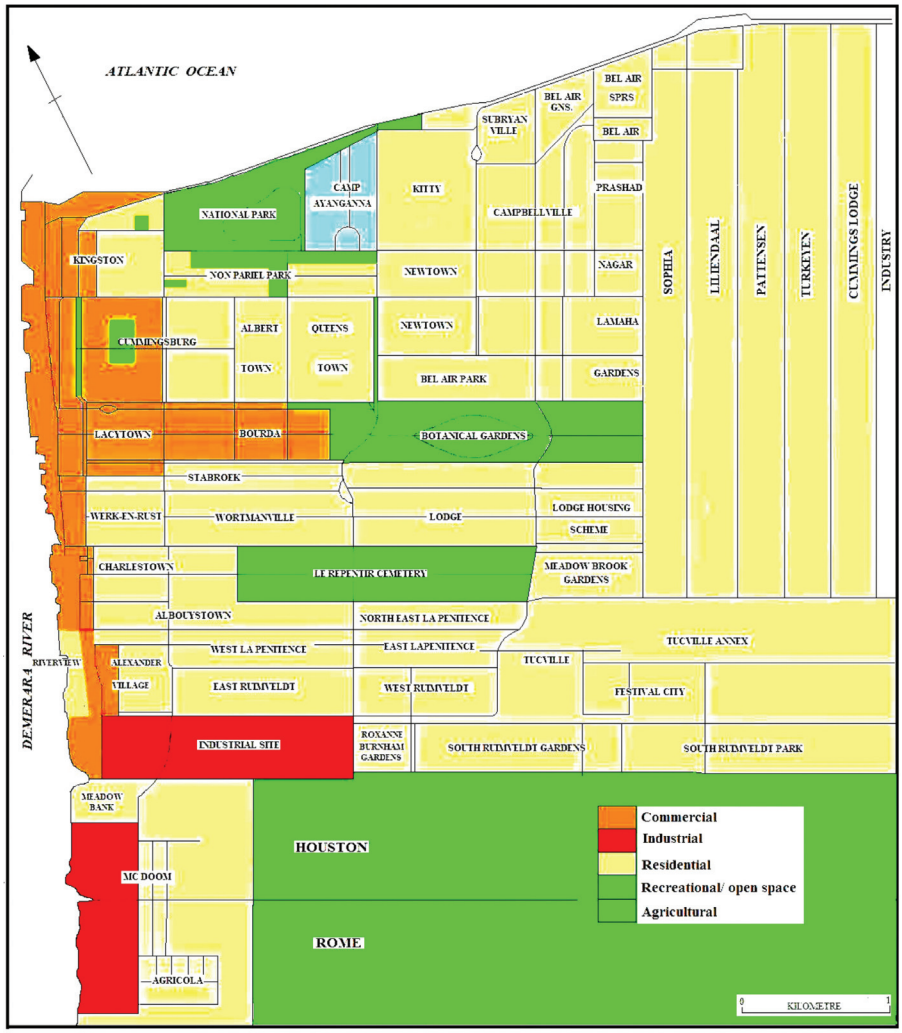


Figure1.8: *Current Land Use in Georgetown*
Source: Central Housing & Planning Authority, Guyana

1.3 Administrative and Social Overview

1.3.1 Administrative Structure of Guyana and Georgetown

Guyana is divided into ten Administrative Regions which are the Barima/Waini, Pomeroon/Supenaam, Essequibo Islands/West Demerara, Demerara/Mahaica, Mahaica/ Berbice, East Berbice Corentyne, Cuyuni/ Mazaruni, Potaro/Siparuni, Upper Takutu/Upper Essequibo and Upper Demerara/Berbice (Figure 1.9).

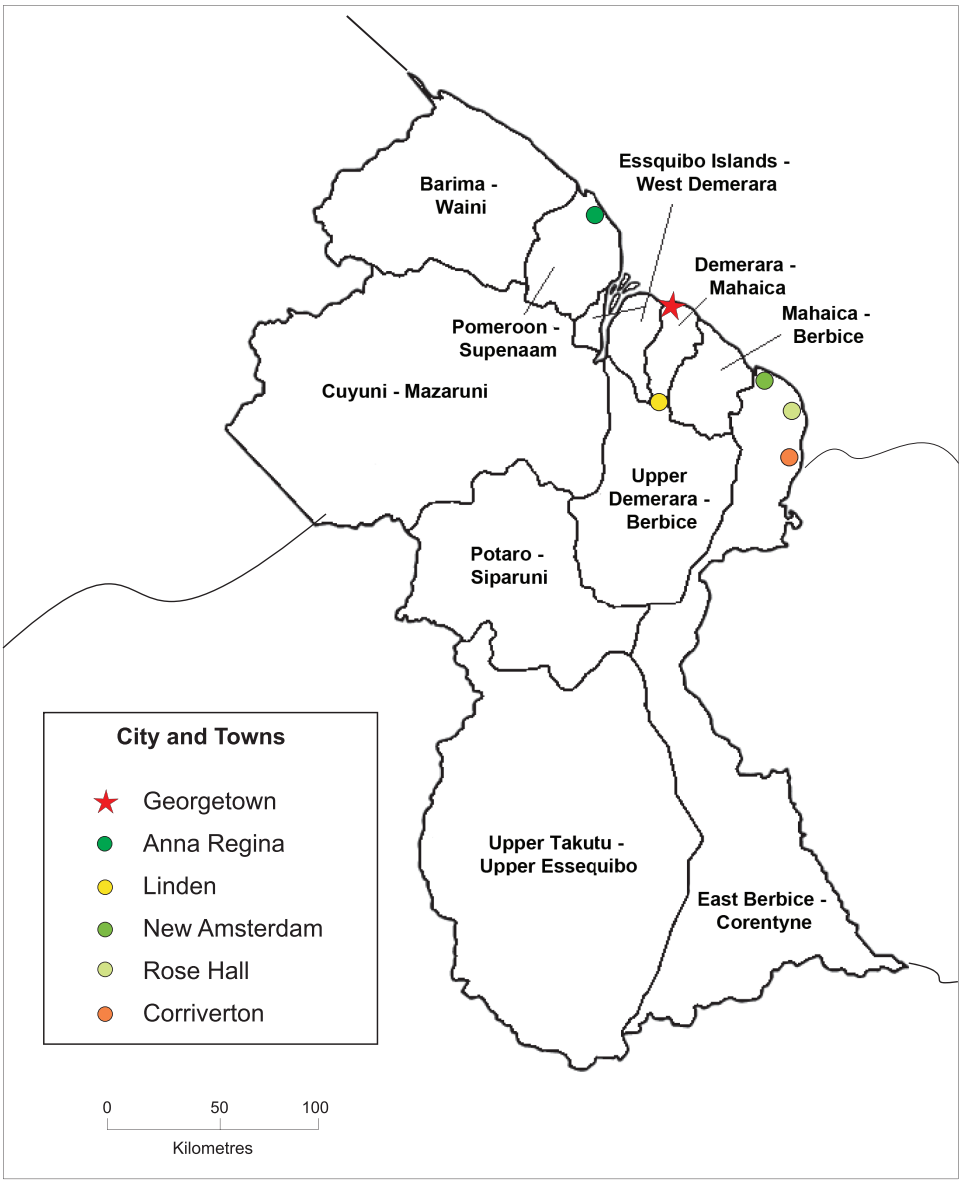


Figure 1.9: *Administrative Regions and Towns*

There are six municipalities/towns in Guyana; Georgetown, the capital city, and four other towns are located on the Low Coastal Plain and one town, Linden, is in the Hilly Sand and Clay region (Figure 1.9 above). Except for the six towns, each Administrative Region is governed a Regional Democratic Council (RDC) which is headed by a Chairman. In addition, there are many Neighbourhood Democratic Councils (NDC) within each Region. These NDCs operate at the local or village council level. The city is governed by a team of councilors as shown in Appendix 3.

1.3.2 Characteristics of the Population

1.3.2.1 Population Age/Sex Distribution

Guyana's population rose by 7.1 percent between 1970 and 2002, with a notable decline of 4.7 percent between 1980 and 1991 (Figure 1.10). Over the period under discussion, the population was lowest in 1991 with 723,673 persons, which is best explained by high emigration flows. The estimated growth rate for 2006 was 0.25 per cent.

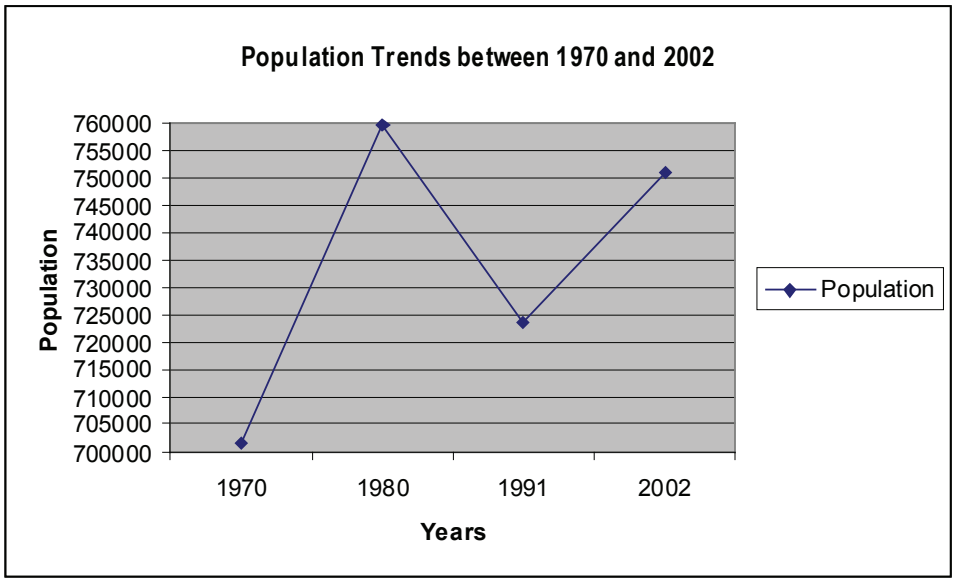


Figure 1.10: *Population Trends between 1970 and 2002*
Source: Housing and Population Census, 2002

Georgetown, with its density of 5,380 persons/km^2, is by far the most densely populated part of the country. Twenty five percent of the city's 134,497 inhabitants is distributed within the city itself, while the remaining 75% resides in its suburbs (Figure 1.11). Despite overall population increase during the last three decades, Georgetown's population declined by 9.6 percent between 1980 and 1991 and then by a further 1.2 percent between 1991 and 2002 as indicated in the Figure 1.11. The National Census Report (2002) stated that Georgetown's population of 134,497 constitutes approximately 17.9 percent of the population of Guyana.

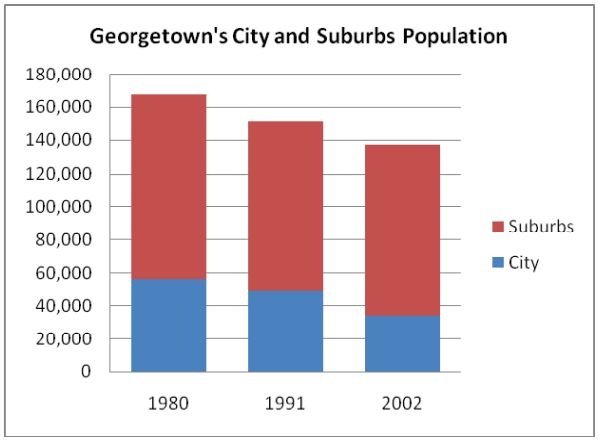


Figure 1.11: *Georgetown's Population by City and Suburbs*
Source: Housing and Population Census, 2002

In 2002, females comprised 52.4 percent of the population, giving rise to a sex ratio of 91 males to every 100 females in the city[1] (Figure 1.12). Females accounted for 51.7 percent of the overall urban dwellers, while this situation was the reverse for the rural areas, where males accounted for 50.8 percent of the population and females 49.2 percent.

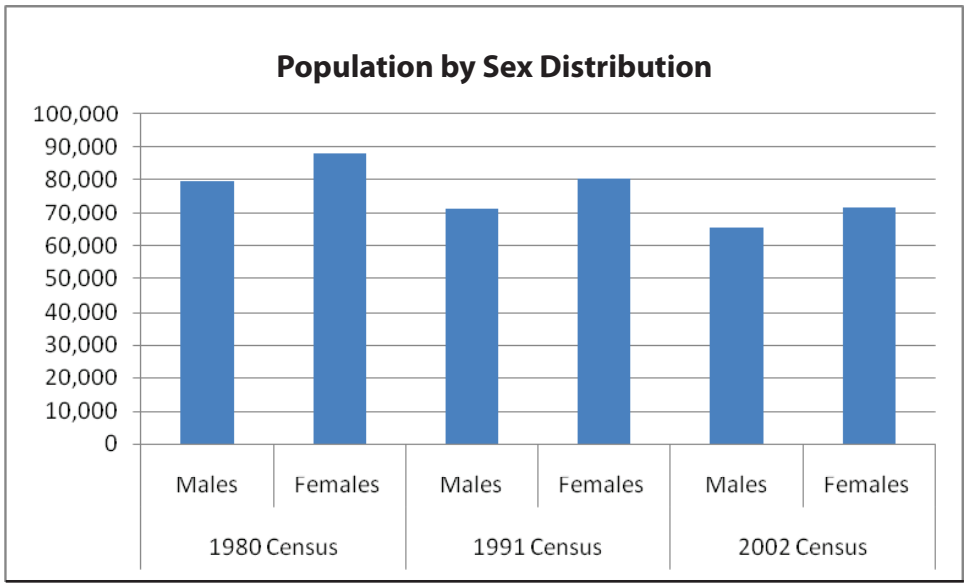


Figure 1.12: *Georgetown's Population by Sex*
Source: Housing and Population Census, 2002

The population structure revealed that 31.4 percent were below age 15 and 6.9 percent above age 60, leaving the rest, 61.7 percent, as the working-aged population of the city (Figure 1.13).

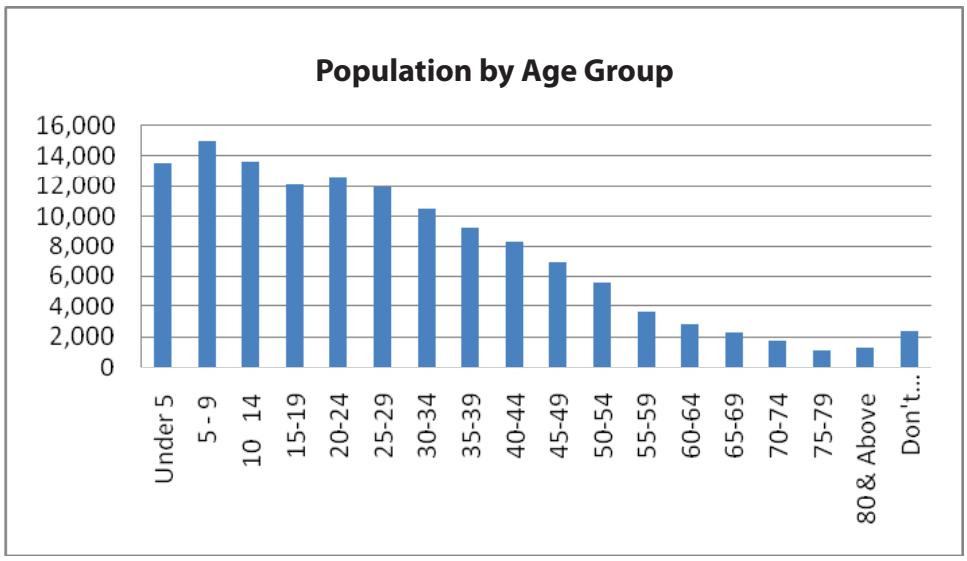


Figure 1.13: *Georgetown's Population By Age Group*
Source: Housing and Population Census, 2002

Guyana's population is concentrated along the main public roads and where most social services are available. Similar distributions can be observed for Georgetown.

[1] Sex-Ratio is the sex composition of the population expressed as the number of males per one hundred (100) females.

1.3.2.2 Fertility and Mortality Rates

Childbearing in Guyana peaks at age 27.2 years dropping thereafter, a trend that has changed little over the last three census periods. The pattern also shows that there has been a decline in the teenage fertility rate, and a slight increase in births among women in their terminal years of childbearing. Specifically, the rates were 95 births per 1,000 teenage girls in 1980 which declined to 58 by 2002; and 8 births per 1,000 women aged 45-49 years in 1991 increasing to 20 births per 1,000 women in 2002. As a result of the decline, the contribution of teenage fertility to the total births which was nearly 18 percent in 1980, declined to 12.6 percent in 2002. The high fertility areas include Regions 1, 9, 8 and 7 (predominantly rural areas) in that ranking order. These Regions recorded average numbers of children born (TFR) - by the time each woman there completes her childbearing - as 9.6, 8.0, 7.9 and 6.0 respectively, while the general fertility rate (GFR) for each of these Regions respectively, was registered as 303, 231, 242 and 190 children per 1,000 women aged 15-49 years.

Region 4 is considered a modest fertility region, with TFR averaging less than 4 children per child-bearing woman. It recorded a TFR of 3.38 for each woman by the time she has completed her child-bearing years. This is much lower when compared with the national TFR of 5.19. The GFR was computed at 105 per 1000 women and the Crude Birth Rate (number of births per 1000 women) was 28, relatively low in relation to the hinterland Regions (Refer to Figure 1.14).

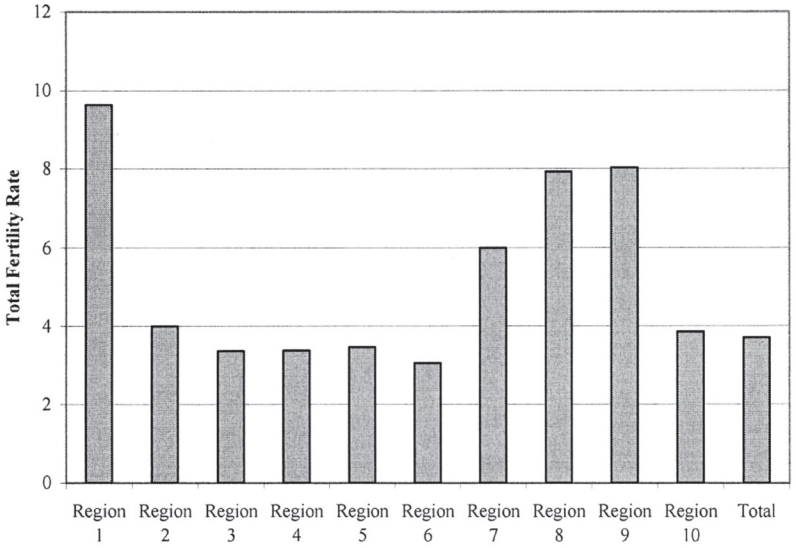


Figure 1.14: *Regional Fertility Differentials*
Source: Census, 2002

Overall life expectancy of the population in Guyana is 65.86 years. The Infant mortality rate (IMR) remained stable at 41 deaths per 1,000 from August 1995 to March 2000. According to UNICEF data, for 2007, IMR was 45 (UNICEF-Guyana-Statistics, unicef.org/infobycountry/guyana_statistics). The 10 year trend has shown that as age of mothers increased, there has been a steady decline in the IMR.

1.3.2.3 Migration

Four of the ten administrative regions have urban centres: Regions 2, 4, 6 and 10. The combined population of these towns and the capital city, Georgetown, totalled 213,705 or 28.5 percent of the population in 2002. The remaining 71.5 percent of the population is clustered in villages, mainly along the coastal belt, while a few are scattered deep in the hinterland of the country.

Rural to urban migration continues to be influenced by the availability of job opportunities and the provision goods and services within the city. This has resulted in high population density within Georgetown with close

to 18 percent of the country's population. 68 percent of the urban labour force is located in Georgetown (Figure 1.15) and it still attracts migrants from the other urban centres in search of educational and certain health services. This is because the country's highest institution of learning, i.e. the University of Guyana, all the senior secondary schools; and the major health facilities are located within the city.

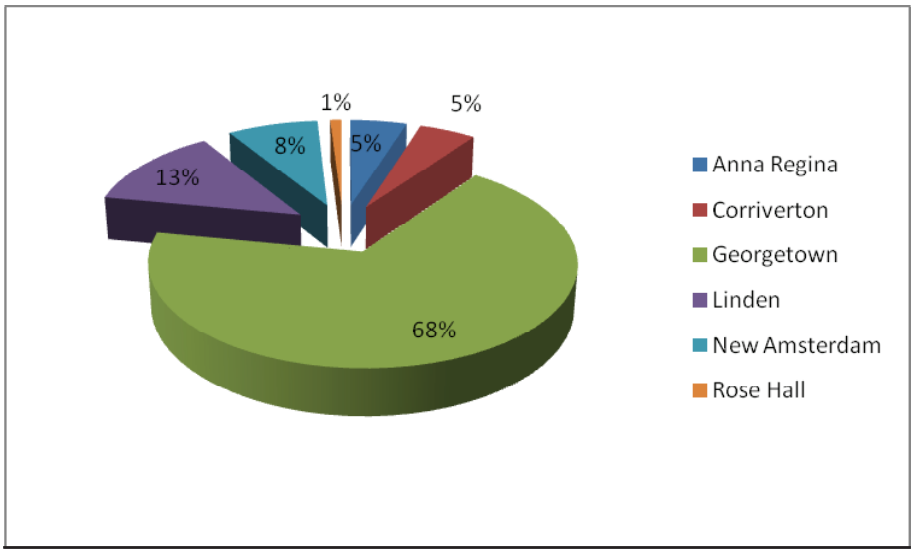


Figure 1.15: *Labour Force Distribution by Towns*
Source: Housing and Population Census, 2002

Transient migration is present as would be the case in any urban centre. As Guyanese migrate into the city to acquire a tertiary education many have used this move as a stepping stone to migrate into the Caribbean and North America. This has led to Guyana loosing many of its citizens with higher education. This brain drain has severely affected the health, education and manufacturing sectors.

1.3.2.4 Occupations and Employment

A combined total of 36% of the city's working population is employed as Service Workers and Shop and Market Workers and in Elementary Occupations while 15% and 12% work as Crafts and Related Trades Workers and Clerks respectively (Figure 1.16). Only 8 percent of the working population have occupations as Professionals, Legislators, Senior Officials and Managers.

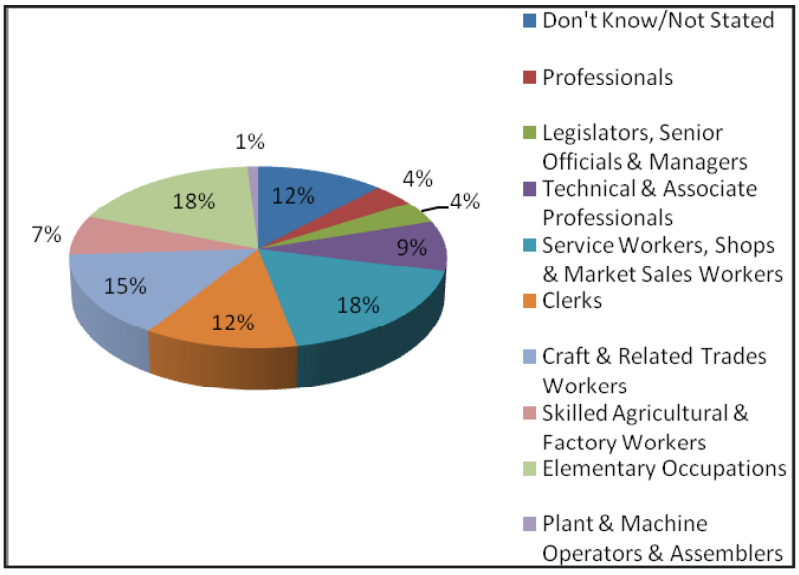


Figure 1.16:
Population by Main Occupation within Georgetown
Source: Housing and Population Census, 2002

The unemployment rate was 11.7% at the time of the 2002 population census. The minimum wage was approximately US$4.50 per day or US$133 a month for persons working in the public sector. The female participation rate in the labour force was 34.1%, while for males, the rate was 78.5%. The working age population represented about two-thirds of the total, of which 56% were economically active. The occupational structure of the labour force was more or less the same at the end of the 1990s as it had been for three decades previously. As one would expect agriculture, mining and quarrying together accounted for a large part of employment: 34.1% in 1970 and 31% in 1999. Services generated the most employment (45.1% in 1970 and 44% in 1999), but these jobs were low in their technological component.

1.3.2.5 Education

The 2002 National Census Report indicated the highest level of education achieved by the citizens of Georgetown was 53 percent secondary, 27 percent primary, 14 percent tertiary and 2 percent nursery education (Figure 1.17). This indicates that the population is relatively well educated, since 67 percent have secondary or higher level education as shown in figure 1.17 below.

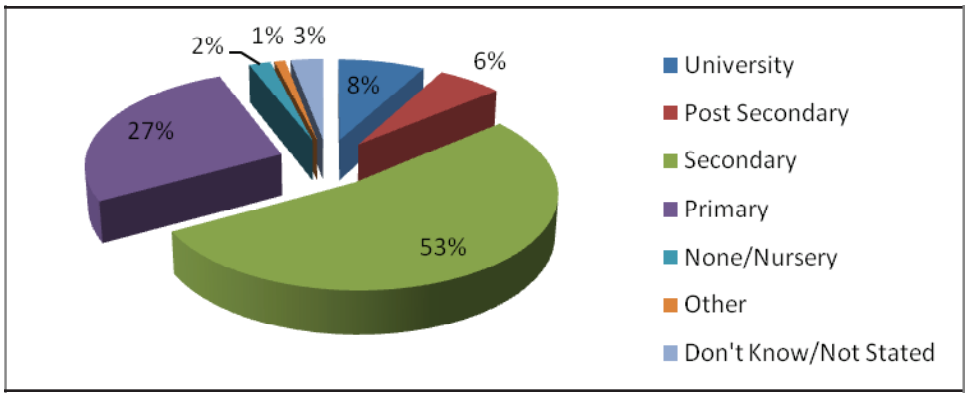


Figure 1.17: *Population by Highest Education within Georgetown*
Source: Housing and Population Census, 2002

1.3.2.6 Culture and Identity

Post independence Guyanese culture still bears the imprint of its colonial heritage. Guyanese were taught to respect and covet European values during the colonial era, and this has not changed despite government exhortation. Yet ethnic identity continues to be important, with daily life centred on ethnic and family groups; the mother- and grandmother-dominated family among blacks differs from the father-oriented East Indian family. Men of both groups often commute long distances to work along the coastal highways. Daily dress normally does not distinguish one group from another.

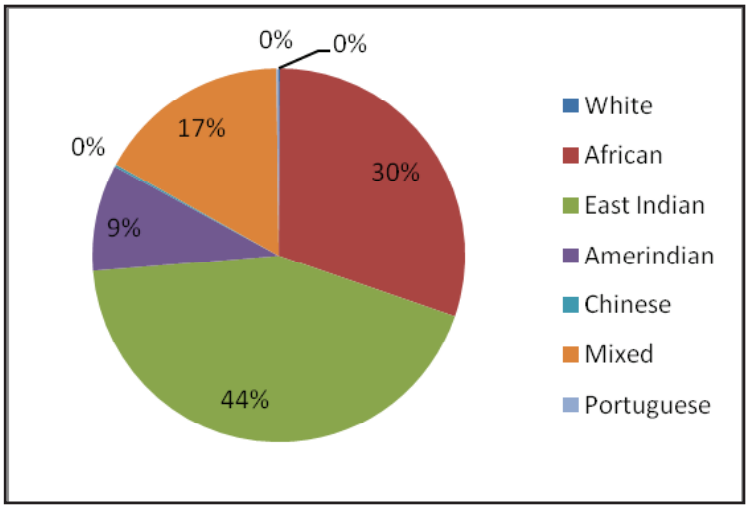


Figure 1.18: *Ethnic Composition of Population 2002*
Source: Housing and Population Census

According to the Census Report, the three largest ethnic groups of Guyana are: the East Indians (43.5%), the Africans (30.2%) and those of mixed origin (16.7%) (Figure 1.18).

Amerindian cultures are an important element in Guyanese culture and are the focus of museum displays and a popular inspiration in jewellery design, graphic arts and painting.

Cultural institutions are concentrated in Georgetown, including the National Library, the National Museum, the Guyana Zoological Park, with its collection of fauna from northern South America, the Museum of Anthropology, the Castellani Art Gallery, the African Museum and the collection of art located at the Department of Culture. The National Library is the official repository of works by Guyanese writers, some of whom have made noteworthy contributions to literature; the works of Wilson Harris, A.J. Seymour, and Walter Rodney are among the foremost.

Christianity, Hinduism, and Islam are the dominant religions in Guyana. The majority of the Indo-Guyanese are Hindus, although a substantial number are Muslims. Some Indo-Guyanese have converted to Christianity, but conversion was often motivated by educational and professional reasons. According to the 2002 Census, distribution of the population's religious beliefs is 57 percent Christian (of which 16.9 percent Pentecostal, 8.1percent Roman Catholic, 6.9 percent Anglican, 5 percent Seventh-day Adventist and 20 percent other Christian denominations), 28.4 percent Hindu, 7.3 percent Muslim, 0.5 percent Rastafarian, 0.1 percent Baha'i, 2.2 percent other faiths, and 4.3 percent no religion. This diversity in religious faith is reflected in national holidays and observances, as shown in the Table 1.1 below.

Date	Holiday	Religion
01 January	New Year's Day	Non-denominational
23 February	Republic Day (Mashramani)	Non-denominational
20 March	Yum an-Nabi (Birth of the Prophet)	Muslim
21 March	Phagwah (Holi)	Hindu
March	Good Friday	Christian
March/April	Easter Monday	Christian
01 May	Labour Day	Non-denominational
05 May	Arrival Day	Non-denominational
26 May	Independence Day	Non-denominational
1st Monday in July	Caricom Day	Non-denominational
01 August	Freedom Day	Non-denominational
2nd October	Eid Al Fitr	Muslim
28th October	Diwali (Festival of Light)	Hindu
09 December	Eid Al-Adha (Feast of the Sacrifice)	Muslim
25 December	Christmas	Christian
26 December	Boxing Day	Non-denominational

Table 1.1: *National Holidays*

The traditional national diet reflects the ethnic makeup of the country and its colonial history, and includes African and Creole, East Indian, Amerindian, Chinese and Europeans (mostly British and Portuguese) dishes. These dishes have been adapted to Guyanese tastes. Unique preparations include pepper pot, a stew of Amerindian origin made with cassareep (a bitter extract of the cassava), hot pepper and seasoning. Other favourites are cassava bread, stews, and metemgie, a thick rich soup with a coconut base and fluffy dumplings, eaten with fried fish or chicken. Homemade bread-making, an art in many villages, is a reflection of the British influence that includes pastries such as cheese roll, pine (pineapple) tart, and patties (sister to the Jamaican beef patty).

Caribbean and Latin American ground provisions are part of the staple diet and include cassava, sweet potato, eddoes and others. Fresh fish and seafood are an integral part of the food of the rural areas and small villages

along the coast. The crab soups and soups with okra from the Berbice coastal region resemble the Louisiana Creole soups like gumbo. Chinese food, sold in restaurants in the bigger towns, includes Caribbean-style chowmein and fried rice with Chinese-style fried chicken.

There is an abundance of fresh fruits, vegetables and seafood on the coast. Most people use fresh fruit to make their own beverages, which are called "local drink". Popular homemade drinks are mauby, made from the bark of a tree; sorrel drink, and ginger beer (made from ginger root) and peanut punch.

English is the official language of Guyana and used for all business and educational activities. In addition, Amerindian languages (Akawaio, Wai-Wai, Arawak and Macushi) are spoken by a small minority, while Guyanese Creole (an English-based Creole with African and Indian syntax) is widely spoken.

1.4 Economic Overview

1.4.1 Economic Structure

The composition of Guyana's GDP is largely skewed towards primary products, and output can display significant annual shifts. For the period of 1998-2005 about 43 percent of GDP by industrial origin was in the primary sector (agriculture industry, livestock, forestry and fishing, and mining and quarrying). Services account for 38 percent of GDP, government 12 percent and manufacturing just under 6 percent. Most of the services are low-end, non-professional services in retailing and transport. A broadly similar situation continues to date. Trade consists mainly of primary and natural resource-based products sold to a mix of open and protected markets, which sometimes offer price guarantees as well as quotas. The main export products are sugar, rice, gold, diamonds, forest products, fish products, bauxite and silica. There also exists a fledgling eco-tourism export industry (Ministry of Finance Budget Speech 2007).

Exports of Guyana include rice, sugar, molasses, bauxite, gold, and furniture, alcoholic beverages, chemicals and pharmaceuticals, wood, wood products, processed food, spices, fish, fruits, vegetables, hides, skins, leather and leather products, flowers and plants, textiles, yarns, fabrics, gold jewellery, toys and games, travel goods, stationery, paper products, ceramics, handicrafts, wildlife, packaged foods, and tobacco. Imports include manufactures, machinery, petroleum, pharmaceuticals and food.

The informal sector has been important to the Guyanese economy from the 1980s, to the present, although its character has changed. Different estimates of the sector's significance in terms of its contribution to the national economy have been made. Faal (2003) calculates that the informal sector accounted for 47 percent of the economy in the 1990s, while Bennett (1995) estimated it for the period 1979-1989 as one-third of official economy. The averages produced by Thomas (1989) range from 26 - 99 percent for the period of 1982-6.

In recent times, GDP growth rate has been low over an extended period; from 1970 to 2006 the real annual growth of GDP was less than 1percent (both total and per capita). Disaggregated, real GDP growth averaged 4 percent per annum in the 1960s, less than 1 percent in the 1970s; and -2.5 percent in the 1980s. Between 1991 and 1997 growth accelerated at the remarkable rate of over 7 percent per annum, but since 1998 it has grown by under 0.8 percent per annum. Guyana's total real GDP at factor cost was US$847.9 million and US$1,111 per capita in 2007. Guyana maintains a very open economy as exhibited by the ratio of total trade to GDP, which was 270 percent.

1.4.2 Energy

Energy consumption per capita in Guyana is among the highest in Latin America and the Caribbean. This is the main justification behind the government's current un-served areas electrification project. Energy intensity has been declining over the years (Figure 1.19), but this has reversed with the recent turmoil in the energy market.

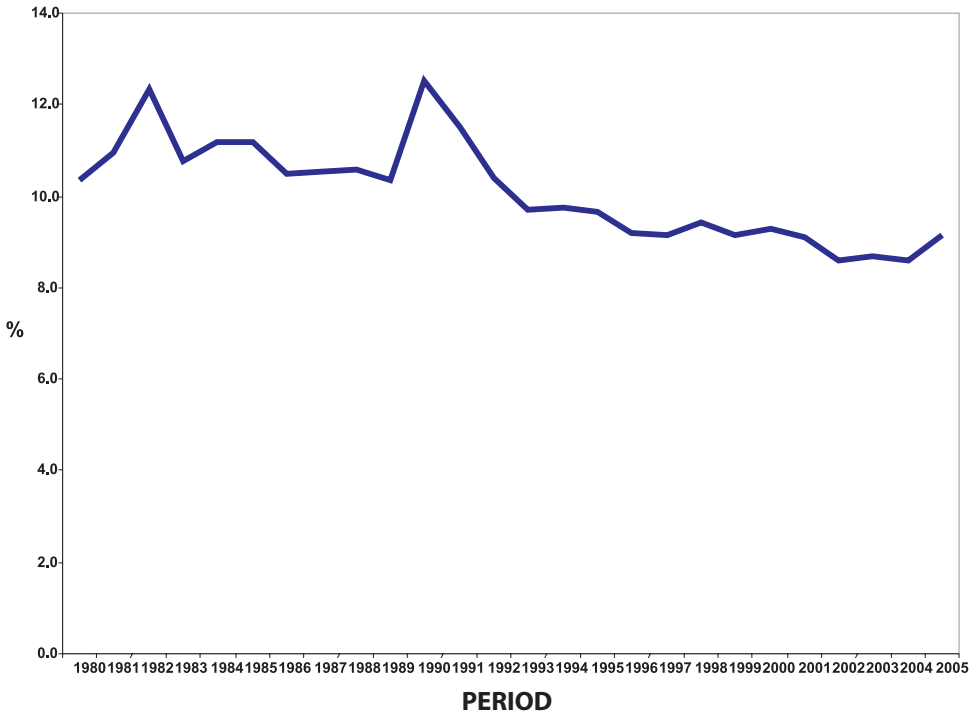


Figure 1.19: *Guyana Energy Intensity of GDP*
Source: ECLAC, 2005

Electricity production in 2008 for the country totalled 807.3 million kilowatt hours (kWh), 99.4 percent of which was from fossil fuel imported from Venezuela and Trinidad and Tobago, and 0.6 percent from hydropower in an interior location called Lethem. Official oil imports for Guyana totals 10,070 barrels of oil per day, and constitutes the largest use of foreign currency in the country. There is suspected to be a significant amount of oil smuggled from Venezuela, both as a means of circumventing payment of the high excise tax that the commodity attracts and as well to benefit from the domestic price in Venezuela which is much below the prevailing market price elsewhere.

Current energy demand in Guyana, most of which is from Georgetown, is met by a public utility which has a generation capacity of about 100 MW. Electricity consumption totalled 750.7 million kWh in 2008. The 2002 population census found that overall, 81.7 percent of households used publicly supplied electricity for lighting, 8.3 percent generated their own electricity and another 15.3 percent used gas and kerosene for lighting. Most large businesses self-generate their power, and a tiny number of households access energy from PV systems for lighting and heating water. Most households, a total of 23,101 or 65.6 percent use gas as fuel for cooking, 11,139 use kerosene, 375 use wood and coal and 231 use electricity.

The heavy dependence on fossil fuel leaves the capital city entirely vulnerable to price escalations leading to widespread dissatisfaction among consumers. The public policies to support switching from fossil fuels to renewable energy sources are partial at best and have not produced a positive outcome, due in part to the cost of infrastructure and the lengthy payback period in the case of hydropower and the high cost of acquisition of components for photovoltaic and other alternative energy systems, compared to other Caribbean countries. Institutional arrangements have not favoured private sector investment into this area either, hence financing has not been easy to obtain.

1.4.3 Transportation

The high population density in Georgetown promotes development in sectors such as transport, even as it increases unplanned settlements and places stress on the city's basic infrastructure. As the capital city and business centre of Guyana, Georgetown is a major transportation hub for the country. Currently, there is no public sector operated road transportation system in Guyana; instead there is a widespread and efficient system provided by private operators. The Operators use minivans known locally as minibuses. There are frequent complaints about the poor regulation of the service, and the control of various antisocial features such as speeding, loud music and attitudes of operators.

While there are no figures specifically for Georgetown, there has been a general increase in new vehicle registrations in Guyana (Figure 1.20). In each year, private cars and motorcycles account for most of the registrations. For the period 2005 to 2007 alone, there was an increase of more than 66 percent in motor vehicles registered compared to the levels in 2001-2003. This is consistent with the perceived improvement in life styles by groups that are enjoying higher incomes, and shifting to private transport in preference to the public system. These factors have led to increased traffic on the already inadequate (in terms of capacity, maintenance and structure) road network of Georgetown which has not expanded simultaneously. More vehicles have naturally led to increased exhaust emissions in Georgetown, compounded by the traffic congestion.

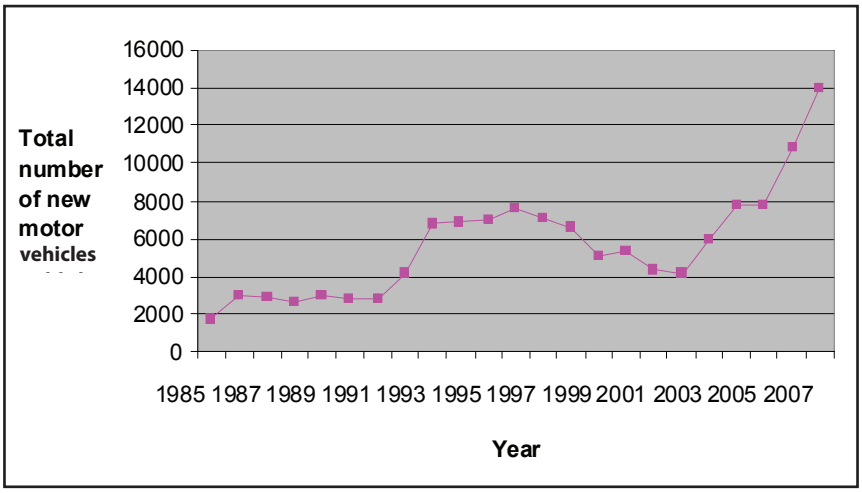


Figure 1.20: *Annual Registration of New Motor Vehicles 1985-2007*
Source: Based on statistics from the Bureau of Statistics (2008)

1.4.4 Tourism

The tourism sector, which has recorded significant development in recent years, has increased its contribution to the Gross Domestic Product by creating thousands of jobs, generating revenues, and attracting both local and foreign investors. In 2009, Guyana recorded the highest percentage increase in arrivals in the Caribbean despite the global economic and financial crisis.

Georgetown offers a cultural (anthropological, historical and architectural) tourism product. The city contains several historical buildings, including many wooden structures reflecting the unique 18th and 19th century architectural styles. It also includes tree-lined boulevards, administrative facilities and shopping centres. The museums have a wide collection of flora and fauna, archaeological artifacts, and examples of local and Amerindian arts and crafts, 18th and 19th century maps, coins and stamps, African Art, mostly West African. The National Stadium, Theatre Guild and National Cultural Centre provide a variety of shows. There is a national park located close to many hotels and the sea wall area, as well as the Botanical Gardens, located in close proximity to the zoo, offer examples of local flora and fauna. There are several interior resorts and lodges providing accommodation for ecotourists.

Plates 1.2 and 1.3 below show samples of the tourism stock of the City: Pegasus Hotel and a section of the Botanical Gardens.

Plate 1.2 *Pegasus Hotel*

Plate 1.3 *Botanical Gardens*

1.5 Human Poverty

In 2004, Guyana ranked 103 of the 184 UN member countries ranked on the UNDP Human Development Index (HDI). The HDI which incorporates the standard economic measure of national wealth/poverty (GDP) with social indicators which evaluate access of citizens to essential basic services was computed at 0.725. The highest level achieved by Guyana is 0.750 in 2005 as shown in Table 1.2 below.

Period	%
1975	0.678
1980	0.684
1985	0.677
1990	0.683
1995	0.685
2000	0.734
2003	0.723
2004	0.725
2005	0.750
2006	0.725

Table 1.2: *Trend of Human Development Index*
Source: UNDP Human Development Reports 2006 and 2008

1.5.1 Poverty and Inequity

Using the Head Count Ratio methodology, absolute poverty was measured at 36.3 percent in 1999 for all Guyana. This represented an improvement of almost 7 percent compared to 1992. Poverty was more concentrated in rural areas, particularly the rural interior, among the indigenous Amerindian people. Urban poverty was less than half the national average in 1999, and a significant improvement of 12.8 percent was noted in case of Georgetown between the two survey periods (Table 1.3).

Area	1992/1993				1999			
	P_1	P_2	P_G	$FGTP_2$	P_1	P_2	P_G	$FGTP_2$
All Guyana	43.2	27.7	16.2	8.2	36.3	19.1	12.4	6.1
Urban Georgetown	28.9	15.7	8.7	3.6	16.1	8.2	5.4	2.6
Urban Other	23.1	12.2	6.3	2.5	16.3	3.0	0.8	
Rural Coastal	45.1	27.9	14.4	6.3	39.8	18.1	11.3	4.6
Rural Interior	78.6	70.8	46.1	31.0	78.4	70.8	44.9	30.0

Note
P_1 = Absolute Poverty; P_2 = Critical Poverty;
P_G= Poverty Gap Index;
$FGTP_2$ = Foster-Greer-Thorbecke Poverty Measure

Table 1.3: *Poverty Indicators of Guyana*
Source: Thomas, C.Y. (1999); GSLC (2000); World Bank (1994)

Additional measures of poverty and well-being for the country show a fairly inequitable distribution of income, relatively high education expenditures (in relation to total expenditure, but not per capita), and a relatively high level of disabilities. (See table 1.4 below)

Indicator	Year	Figure
Income Distribution (Gini Coefficient)	1999	0.421
Education exp./Total exp. (Ratio)	unavailable	13.0
Population with Disabilities (%)	2002	2.2

Table 1.4: *Poverty and Social Indicators*
Source: Thomas (2000); Bureau of Statistics (2002); Census and UNDP (2006)

Facilities to manage disabilities are concentrated in Georgetown, and the quality of life is generally much better than in other areas of the country.

1.5.2 Access to the Basic Services

Guyana is on the way to meeting some of the Millennium Development Goals (MDGs). There is near universal primary education. More than 75 percent of the population has access to piped water in their homes or yards. Improved sanitation (pit latrines and WCs) was available to a substantial majority of the population at the time of the 2002 Census. In addition, the caloric consumption per capita was above the average of 2,400 kilocalories recommended by WHO.

Other goals that have been achieved in Guyana include access to education for girls, gender equality and access to electricity.

1.5.2.1 Water and Sanitation

In Georgetown, sanitation services are managed by the Mayor and City Council of Georgetown through its Public Health and Municipal Solid Waste Management Departments and the Guyana Water Inc. The Municipality provides solid waste management services, inclusive of street and drain cleaning to the city, and is also involved in regulating public health matters. The GWI, a state owned entity, is responsible for the provision of potable water and waste water treatment and disposal services for the entire country. There is a small proportion of the populace that obtains water from private sources, particularly for drinking.

During 2007 approximately 34,000 tonnes of waste was collected from households within Georgetown and 40,000 tonnes from the commercial and industrial activities conducted in the city. The total amount

of waste received at the landfill for that year was 90,000 tonnes, of which about 12 percent came from the Neighbourhood Democratic Councils contiguous to Georgetown.

With a population of 134,497 (2002) Georgetown consumes a total of 18,446 m^3 of potable water per day. This constitutes a consumption of 521 litres/household/day and 137.15 litres/person/day. Of the 35,215 households in Georgetown, over 90 percent of them receive water piped into their yard or dwelling from mostly public sources.

Situated on the strip of swampy clay soils which run roughly in an east west direction parallel to the shoreline, Georgetown is well endowed with water, and has to be drained by a complex system of canals, drains and sluices. The city is below high-tide sea level and has to be protected by a wall to prevent inundation, and continues to be faced by challenges from flooding and consequential nuisances such as mosquitoes and other insects. The water table is very close to the surface; as such Georgetown is able to obtain water from both surface and sub-surface sources. Because of the cost of treating the surface water, the water utility has, in recent time, switched to sourcing over 90 percent of its supply of potable water from wells. This water needs only to be chlorinated to remove contaminants and aerated to remove iron and other minerals.

Along with the cost of treating water, vulnerability to droughts has lessened somewhat with the change from surface sources to wells. However, the risk of contamination and consequent disease remains due to the low water pressure, less than perfect distribution system and the propensity of citizens to break the water mains when water is not flowing through the taps. There is no study of the rates of water extraction relative to the rate of recharge of the aquifers and neither is there any consideration given to the risk of locating farms and other economic activities on the sandy belt through rainwater percolates.

Both entities have public education/community relations units which are tasked with raising awareness and educating citizens about issues related to the provision of their respective services (e.g. a Community Relations Department within the Municipal Solid Waste Management Department). Their programmes range from face to face interactions with the relevant communities, school visits and outreach programmes. In the case of the Municipal Solid Waste Management Department such outreaches have included placing bins into Mini-Buses and the sensitization of persons who engage in leisure activities on the seawall on Sundays as to their responsibilities.

The Solid Waste Management Administration Department utilizes on an average a total of 8,910 litres of gasoline per year. The Transportation Unit utilizes 12,528 litres of diesoline and the Disposal Unit utilizes 16,308 litres of diesoline per year.

1.5.2.2 Health

Among the leading causes of mortality in Guyana are: cerebrovascular diseases (11.6%); ischemic heart disease (9.9%); immunity disorders (7.1%); diseases of the respiratory system (6.8%), and diseases of pulmonary circulation and other forms of heart disease (6.6%).

The picture in regard to morbidity patterns, however, differs considerably. The leading causes of morbidity for all age groups include: malaria; acute respiratory infections; hypertension; accident and injuries; acute diarrhoeal disease; diabetes mellitus; worm infestation; rheumatic arthritis; and mental and nervous disorders. This morbidity profile indicates that it can be improved substantially through enhanced preventive health care, better education on health issues, more widespread access to potable water and sanitation services, and increased access to basic health care of good quality.

Health services are provided at five different levels in the public sector:

- Level I: Local Health Posts (166 in total) that provide preventive and simple curative care for common diseases and attempt to promote proper health practices. Community health workers staff them.

- Level II: Health Centres (109 in total) that provide preventive and rehabilitative care and promotion activities. These are ideally staffed with a medical extension worker or public health nurse, along with a nursing assistant, a dental nurse and a midwife.

- Level III: Nineteen District Hospitals (with 473 beds) that provide basic in-patient and outpatient care (although more the latter than the former) and selected diagnostic services. They are also meant to be equipped to provide simple radiological and laboratory services, and to be capable of gynaecology, providing preventive and curative dental care. They are designed to serve geographical areas with populations of 10,000 or more.

- Level IV: Four Regional Hospitals (with 620 beds) that provide emergency services, routine surgery and obstetrical and gynaecological care, dental services, diagnostic services and specialist services in general medicine and paediatrics. They are designed to include the necessary support for this level of medical service in terms of laboratory and X-ray facilities, pharmacies and dietetic expertise. These hospitals are located in Regions 2, 3, 6 and 10.

- Level V: The National Referral Hospital (937 beds) in Georgetown that provides a wider range of diagnostic and specialist services, on both an in-patient and out-patient basis; the Psychiatric Hospital in Canje; and the Geriatric Hospital in Georgetown. There is also one children's rehabilitation centre.

In addition to these facilities, there are 10 hospitals operated by the private sector and public corporations, plus diagnostic facilities, clinics and dispensaries in those sectors.

The Georgetown Municipality also has a Public Health Department and a Health Education Department whose responsibilities are to provide the general public with public health information and services. The Health Education Department also goes into schools and conducts public outreach programmes. The Environmental Health Department provides the 135,000 residents of Georgetown with a basic service of ensuring that they uphold the public health laws of keeping a tightly covered garbage receptacle, weeding their yards and parapets and most importantly keeping their yards and immediate environment clean at all times.

CHAPTER TWO: STATE OF THE ENVIRONMENT
2.1 Climate and Air Quality

Climatic data are collected by a meteorological station located in Georgetown. However, there is no air quality monitoring facility. Figures 2.1 and 2.2 below show the total annual rainfall in Georgetown and the maximum and minimum temperatures in Georgetown, respectively, over the period 1998 to 2008. While there has been an increase in the total annual rainfall in Georgetown over the ten year period, there have been no significant changes in the maximum and minimum temperatures over the same time period. The mean maximum and minimum temperatures in Georgetown over the period 1998 to 2008 are 30.5 °C and 24.2 °C, respectively.

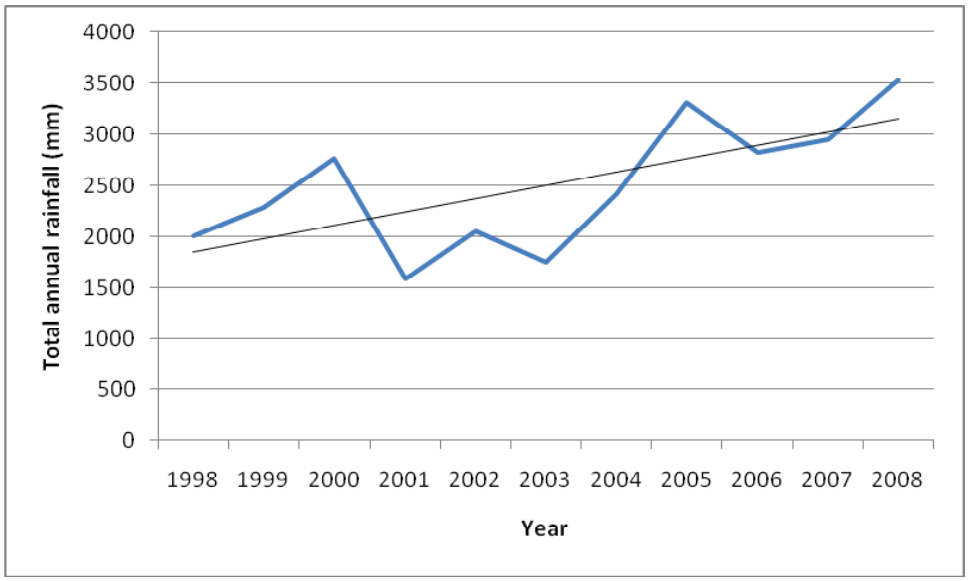


Figure 2.1 *Total annual rainfall in Georgetown over the period 1998 to 2008*
Source: Based on data from the Bureau of Statistics

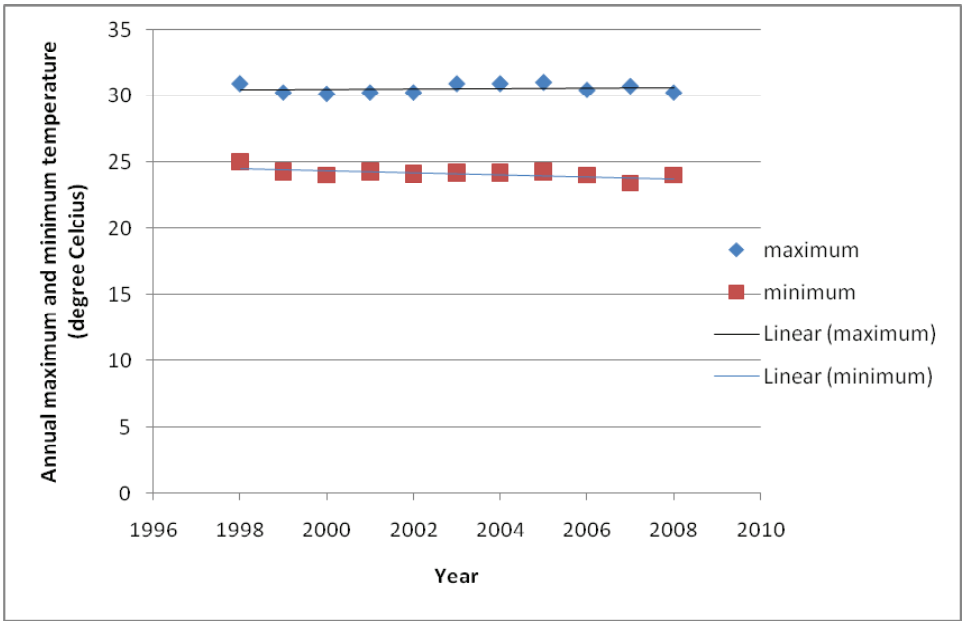


Figure 2.2 *Annual maximum and minimum temperature in Georgetown for the period 1998 to 2008*
Source: Based on data from the Bureau of Statistics

The annual mean hours per day of bright sunlight in Georgetown over the period 1998 to 2008 varied between a minimum of 6.4 hours per day in 2000 to a maximum of 7.6 hours per day in 2001 (see Table 2.1).

Year	Annual mean
1998	6.8
1999	7.0
2000	6.4
2001	7.6
2002	6.9
2003	7.2
2004	7.3
2005	6.8
2006	6.9
2007	6.9
2008	6.8

Table 2.1 *Average number of hours per day of bright sunlight in Georgetown over the period 1998 to 2008*
Source: Based on data from the Bureau of Statistics

There was little variation in the annual mean relative humidity in the morning and evening – as measured at 08:00 hrs and 14:00 hrs in Georgetown over the period 1998 to 2008 (see Figure 2.3). The relative humidity in the morning varied from a minimum of 77 percent in 2000 and 2002 to a maximum of 83 percent in 2005, while the evening level was recorded at 70 percent 2003 and 75 percent in 2005.

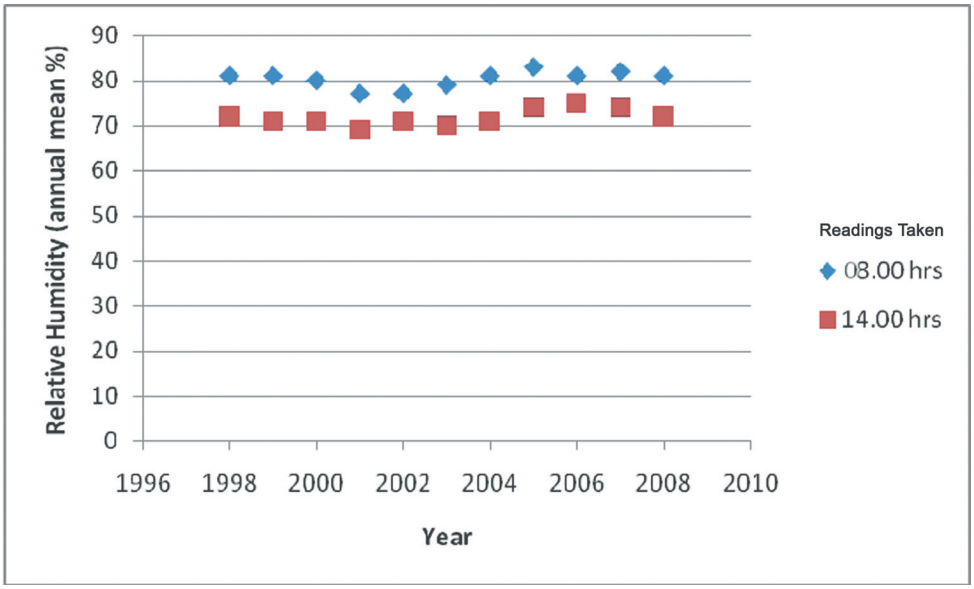


Figure 2.3: *Annual mean relative humidity at 08:00 hrs and 14:00 hrs for Georgetown 1998 to 2008*
Source: Based on data from the Bureau of Statistics

Air Quality

The factors that are currently influencing the quality of air within Georgetown include:

- Burning of sugar cane fields (to the south of Georgetown);
- Uncontrolled burning from the Mandela land fill site;

- Burning of household wastes in yards;
- Increase in waste generation;
- Improper waste disposal at the landfill site;
- Change in the composition of waste;
- Traffic congestion in the central Georgetown;
- Unauthorized small-scale industrial activities (e.g. paint shops); and
- Presence of the Guyana Power & Light for electricity generation.

A recent estimate of emissions was prepared for the Demerara Watershed using the Industrial Pollution Projection System (IPPS)[2] software by SENES (2006). Emissions of sulphur dioxide (SO_2), nitrogen dioxide (NO_2), carbon monoxide (CO), volatile organic compounds (VOCs), particulate matter of size 10 microns (PM10) and less and total particulates (PT) were estimated. Given that Georgetown is located within the Demerara Watershed, this estimate is used to describe the air quality in Georgetown.

Table 2:2 highlights the total estimated emissions from the various industrial sectors in the Demerara Watershed.

	Air Quality Lower Bound Intensities/kg					
Location	SO_2	NO_2	CO	VOCs	PM10	PT
Demerara Watershed	63,903	62,438	47,117	34,324	2,386	40,563
The Rest of Guyana	1,293,647	199,571	624,306	78,986	21,783	229,364
Totals	1,357,551	262,009	671,423	113,310	24,169	269,927

Table 2.2 *Air Pollutant Emissions (Kg) 2005*
Source: SENES, 2006

According to the data, emissions of SO_2 are the largest. Furthermore, the model also estimated the contribution of key industrial sectors to air pollution in the Demerara Watershed. Overall, it was found that within the Demerara Watershed sugar factories and refineries, and saw mills, planing and other wood milling industries are predominantly responsible for air pollution, except for VOCs which are dominated by the distilled spirits sector. However, it should be noted that of these sectors addressed by the model, it is the wood processing sector, specifically the lumber yards that are present in Georgetown. Therefore, the actual emissions in Georgetown would be less than that presented in the table.

In 2002, Guyana submitted its First National Communication to the United Nations Framework Convention on Climate Change. As part of the preparation of this document a national inventory of greenhouse gas was conducted for the year 1994, see Table 2.3. This inventory revealed that Guyana is a net sink for carbon dioxide (CO_2), since the removals (26,664 Gg) greatly exceed emissions (1,446 Gg) with a removal balance of 25,218 Gg. Carbon dioxide removal is realised through absorption by the vast area of tropical rain forest. Carbon dioxide was the major greenhouse gas emitted in comparison to other greenhouse gases examined, namely methane (CH_4), nitrous oxide (N_2O), carbon monoxide and non-methane volatile organic carbon compounds (NMVOC). The major source of emission of carbon dioxide was the energy sector (fuel combustion activities). The agriculture sector was the major source of methane. Carbon monoxide was emitted by the energy, land use, forestry and agriculture sectors in 1994.

[2]The industrial pollution projection system (IPPS) was developed in response to the need for estimates on industrial emissions. The IPPS has been developed to convert the detailed industry-survey information on employment, value added, or output generally available in developing countries into a profile of associated pollutant output for countries, regions, urban areas, or proposed new projects. It can project air, water, and solid waste emissions (Hettige et al, 1994).

Greenhouse gas source & sink categories	CO_2	CH_4	N_2O	NO_2	CO	NMVOC
Fuel Combustion	1,446	1		11	45	6
Industrial Processes						16
Industrial Processes						16
Land use change & Forestry	(-26,664)	8		2	68	
Waste		1				
Total national emissions & (removals)	1,446 (-26,664)	51	1	17	208	22

Table 2:3 *National Greenhouse Gas Inventories (Gg) for 1994*
Source: Government of Guyana, 2002

As mentioned before, air quality in Georgetown is also adversely affected by the burning of sugar cane prior to harvesting which produces air borne ash in south Georgetown. The decomposition of waste in the Mandela landfill site produces odours and gases, primarily carbon dioxide and methane, which also affects south Georgetown. When combustion occurs at the dumpsite, it is usually accompanied by heavy smoke. In addition, combustion of organic matter may produce polycyclic aromatic hydrocarbons (PAHs) and dioxins may be produced if there is organic matter and chlorine present during combustion and the temperatures are sufficiently high. While motor vehicles produce particulate matter and gaseous emissions, such as carbon dioxide and hydrocarbons, which would increase during periods of traffic congestion, power generation, including the frequent use of small to medium-sized generators, produces noise, particulate matter and gases. However, it must be noted that the levels of these pollutants have not been measured up to now.

2.2 Water

2.2.1 Review of the Pressures

The water resources identified in Chapter 1 are subject to a number of pressures that are leading to scarcity and degradation. The pressures include: demands and effluents from extended urban centres, rural communities, unplanned settlements, agricultural, industrial and mining uses (Atkins, 2005). It has been noted that during 1913 to 1993, excessive abstractions from the A sands aquifer have caused the piezometric head to fall about 20 m. In addition questions have been raised about the rate of recharge with housing and agricultural developments taking place on the white sand areas.

Moreover, the water supply and distribution system suffers from a shortage of resources which then lead to:
- inadequate treatment capacity to meet demand;
- high losses of water due to the compromised distribution system;
- contamination occurring through the distribution system; and
- lack of adequate resources to refurbish and maintain distribution systems.

The quality of water in the Demerara River is threatened in a variety of ways including:
- biological and chemical contamination, especially from industries downstream of Timehri to the Georgetown area;
- sedimentation from mining activities in the watershed;
- inadequate sewage systems within Georgetown;
- inappropriate disposal of effluent from rice mills and sugar facilities;
- agricultural practices that result in pesticides and fertilizers being washed directly into the river, or into drains, canals, creeks, etc., that eventually flow into the river; and

- direct dumping of solid wastes into the river and tributaries. (SENES, 2006)

2.2.2 The Demerara River

The water in the Demerara River is freshwater and brackish (or estuarine). Within the area of Georgetown, which is subject to tidal patterns, the water is brackish. Recent water quality monitoring undertaken by SENES (2006) revealed the following:

- In the freshwaters of the Demerara River the pH averaged 4.5; the conductivity was high with an average of 200 micro Siemens per centimetre (µS/cm); and the turbidity levels varied from 1 to 3 Nephelometric Turbidity Units (NTU), which indicates clear waters.
- In brackish waters of the Demerara River the pH averaged 6.1 as a result of the mixing of the freshwaters with the ocean waters which have pH of higher than 8.0; the conductivity averaged 620 µS/cm; and the turbidity varied from 10 to 47 NTU indicating the presence of algae, sediments, suspended solids, domestic and industrial wastes.
- Alkalinity was found to be low at an average of 17.4 milligrams per litre calcium carbonate (mg/l ($CaCo_3$)); therefore, the river chemistry is susceptible to pH alterations. In the brackish waters, alkalinity increased to an average of 33.8 mg/l ($CaCo_3$).
- Carbon dioxide in the Demerara freshwaters averaged 12 mg/l, while it was 6.6 mg/l in brackish waters; hardness averaged 0.1 mg/l in freshwaters and 0.5 mg/l in brackish waters. Therefore the Demerara waters are of low calcium and magnesium mineral content and can be considered "soft water."
- The dissolved oxygen (DO) averaged 5.0 mg/l throughout.
- With respect to total ammonia, it averaged 0.4 mg/l in the Demerara freshwaters and was 0.3 mg/l in the brackish section. Phosphate averaged 0.0 mg/l (i.e., non-detectable with the test method utilized) in both freshwaters and brackish waters.

In summary, the freshwaters of the Demerara River are slightly acidic and generally clear, while the brackish waters are slightly alkaline and contain suspended solids. The Demerara River is susceptible to changes in pH and can be considered "soft water." The amount of dissolved oxygen was constant throughout the River and with no phosphate being detected.

2.2.3 Potable water

The Guyana Water Incorporated (GWI) is responsible for providing water and sanitation services to the entire country. Georgetown falls within Division 3 of the Administrative Divisions of the GWI. This Division serves one hundred and thirty seven thousand, six hundred and twenty five (137,625) customers in the Georgetown area.

GWI produces treated and untreated water for its Georgetown customers; treated water is produced by one water treatment plant at Shelter Belt and untreated water is provided by wells in the areas listed in Table 2:4.

Area	Water supply system
Central Ruimveldt	Storage and distribution
Sophia	Storage and distribution
Textile Mill, Industrial Site	Pump directly from aquifer
Festival City	Pump directly from aquifer
North Ruimveldt	Pump directly from aquifer
Tucville Terrace	Pump directly from aquifer
Agricola	Pump directly from aquifer
Turkeyen	Pump directly from aquifer
Kingston	Pump directly from aquifer

Table 2:4 *Areas with Wells Providing Untreated Water to the Georgetown Area*
Source: GWI

GWI is currently constructing water treatment facilities at Central Ruimveldt and Sophia. None of GWI's water supply centres provide water on a 24 hour basis. The water treatment plant at Shelter Belt provides water thrice a day for a total of eleven (11) hours per day - 05:00 to 10:00, 12:00 to 13:00 & 17:00 to 22:00 hrs. The remaining wells provide water twice a day for ten (10) hours per day each - 05:30 to 12:30 & 17:00 to 22:00 hrs.

Monitoring of water produced by the water treatment plant and the wells and water received by persons within the distribution system is conducted on a routine basis. While treated water produced by the Shelter Belt is monitored for the seven (7) water quality indicators: pH, turbidity, iron, aluminium, colour, total coliform and faecal coliform, untreated water is monitored for the following five (5) water quality indicators: pH, turbidity, iron, total coliform and faecal coliform. The data for 2006 reveals that a number of the water quality indicators did not meet drinking water standards. Table 2.5 below shows the drinking water standards.

Indicators	Standard	Unit of measurement
pH	6.5-8.5	
Turbidity	< 5	Nephelometric Turbidity Units (NTU)
Iron	0.3[(1)]	milligrams per litre (mg/l)
Aluminium	0.2	milligrams per litre (mg/l)
Colour	15	Hazen
Total Coliform	0[(2)]	total coliforms per 100 ml
Faecal Coliform	0[(2)]	faecal coliforms per 100 ml

Notes:
(1) The Guyana Water Incorporated uses a relaxed standard of 0.5 mg/l
(2) United States Environmental Protection Agency standards

Table 2.5: *World Health Organization Standards (2008)*

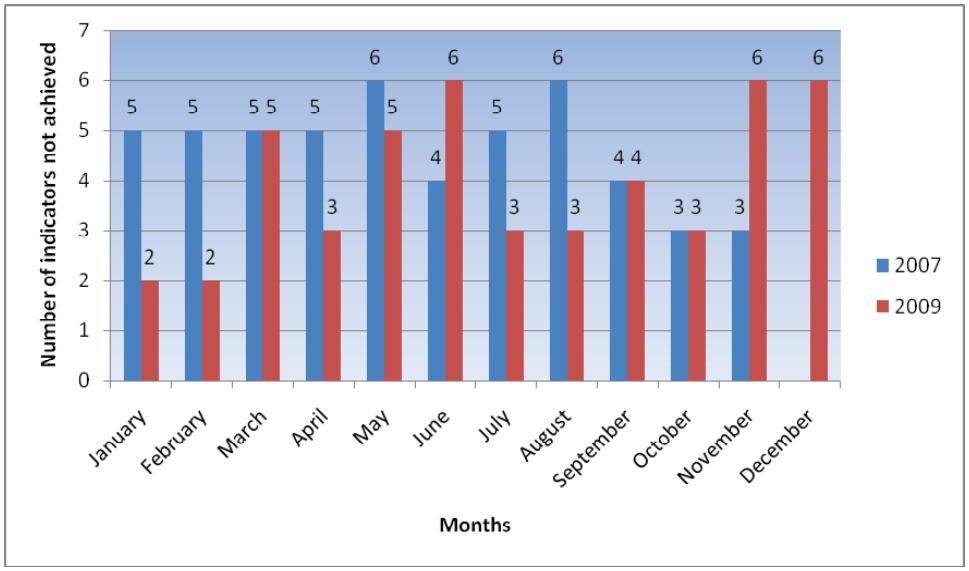
The data for 2007 and 2009 revealed that for each month in both years, except for December 2007 for which no analyses were conducted, the treated water produced by the Shelter Belt failed to achieve the seven drinking water standards. In 2007, for two months - May and August - Shelter Belt produced treated water in which six of the seven indicators failed to meet the drinking water standards. In addition, for five months, January – April and July - , Shelter Belt produced treated water in which five of the seven indicators did not meet the drinking water standards (see Figure 2:4). In 2009, there were three months – June, November and December – during which treated water that was produced by Shelter Belt failed to meet six of the seven drinking water indicators.

The three indicators that most often failed to meet the drinking water standards in 2007 and 2009 were: aluminium (85%), turbidity (75%) and total coliform (65%); and colour (100%), iron (86%) and turbidity (64%), respectively, see Figure 2:5. This is evidence that the colour removal, solids removal and disinfection stages of the Shelter Belt water treatment plant were not functioning effectively.

Except for November and December 2007, and February 2009 when no samples were analysed, the untreated water produced by Central Ruimveldt failed to achieve all five drinking water standards for each month of 2007 and 2009, see Figure 2:6. The untreated water produced by Sophia also failed to meet the five drinking water standards for each month of 2007 and 2009, except for December 2007 and February 2009 when no samples were analysed, see Figure 2:7. The water extracted and distributed by Central Ruimveldt achieved more of the water quality standards than that from the Sophia station.

For three quarters of 2007 (9 months), the untreated water from the well at Central Ruimveldt failed to achieve three of the five water quality indicators, while for six months of 2009, water from Central Ruimveldt failed to achieve three of the five water quality indicators, see Figure 2:6. In 2009, there were two months - August and December - when four of the five water quality indicators were not met.

During two months of 2007 - August and October - and one month of 2009 – June - , respectively, the water extracted and distributed by the Sophia well met none of the five water quality indicators, see Figure 2:7. Water produced by Sophia did not meet four of the five water quality indicators for five months each in 2007 and 2009.



Note: No samples were analysed in December 2007.

Figure 2:4 *Shelter Belt: Number of Failed Indicators for Drinking Water Standards 2007-2009*
Source: Based on GWI Statistics

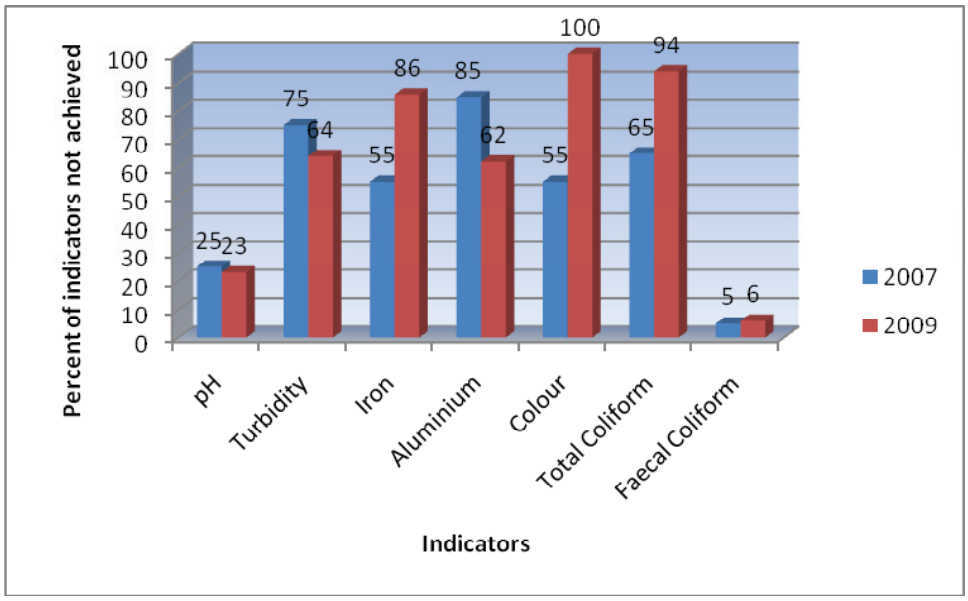
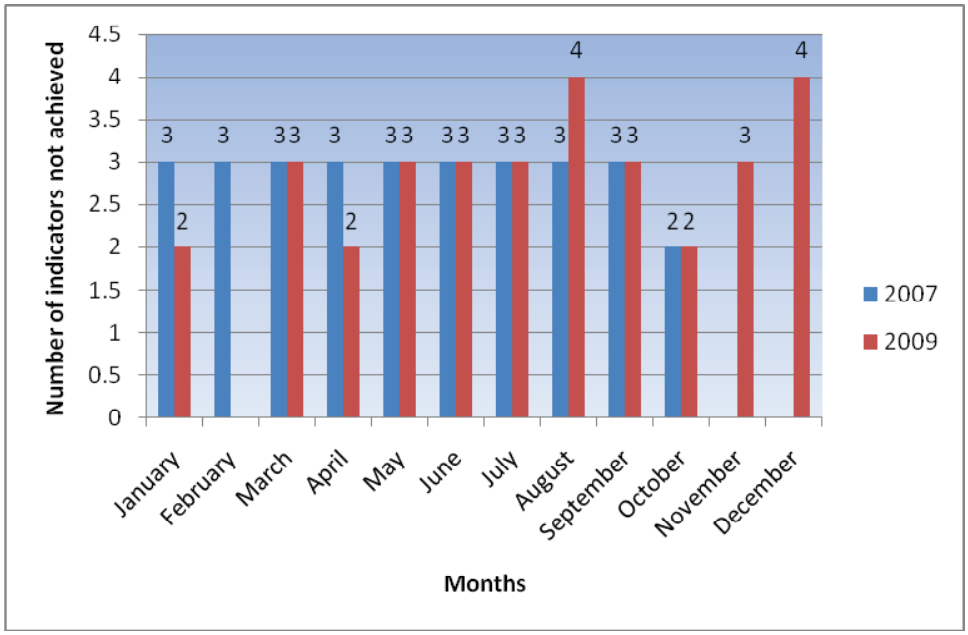
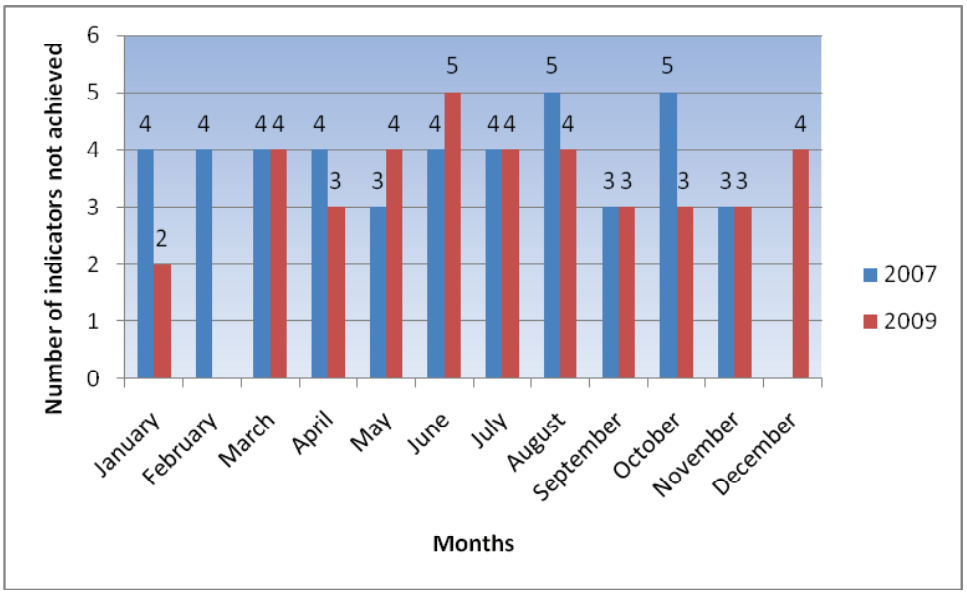


Figure 2:5 *Shelter Belt: Percent of Indicators Failing Drinking Water Standards 2007-2009*
Source: Based on GWI Statistics



Note: No samples were analysed in November and December 2007 and February 2009.

Figure 2:6 *Central Ruimveldt: Number of Indicators Failing Drinking Water Standards 2007 - 2009*
Source: Based on GWI Statistics



Note: No samples were analysed in December 2007 and February 2009

Figure 2:7 *Sophia: Number of Indicators Failing Drinking Water Standards 2007 - 2009*
Source: Based on GWI Statistics

The three most prevalent indicators failing the drinking water standards for the untreated water produced by Central Ruimveldt in 2007 and 2009 were: total coliform (95%), iron (75%) and turbidity (70%); and turbidity (100%), total coliform (93%) and iron (69%), respectively, see Figure 2.8. For the untreated water produced by Sophia, the three most prevalent indicators failing the drinking water standards in 2007 and 2009 were: iron (100%) and total coliform (100%), and turbidity (95%); and turbidity (100%), total coliform (93%) and iron (90%), respectively, see Figure 2.9. Given the fact that the water provided by Central Ruimveldt and Sophia was untreated water, the high proportion of indicators failing the drinking water standards, particularly for iron and turbidity, is expected. These results are evidence of the necessity to install water treatment facilities – specifically to remove iron and solids and for disinfection - at these wells in order to produce potable water of an acceptable quality.

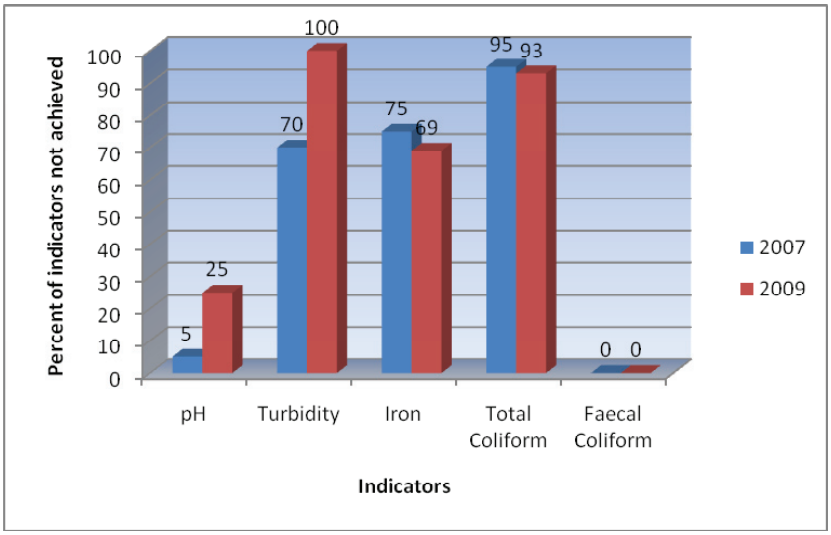


Figure 2:8 *Central Ruimveldt: Percent of Indicators Failing Drinking Water Standards in 2007 and 2009*
Source: Based on GWI Statistics

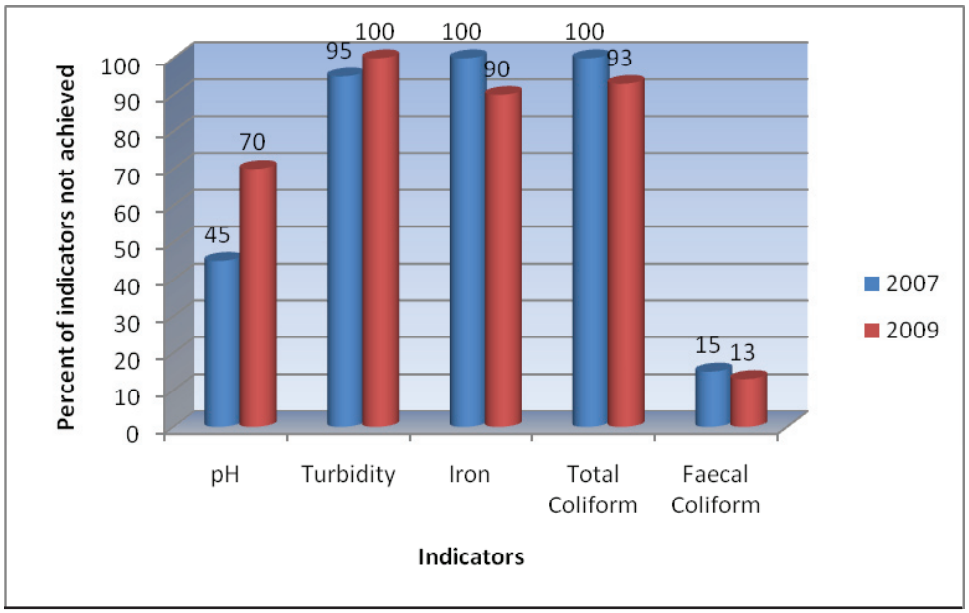


Figure 2:9 *Sophia: Percent of Indicators Failing Drinking Water Standards in 2007 and 2009*

An analysis of the quality of water received in 2007 and 2009 by customers within the catchment area served by the Shelter Belt, Central Ruimveldt and Sophia revealed that the poor quality of water produced by the water treatment system and well was the main reason for consumers receiving contaminated water. Reduction of positive pressure in the distribution system, leakages and breakages by citizens are also contributory factors. Total coliform, iron and turbidity were the indicators that most often failed drinking water standards, see Table 2:6.

Water supply system		Most prevalent indicators failing drinking water standards		
	Year	Most prevalent	Second most prevalent	Third most prevalent
Shelter Belt	2007	Iron (85%)	Turbidity (83%)	Aluminium (70%)
	2009	Total coliform (94%)	Colour (94%)	Turbidity (85%)
Central Ruimveldt	2007	Total coliform (84%)	Iron (79%)	Turbidity (41%)
	2009	Turbidity (97%)	Total coliform (93%)	Iron (64%)
Central Ruimveldt	2007	Total coliform (84%)	Iron (79%)	Turbidity (41%)
	2009	Turbidity (97%)	Total coliform (93%)	Iron (64%)

Table 2:6 *Shelter Belt, Central Ruimveldt and Sophia: Indicators most often Failing Drinking Water Standards for 2006*
Source: Based on GWI Statistics

2.2.4 Drainage Water

A general pervasive problem that severely affects urban areas is drainage. As noted by the National Development Strategy (2000):

The expanded boundaries of the city of Georgetown and other councils have placed severe strain and pressure on their drainage systems, due to the increased volume of flood waters and limited capacity of the drainage infrastructure to cope, especially during periods of high tides and prolonged rainfall. Together with

the heavy siltation of drainage canals and dumping of refuse, the lack of maintenance of the sea and river defences, drainage canals, and other infrastructure, is the main causes of poor drainage.

In Georgetown there is a system of drainage canals that contributes to hydrology management. These canals run primarily south to north and east to west to drain the city and beyond, into the Atlantic Ocean and Demerara River, respectively. Waste water from domestic, commercial and industrial premises and agricultural areas utilize these drainage canals.

In 2008 a survey of the quality of water in the drainage network of Georgetown was conducted. Plate 2.1 shows the drainage canals that were targeted.

Plate 2:1 *Selected Drainage Canals in Georgetown*
Source: Adapted from Google Earth

The survey revealed the following at the time of sampling.

- The pH of the water ranged between 6.66 and 9.1 and was therefore within the maximum allowable limits of the Guyana National Bureau of Standards (GNBS) for pH which is set at pH = 5.0-9.0.
- The total coliform and faecal coliform in the drainage water of Sussex Street, Princes Street, Laing Avenue, North Ruimveldt, Liliendaal and North Road canals was greater than or eqal to 1600 MPN per 100 mls which far exceeded the maximum allowable limit for total coliform of 400 MPN per 100 mls set by the GNBS. This is an indication that there was contamination with sewage, and contamination with the faecal matter of animals.
- Cadmium was not detected with the method utilised in any of the drainage waters sampled.
- The drainage waters sampled consisted of high amounts of suspended matter that varied along the canals and which in all cases exceeded the maximum allowable limit of 10 mg/l set by the GNBS, see Figures 2:10 and 2:11.

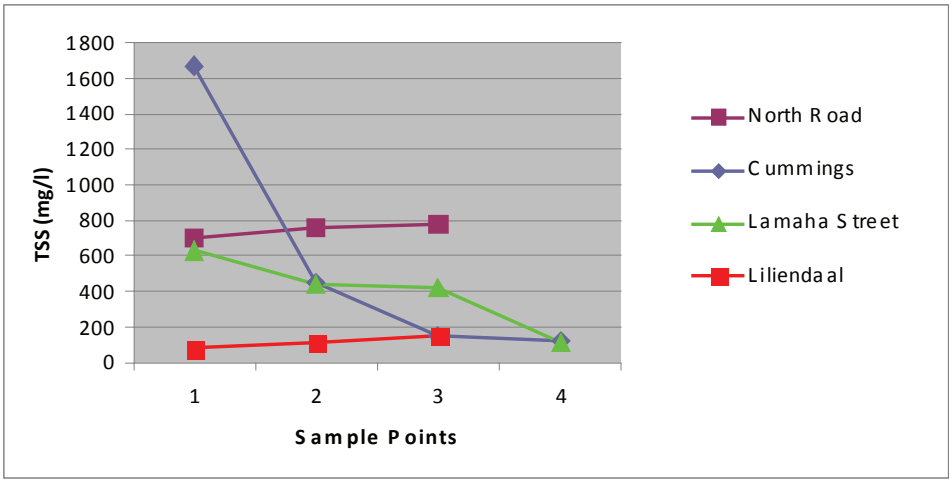


Figure 2:10 *Total Suspended Solids in the Drainage Canal Waters along North Road, Cummings Street, Lamaha Street and Liliendaal Canals*

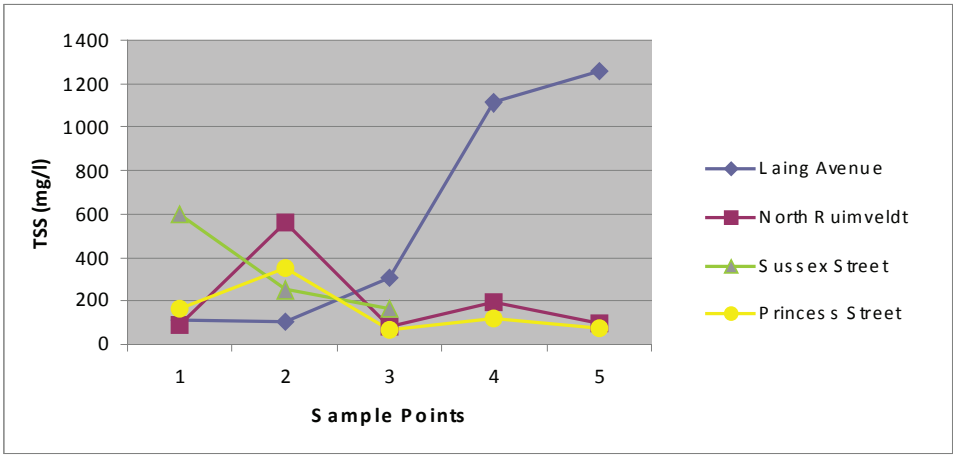


Figure 2:11 *Total Suspended Solids in the Drainage Canal Waters along Laing Avenue, North Ruimveldt, Sussex Street and Princess Street*

- The Total Kjeldahl Nitrogen levels in the drainage waters sampled were below the limit, see Figures 2:12 and 2:13. The levels were below the maximum allowable limits for ammonia (NH_4) as well as Nitrogen of 10 mg/l set by the GNBS. However, one sample point in the drainage canal of North Road, at the site of one of the municipal markets, was high - 36 mg/l.

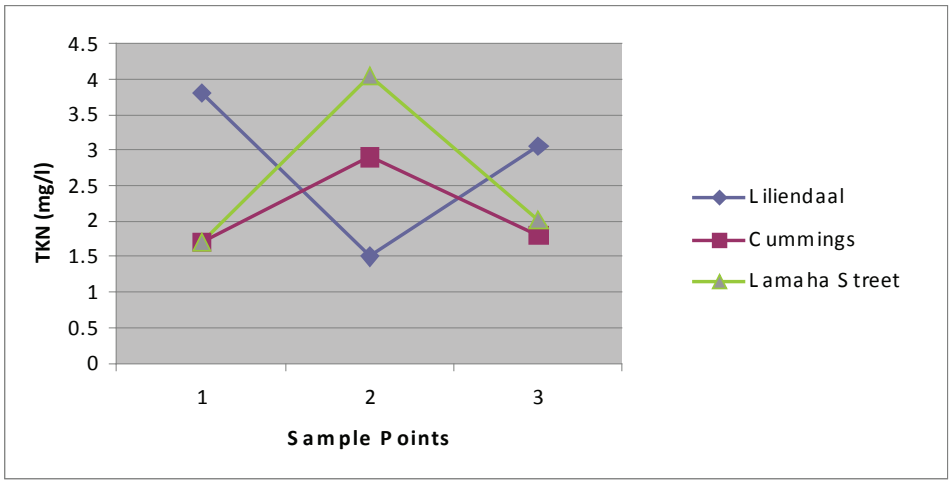


Figure 2:12 *Total Kjeldahl Nitrogen in the Drainage Water of Liliendaal, Cummings and Lamaha Street Canals*

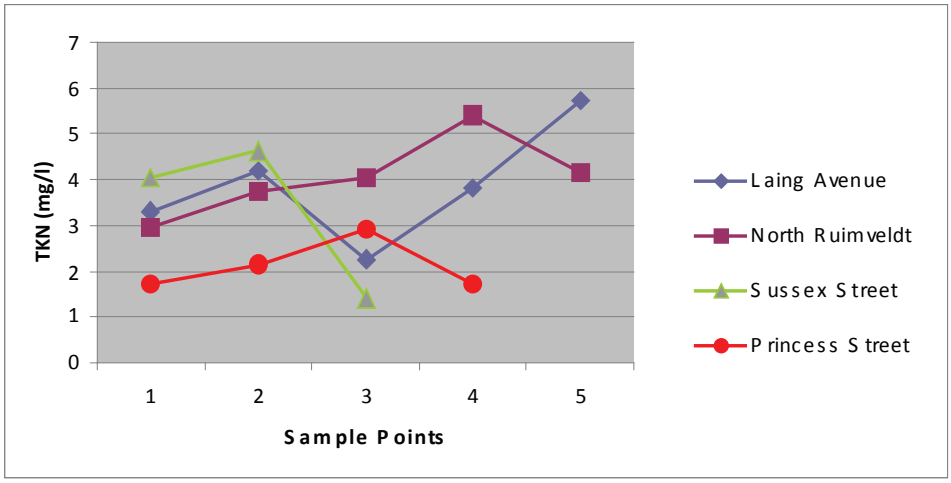


Figure 2:13 *Total Kjeldahl Nitrogen in the Drainage Water of Laing Avenue, North Ruimveldt, Sussex Street and Princess Street Canals*

- The phosphate levels in the drainage canals varied above and below the maximum allowable limit of phosphorus of 2 mg/l set by the GNBS, see Figures 2:14 and 2:15.

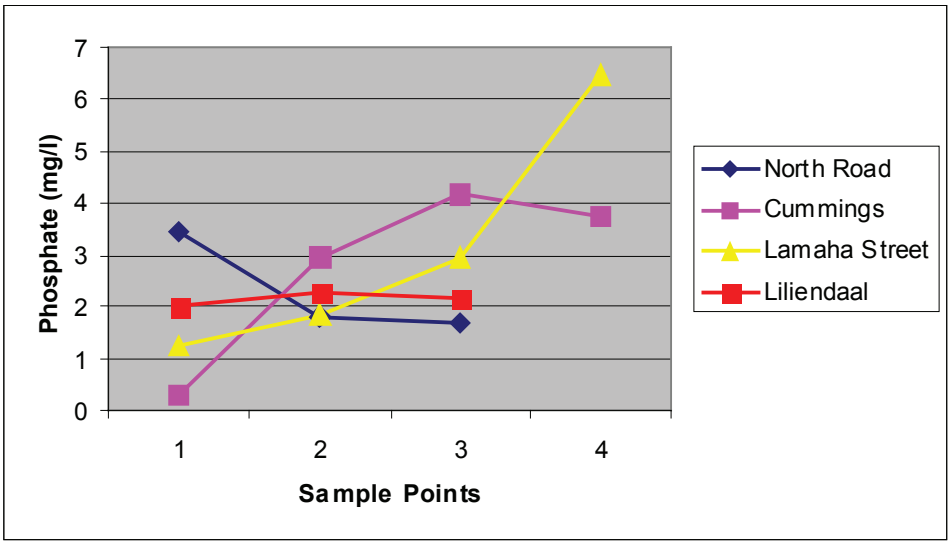


Figure 2:14 *Phosphate Levels in the Drainage Water of North Road, Liliendaal, Cummings and Lamaha Street Canals*

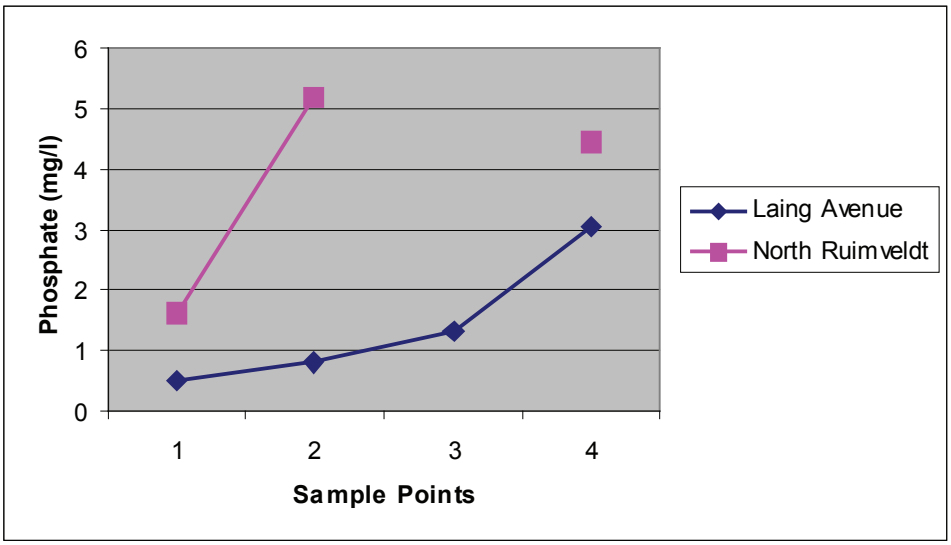


Figure 2:15 *Phosphate Levels in the Drainage Water of Laing Avenue and North Ruimveldt Canals*

In summary, the effluent in the drains was slightly more alkaline than the potable water used by the residents of Georgetown although it was within the maximum allowable limits of the GNBS. While there was no evidence of the presence of the heavy metal cadmium in these waters, there were high levels of suspended material from domestic and industrial waste and an indication of contamination by the faecal matter of animals and/or humans.

A strategy for water resources management was approved in May 1998 by the GWI. According to one of the reports, it proposed to incorporate the principles of integrated water resources management into the operations related to water resources and watershed management, with a view to conserving and making efficient use of water. The strategy proposed a comprehensive incentive-based, participatory, and environmentally conscious approach. It seeks to provide operational guidelines in support of efforts in the region to achieve a change from the fragmented (subsectoral) approach to an integrated (sectoral)

approach, and from an emphasis on increasing supply to an emphasis on the sustainable management of demand. This approach seeks to recognise the social, economic, and environmental value of water, while also recognizing the need for the participation of the communities and the private sector. It also incorporates issues of equity and Sources management, such as modernization of the state, drinking water, sanitation, and watershed management. In addition to offering support for implementing the strategy in the operations, the development of analytical guidelines in four areas continued: policy instruments (privatization, water markets, and trading in water rights), integration of the function and services of fresh-water ecosystems into water resource development projects, the legal framework, and an analytical framework for solving the institutional situation. As a result of these efforts, the following technical studies were published and disseminated: "Integrating Freshwater Ecosystem Function and Services with Water Development Projects". Georgetown's other source of potable water is the Lamaha Canal, a surface water source.

2.3 Land and Waste Management

2.3.1 Land

The key environmental problems affecting the urban landscape arise from several pressures/causes. Chief among these are:

- Lack of resources to implement programmes. The City Council's Revenues fall short of its Expenditures. Part of the reason for this is that forty to fifty per cent of the city population is in default with their taxes;
- Outdated legislation and limited enforcement capacity. As a consequence defaulting rate payers openly defy city regulations. Arguably, forceful implementation of the by-laws is compromised by a number of factors, including: Conflicts between the City administration and policy makers;
- Lack of technical resources due to lack of finances;
- Authorized and unauthorized urban development;
- Lack of appropriate land use plans and planning;
- Overlapping institutional responsibility (no collaboration of entities); and
- Current volumes of waste for disposal which render existing current waste disposal facilities inefficient and ineffective.

The principal driving forces are: (i) urbanisation; specifically rural to urban migration, urban to urban migration, and natural increase[3]; and (ii) the currently high bank interest rates that mitigate against low-income would-be homeowners borrowing, resulting in unmet demand for housing.

2.3.2 Waste Management

For decades, Georgetown has been showing clear signs of stress on its ability to provide adequate services to citizens including infrastructure maintenance and cleansing. The high population density in the City, coupled with expanding city boundaries and a concomitant lack of adequate infrastructure, have particularly exacerbated the problem of waste disposal.

[3] Region 4, which includes Georgetown has a population density of 139 persons per sq. km and accounts for 43.1 per cent of the total population, and a mere 1 per cent of the land area (Population and Housing Census, 2002).

2.3.2.1 Solid Waste Management

The Guyana Country Environmental Profile, (2005, pp. 25) notes that solid waste management is compounded by five factors, namely:

- Absence of effective record keeping and statistical data on the type of waste generated by commercial, industrial, medical, agricultural, transportation activities;
- Lack of a national policy or strategy to deal comprehensively with waste management;
- Inadequate infrastructure and services for collecting, transporting, treating and disposing of waste;
- Poor health and safety compliance and enforcement mechanisms associated with integrated waste management and disposal; and
- A lack of public awareness and education programmes.

In short, inadequate institutional capacity to plan or even finance implementation of a modern eco-friendly strategy.

The Municipal Solid Waste Management Department comes under the Georgetown Municipality. A recent report funded by the IDB has estimated that 247 tonnes of mixed waste is disposed of on a daily basis at the Mandela Landfill Site. This site is in the heart of the city in close proximity to residential and recreational facilities and has been in operation since 1993. When initially established the site was operated as a sanitary landfill with an intended life of two years, while the identification of a location and the construction of a more permanent facility was being pursued. Severe strain has been put on the landfill with the protracted period taken to establish a new facility. The IDB funded Georgetown Solid Waste Management Programme which is currently being executed has as its main component the construction of a sanitary landfill site at Haags Bosch on the East Bank of Demerara, for access by January 2010.

In another study, by Guyenterprise Advertising Agency, "Impact of Solid Waste in Georgetown" also funded by IDB in 2004, it was found that 117 tonnes of mixed waste is generated daily in the city, including paper, cardboard, plastic, textile, wood, metal, glass, rubber soil and dirt among others, all of which is recyclable. However, there is limited waste-recycling being done in Georgetown. Some of the materials are removed informally by Litter Pickers both at the Landfill and the source of generation. The cardboard goes to Caribbean Containers Inc., while some of the other materials such as metals, batteries and glass bottles are exported for recycling and some is reused in local industries.

According to the information obtained from a sectoral analysis that was done in 2004, the national per capita production of waste ranges from 0.23 to 1.76 kg/day, including Georgetown. A consultancy firm funded by the IDB and complemented by input from the SWM Department, reporting on the origin and nature of wastes in 2000 stated that nearly 50 percent of the total waste stream is domestic, 17 percent is drainage and street cleansing waste, 10 percent commercial, 8 percent is garden and parks green waste, 6% abattoir and markets, 5 percent industrial and 4 percent construction and demolition waste. The waste comprises around 50% organic putrescence, 14 percent cardboard and paper, 10 percent each for textiles and plastics, and the remainder debris, like dirt and rocks, metal, wood and glass. In relation to storage, many anomalies were detected both in household and public spaces. In the statute books are obsolete regulations governing size and types of waste containers that are permissible. The Street cleansing service is provided only in downtown areas, supposedly since most streets lack sidewalks which makes them difficult to cleanse.

Ninety-five percent of the municipal waste collection services in Georgetown have been outsourced, and waste collection coverage is reported to be 87 percent. The Solid Waste Department collects 5 percent of the total waste, mostly special wastes (hospital, abattoir, and voluminous wastes). Frequency varies from 6 times a week in large waste generators like commercial entities in central Georgetown's hospitals, markets and the abattoir. Waste is removed once or twice a week in the residential areas. As part of the contractual

arrangements with the collection contractors there is also a facility for bulky waste collection which can be requested by domestic customers once per month.

2.3.2.2 Sewerage Management

The GWI discharges its responsibility for sewage disposal via two networks installed in central Georgetown and Tucville. The central Georgetown Sewerage Network is the main network designed to serve a population of 60,000. It includes all the communities from Kingston to Albouystown between Vlissengen Road and Lombard Street. This network was commissioned in 1929 and the system was intended to remove kitchen, storm and lavatory waste water. Electromechanical pumps installed at twenty-four (24) pump stations across the city are connected to a single outfall which discharges the untreated waste directly into the Demerara River (Halcrow et al, 1993). The network was designed with the capacity to discharge approximately 5 million gallons of waste water per day with each pump discharging approximately 400 gallons per minute. The Tucville Sewerage Network is the secondary sewerage system. It was commissioned in 1970 and was designed to serve a population of 15,000. It is composed of a collection of gravity sewers that drain into a treatment plant. This treatment plant is intended, in design, to physically and biologically treat domestic waste water (Halcrow et al, 1993).

In the original design, each of the stations in the sewerage system was equipped with two pumps, one on duty and one on standby. During the period 1984 – 1987, as part of a rehabilitation programme, both the duty and standby pumps were replaced at all but one station. However due to chronic underfunding, to date not a single station currently has two pumps that work (Halcrow et al, 1993). As a matter of fact, reports from the Chief Engineer/Sanitation Manager indicate that currently there are only nine (9) operable pump stations in the Central Georgetown sewer system, this means that the existing network is operating beyond its designed capacity[4].

The absence of a screening process in the design of the two sewerage networks has led to large volumes of solid waste entering the system. These include plastic bags, newspapers, condoms, sanitary napkins and clothing. This waste causes blockages in the yard sewers and in the inlets of the pumps. The pumps are thus required to operate under a greater load causing the electric motors to fail (Halcrow et al, 1993). This is further exacerbated by the lack of grease traps at many restaurants along with the dumping of various types of solid materials such as: rags and kitchen waste into the inspection chambers and gullies. These materials clog the system resulting in blockages, sewerage overflows and inevitably severe damage to the sewer network. The Tucville Network also has some other unique problems since the sewer lines and manholes are located in alleyways that are often flooded resulting in overflowing manholes, inspection chambers and gullies (Halcrow et al, 1993). This situation poses a significant threat to public health since it exposes citizens to micro-organisms that cause infectious diseases such as typhoid fever, dysentery, gastroenteritis and hepatitis.

The GWI has recognized the importance of upgrading and modernizing this sector. To this end, GWI is currently implementing a capital programme valued at in excess of US$300M funded through the national budget and IDB loans to rehabilitate the Sewerage Networks. By the end of 2009, rehabilitation works on the Tucville Sewage Receiving Station and linking of this station to the Georgetown Sewerage Network were to be complete. In addition, rehabilitation of all the Georgetown Sewer Stations which will involve the replacement of submersible pumps and changing of all the sewerage riser mains should also be completed. It is hoped that these improvements will significantly reduce the number of blockages and overflows experienced by the networks. Funding will soon be sought to conduct a feasibility study on the installation of a sewerage treatment plant[5].

[4 & 5] Personal Communication Rensforde Joseph, Sanitation Manager(ag), GWI.

2.3.2.3 Medical Waste

Currently approximately one tonne of waste is collected daily utilizing the Council's transportation. This waste is buried at the Le Repentir Landfill Site. There is need for a study of this waste stream to ascertain its current composition and to identify appropriate administrative and legislative changes required to improve its management and also, to identify appropriate equipment for the collection and disposal of this waste stream. These matters are proposed to be addressed as a component under the IDB Funded "Georgetown Solid Waste Management Program".

Proper final disposal is not practised in Georgetown, since the Le Repentir Landfill site can not be classified as a sanitary landfill facility. The project for the construction of Haags Bosch is underway and is expected to address the disposal of municipal, commercial/industrial and some hazardous waste.

2.4 Natural Disaster Risks

The low lying nature of the coast makes it susceptible to flooding from overtopping of the sea defences and following long periods of intense rainfall.

Using available tide gauge data for the period 1951 to 1979 for Port Georgetown, the mean sea level rise using linear extrapolation was reported to be 10.2 mm/year, see Figure 2:16, which is about 5 times the global average. With an increasing carbon dioxide concentration, predictions indicate that along the coast of Guyana the mean sea level rise will be about 40 cm by the end of the twenty first century, that is, at a rate of approximately 4 mm/year (GoG, 2002). Therefore, this suggests an increase in the probability of occurrence of more frequent floods for the future.

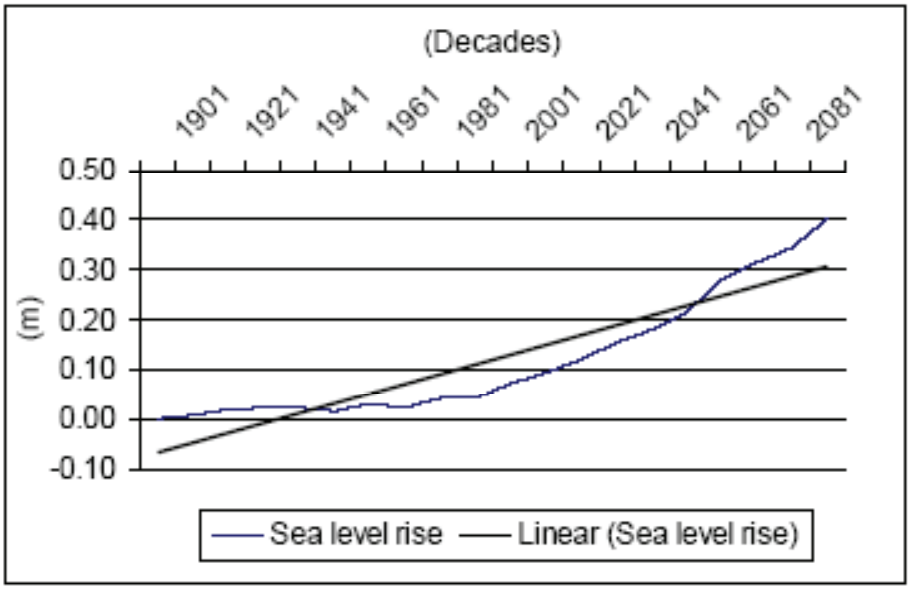


Figure 2.16: *Observed Sea Level Changes at Port Georgetown, Guyana (1951 – 1979)*
Source: GoG, 2002

With an increase in the carbon dioxide concentration, predictions are that the rainfall will decrease. While there is the possibility of a lesser number of rainy days in a year, it is also predicted that the daily intensity of precipitation will increase. This can mean an increase in the probability of occurrence of more frequent droughts and floods for the future. (GoG, 2002).

Guyana's coastal plain, which lies approximately two metres below sea level at Mean High Water, is very vulnerable to floods after prolonged periods of heavy rainfall, or as a result of breaches in the sea defences. Since most of Guyana's population and key investments are located in Georgetown, the city (unless risk management steps are taken) will suffer grave socio-economic and environmental consequences of floods. It is noted that the severe floods in the coastal zone in January 2005 affected 25% of the population[6], and resulted in total losses equivalent to 60% of GDP for that year.

Many current initiatives related to climate change adaptation and disaster management are currently undertaken by the Guyana government (See Chapter 4); nevertheless, several challenges need to be overcome to ensure national capacity to reduce the risks associated with meteorological disasters, particularly floods. These challenges include (i) climate change modeling to accurately predict and evaluate the impacts of sea level rise and climate change; (ii) institutional strengthening through human resource and technical capacity building; (iii) mainstreaming disaster management in the national policy framework; (iv) improved solid waste management; and (v) enhanced public awareness and participation.

Major Floods recorded for the city

2005- 200,000 people were affected, 35,000 of them were severely affected and homeless. We can estimate that at least 50 per cent of those affected are children. The total loss incurred by those affected was huge and it took some residents extensive periods to recover, while others are still trying to recover (UNICEF (2006).

1934- A major flooding disaster that affected Georgetown and the entire East Coast.

1921- A heavy rainstorm, lasting over twenty-four hours, flooded some city streets and swept away bridges. Every decade since the 1920s has had flooding and sea breaches on a smaller scale.

1855- There was what was then termed the "Kingston great flood." Rodway explained the sea rose so high during spring tide and in the course of a few hours swept away nearly the upper part of the embankment, and inundated the military land and the adjoining suburb of Kingston." The efforts of recovery from this 1855 disaster led to a seawall being built up to Kitty.

Effects of tropical cyclones on Georgetown

All locations south of 10° N (Guyana is between 1° to 9° north latitude) have less than a 1% chance of a direct hit, though Georgetown (6.82° north latitude) is demarcated the easternmost border for tropical cyclone warning breakpoints. Georgetown is rarely affected by tropical cyclones. However, rainfall sometimes occurs as a result of a tropical wave outside of Guyana's coast, moving eastwards, and interacting with the Inter-Tropical Convergence Zone.

Georgetown's preparedness

- Education and awareness programmes- Government has been equipping citizens with the necessary knowledge and skill to adequately protect themselves during times of severe flooding.
- Task forces have been working on drainage in Georgetown and the East Demerara Conservancy.
- Rehabilitation of hard structures such as sea wall.
- Initial National Communication and Action Plan developed.
- Civil Defence Commission is formulating a National Flood Preparedness and Response Plan in response to global warming and its effects on rainfall and sea levels.
- Government is collaborating with international organisations such as UNDP for the development of a strategic guidance framework that will tackle issues of recovery, rehabilitation and management coordination in reducing the impact of such events.

[6]http://www.reliefweb.int/rw/rwb.nsf/db900sid/MHII-6974K5?OpenDocument&rc=2&cc=guy

Plate2.2: *The Seawall in Georgetown Protects the Capital from the Sea*
Source: Joint UNEP/OCHA Environment Unit, 2005

2.5 Biodiversity

Very little has been done in terms of investigating the biodiversity present within or even around the city of Georgetown. Planning within the city was originally done with the aim of establishing a Garden City where the wood and concrete structures would blend in with the natural environment. This concept was realised in a number of areas within the city. However, over the years this concept was basically sidelined and there has been a decline in the amount of green space. The most obvious concentration of biodiversity in Georgetown is found within the Guyana Zoological Park and Botanical Gardens.

The Botanical Gardens were established between 1879 and 1884 on the site of an old abandoned sugar plantation by a Trinidadian J. F. Waby according to plans by the botanist H. Prestoe. It hosts a variety of floral, and consequently, faunal diversity, and remains today a popular spot for many bird-watchers, and botanists. The Zoological Park is located as an adjunct to the Botanical Gardens and houses a collection of approximately 30 species of mammals, 40 species of birds, 15 species of reptiles and 20 species of fish.

Guyana's national flower the Victoria regia Lily and the Manatee or seacow are shown in the plates below.

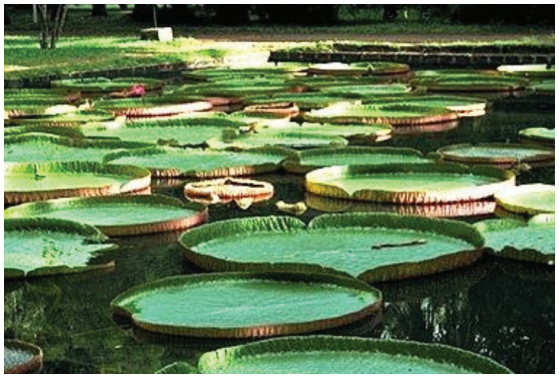


Plate 2.3: *Victoria regia Lily*

Plate 2.4: *Manatee*

Source: www.guyanazoo.org.gy/manatee

According to the Guyana Amazon Tropical Birding Society, more than 200 species of birds from 39 families have been recorded in Georgetown. The families include many sought after bird species in Central America, the Caribbean, and northern South America. Guyana's larger families include: Herons (17 subspecies); Hawks, Eagles (36 subspecies); Falcons, Caracaras (15 subspecies); Rails (16 subspecies); Sandpipers (23 subspecies); Gulls, Terns, Skimmers (15 subspecies); Parrots (29 subspecies); Nighthawk, Nightjar (10 subspecies); Swifts (11 subspecies); Hummingbirds (38 subspecies); Woodpeckers (20 subspecies); Ovenbirds (28 subspecies); Wood creepers (18 subspecies); Typical Antbirds (49 subspecies); Tyrant Flycatchers (111 subspecies); Cotingas (16 subspecies); Emberizine Finches (25 subspecies); and New World Blackbirds (24 subspecies)[7].

Two subspecies of Parrots found in Guyana (Psittacidae) are shown in the plates below[8]

Plate 2.5: *Scarlet Macaw*
Source: Gerard op Vet Veld

Plate 2.6: *Red Fan Parrot*
Source: Chris Collins

The following are ecosystems that form part of Georgetown or are contiguous to Georgetown:

- The marine ecosystem – this includes saline mudflats, mangrove forests, sand and shell beaches.
- The estuarine ecosystem – this includes the wetlands that occur at the mouth of the river where the oceanic water is diluted by freshwater.
- The riverine ecosystem – this includes tidal wetlands which occur along the river banks.

As part of a recent environmental impact assessment, the flora and fauna in the coastal area of Kingston was studied by Environmental Management Consultants in 2008.

Their observations of flora were made on both sides of the seawall; the beach zone between the ocean front and the seawall; as well as between the seawall and the public road. The Report documented the following:

- The vegetation distribution in the beach zone was sparse at the region of the low water mark but increased as progress was made up to the seawall.
- The main species closer to the low water mark were Ipomoea sp. This was followed by Crotalaria sp and then mixed patches of Phyllanthus amarus (Suriname bitters), Ipomoea and Crotalaria sp. These were intermixed with young Terminalia catappa (almond nut) plants. There were a few small Hippomane mancinella (manchineal) plants.
- Closer to the seawall were different grass species again mixed with Ipomoea, Terminalia catappa (almond) plants and some Coccinia grandis (baby pumpkin) vines. The vegetation present within this zone is typical of beach vegetation both in content and distribution.

[7] http://www.guyanabirding.com/trellis/birding
[8] http://www.guyanabirding.com/trellis/feature_bird_E_news_June_08

In the zone between the seawall and the public road the vegetation present was primarily weeds. The main component of this vegetation was various species of grasses. Observations on the fauna indicted that they were all highly mobile and migratory species that easily adapt to changing environments. The majority of fauna observed were avian which are common to Guyana's coast, with lower levels of mammals, reptiles and amphibians.

Findings revealed that the avian species were transient and migratory and generally found in areas inhabited by humans. The avian fauna found at the project site consisted of: Swallow, Blue sakie, Cattle egret, Black vulture, Ground Dove, Hummingbird, Blue-Grey Tanager, Greater Kiskadee, Lesser Kiskadee, Pied Water Tyrant, Roadside Hawk, Semi Palmated Plover, Smoothed- Billed Ani, Snail Kite, House Wren and Yellow Plantain. The Mammals, Reptiles and Amphibians observed at the project site are set out in Table 2.7.

COMMON NAME	FAMILY	SCIENTIFIC NAME
Crapaud	BUFONIDAE	Bufo marinus
Frog	HYLIDAE	Hyla sp
Mongoose	HERPESTIDAE	Herpestes auropunctatus
Lizard	TEIIDAE	Trapidorus hisperus
Salipenta	TEIIDAE	Tupinambus tebuixin

Table 2.7 *Amphibians, Mammals and Reptiles at project site*
Source: EMC, 2008

2.6 Marine and Coastal Resources

Freshwater, coastal and marine resources are important natural resources for potable water and water for industries, fisheries, biodiversity, recreation, and water transportation.

Georgetown is located at the mouth of the Demerara River on the east bank. Along the Demerara River there are regions of freshwater and of brackish water as indicated in section 2.2.2. SENES (2006) reports that in the Demerara River, high flow occurs during two periods, the longest from April to August and the shorter from November to January. The wide variation in rainfall between seasons and from year to year is reported to cause a variable stream flow.

The coastal zone, which lies between the seaward margin of the continental shelves (offshore) and the inland limits of the coastal plains, reported is an area of highest biological productivity on earth (SENES, 2006). The coastal plain supports highly productive habitats: mangroves, swamps and mud flats.

The water resources along the Atlantic coast are marine. At Georgetown there are two low and two high tides occurring per day. The mean high and low water neap tides at the Demerara Bar are 16M (52.44 ft) Georgetown Datum (GD) and 14.9M (48.54 ft) GD, respectively (EMC, 2008).

The piraucu is a freshwater fish that is found in the Demerara River. The snapper and grouper are found in the Atlantic Ocean, while shrimps are common in the sediment-laden currents near the mouth of the Demerara River and off the coast.

The coastal and marine environment is faced with social, economic and ecological stresses that impact on the coastal zone. The stresses, which may aptly be referred to as pressures, are identified by the Integrated Coastal Zone Management Plan for Guyana (2000) as:

Social stresses, caused by the:
- Poorly coordinated sectoral approach to the management of coastal resources used and the coastal zone;
- Improper waste water disposal; and
- Low level of awareness and expertise about management of coastal resources.

Economic stresses, caused by:
- Flooding due to overtopping of weakened sea defences and associated high cost of maintenance improper drainage;
- Quick profit enterprises, which degrade coastal resources, for example beach sand and seashell removal; and
- Lack of understanding of the economic contribution of coastal resources to society.

Ecological stresses, caused by:
- Beach sand and shell removal;
- Over harvesting of mangrove vegetation;
- Excessive targeting of certain marine fish species;
- Habitat destruction;
- Degradation of water quality due to contamination from solid wastes, pesticides and fertilizers from agricultural fields; and
- Degraded fisheries habitats and lack of alternative livelihoods.

Stress from Natural Effects, as a result of
- Sea level rise due to global warming;
- Changes in coastal processes e.g. movement of mud shoals resulting in erosion;
- Modification of run-off patterns and sedimentation; and
- Floods.

As a result of these pressures the mangroves which act as a natural defence against the onslaught of the sea has deteriorated due to the harvesting of mangroves for fuel wood and the natural cycle of erosion and accretion. In Region 4, which includes Georgetown, the Guyana Forestry Commission estimates that approximately 3,540 hectares of mangrove remain[9].

2.7 Built-up Environment

2.7.1 Urbanization and Squatting

Housing is a basic requirement for humanity, providing not only protection against the physical environment, but also security and privacy. For low income families, the satisfaction of this basic need is often a difficult task. The lack of which can lead to the creation of squatting areas and slums, both of which are accompanied by a host of developmental (social, cultural, economic and ecological) problems.

Urban squatting became widespread and threatened to consume all available lands during the economic recession in the 1980's (Bynoe, 1997). When the structural adjustment programme instituted at this time began to take effect, farmers permanently moved into temporary houses on lands previously primarily used for agricultural activities and improved/ fortified them so as to cut costs (Scott, 2000). As real wages declined drastically and consumer prices skyrocketed, urban residents became desperate for housing (Bynoe, 1997). This, accompanied by a nationwide shortfall in accommodation particularly in Georgetown, lead to squalid urban housing conditions and overcrowded premises that householders were no longer willing to live within (Peake, 1997).

[9] Mangrove Management Plan, 2001

In 1970 the boundaries of the city were shifted and Georgetown expanded from 6.5 km^2 (2.5 sq miles) to 39km^2 (15 sq miles). Its new eastern and southern boundaries became Industry Crown Dam and Agricola respectively instead of Vlissengen Road and Sussex Street. Since then, most of the new housing development has taken place in the southern part of the city, including Tucville, Stevedore Housing Scheme, Lamaha Park, Lamaha Springs and Evans Philips Park. Supporting infrastructure such as paved roads, water and electricity supply networks, schools, recreational areas and health centers was also developed. However in spite of these extensive developments in Georgetown, unauthorized housing, or squatting, continues to pose a challenge to the Municipal Authority.

There are now 38 squatting areas in Georgetown. Of these, ten (10) are on the eastern edge of the city and are collectively referred to as Sophia Squatting Area. The lands in that (former) Green Belt had been owned

Area #	Area Name	No. of Households	Population
1	Le Meriden-Pegasus Seawalls	29	101
2	Guyana Sports Club Ground	11	57
3	Lamaha Canal Railway Embankment	174	684
4	Camptown Side Line Dam	6	22
5	Mandela Avenue Phase I	44	206
6	Mandela Avenue Phase II	34	152
7	Meadow Brook Side Line Dam	50	268
8	Mandela Avenue Reserve	3	6
9	Tucville/Telecoms Dam and Playground	23	81
10	Guyhoc/East La Penitence Side Line Dam	17	63
11	Tucville Side Line Dam (a.k.a.Tucville Squatting Area)	40	188
12	Tucville/Turning Point Squatting area	36	173
13	Stevedore/Postal Reserves	60	206
14	Aubrey Barker Road Reserve	12	39
15	Sanata Drive Industrial Backlands, Ruimveldt (a.k.a. Container City)	40	114
16	Rasville	45	188
17	East Ruimveldt Front Road Reserve	57	248
18	West Ruimveldt Front Road Reserve	98	435
19	Laing Avenue Canal Reserve	23	103
20	Laing Avenue Abandoned Cemetery	21	126
21	The Island Reserve (West La Penitence)	11	51
22	Yarrow Dam (a.k.a. Company Path)	47	144
23	La Penitence Side Line Dam	110	484
24	Independence Boulevard (a.k.a. Punt Trench Dam)	2	14
25	Riverview Seawalls	31	130
26	Textile Squatting Area (a.k.a. Textile Dam)	32	124
27	Jackson Dam, East La Penitence	6	36
28	Freeman Street Reserve, East La Penitence	13	63

Table 2:8 *List of Squatting Areas on the Reserves of the City of Georgetown*
Source: Municipal Development Plan 2008 - 2013

by the Guyana Sugar Corporation (GUYSUCO), but were acquired by the Central Government which then deemed squatting in that area as being **"Tolerated for Regularisation."** This applies mostly to squatting areas existing prior to January 1, 1998 that the technical staff of the Central Housing and Planning Authority (CH&PA) have assessed can be converted to **"regular"** housing schemes. The squatting areas of Sophia, are still under the administration of the central government, but are in varying advanced stages of the regularization process. They will eventually be handed over to the municipality, which will be able to collect rates from householders that are supposed to cover the cost of the services provided.

The remaining 28 squatting areas in Georgetown are not eligible for regularization and are classed as **"Zero-Tolerance"** squatting areas. This might be because the area is reserved for designated national, regional, municipal, neighbourhood or community projects. Such zero-tolerance squatting areas in Georgetown are most often located in playgrounds, sea-defence reserves, reserves along major drainage canals and roadways, railway embankments, "old" cemeteries, and areas reserved as industrial sites.

In the perception of squatters, however, "zero-tolerance" is not as rigid and inelastic a concept as the term suggests. It appears that there is some measure of 'incremental' tolerance by the authorities allowing them some degree of tacit 'comfort and security' while a programme to ultimately benefit them is developed. Their expressed hope is to acquire title for the plot they occupy or be relocated to areas considered suitable and convenient or at least to be given 'Letters of Comfort' allowing them to occupy the present plots for an extended period of time without fear or removal.

These squatting areas remained largely unnoticed or were ignored until they had become too large to be allowed to continue. As such, various sanctions were utilized including forced removal of the offending users, however, for the squatters occupancy meant ownership and such efforts proved futile and/or were met with hostility. Householders simply relocated to another spot within the area or returned to the same space after the authorities left.

This forced the authorities to consider other alternatives. Following the belief that access to land titles and to capital (to aid self-financing) would strengthen the capacity of the poor to obtain affordable housing, the government settled upon one of two paths: the regularization of those within the Green-Belt Zone and the relocation of those within the drainage reserves, railway embankments and land initially allocated for other crucial services.

The first approach, though slow, has met with some amount of success, although the physiographic nature of the area limited the extent to which infrastructure, e.g. drainage and roads could be upgraded.

Plate 2.7 *Physical Condition of Squatting Establishments*

Plate 2.8 *Squatter Home*
Source: Bynoe (2007)

The second approach saw the creation of a number of new housing schemes, targeting the various groups seeking housing (i.e., low and middle income). Yet occupancy within these areas, particularly low income areas remained low. The ad hoc creation of housing schemes that often lacked sufficient established infrastructure and other necessary social services resulted in a hesitancy to reallocate to such areas.

2.7.2 Inner City Decay

Allied to the problem of squatting, is that of inner city decay and the overcrowding of dilapidated and often unsafe buildings in the downtown area, particularly between Main Street and Water street, an area known as Tiger Bay. Many of these buildings were once commercial buildings, and many are owed by families that have migrated. In any event dozens of families, often with single women as the head of household crowd into these unsafe dwellings with their children in an attempt to find affordable housing in locations that give easy access to jobs and schools. In some instances slum landlords charge rents, in others, the occupancy is not quite legal and may constitute invasion of an abandoned building.

CHAPTER THREE: IMPACTS

The state of the environment (outlined in Chapter 2 of this Report) has impacted on natural ecosystems and their constituent elements as well as the quality of life of the urban population, the built up environment and the economic activities that stimulate the development of Georgetown.

3.1 Impact on Natural Systems, Quality of Life and Human Health

3.1.1 Water

The urban population of Guyana currently experience certain socio-economic impacts as a result of the environmental and health threats posed to water resources in Georgetown.

With water quality standards failing to meet the minimum levels set by the WHO in several areas (especially total coliform, iron and particles) there is clear evidence that there is contamination of potable water sources. In addition to potable water contamination, waste water drainage systems are shared by industries, businesses and households of the urban population resulting in the pollution of drainage water which then fails to meet the GNBS standards for some parameters. As with the potable water sources, high levels of particulate matter and coliform were also recorded in the urban waste water system.

Sanitation and environmental health problems are on the rise in Georgetown. These occurrences are attributed mainly to the lack of potable water and sanitation services in marginal areas in Guyana, especially recent squatter settlements, combined with the deterioration in water quality and sewerage infrastructure over the last 20 years, improper purification and distribution of potable water supply and last but not least poor monitoring of discharge activities in the local drainage channels that serve this town. While accurate data concerning health indices are lacking, studies have shown that approximately 25% of deaths occur in children under five years old. The major causes attributed to these deaths are as a result of infectious intestinal diseases related to inherent problems of deficient water and sanitation services. In addition, diarrhoeal diseases (usually occurring because of high coliform levels in water) continue to be the major cause of morbidity and mortality in the capital city.

It is reported that malaria and dengue are endemic in Guyana. Moreover, lymphatic filariasis (which can lead to elephantiasis, transmitted by the Culex fatigans mosquito, which breeds in pit latrines, sewers and septic tank overflows is prevalent in Georgetown. Poor drainage, lack of adequate resources to maintain drainage system, inadequate sanitation services and pollution of waterways[10] have resulted in stagnation of polluted water within the city, creating a breeding ground for this deadly mosquito. This occurrence has resulted in approximately 20 – 25% of the city's population being infected. A few years ago, several cases of cholera were diagnosed, but the origin could not be substantiated.[11]

The state of the potable water further leads to the following economic impacts which could further victimize and exacerbate poverty of the citizenry from:

- Increased costs of collecting and treating. Urban households would have to spend more money to receive potable water, and even so the quality of water received is far below health standards. As such, households are forced to informally purify the potable water, a service that is already being paid for, but done inadequately;

- Increased costs to the consumer for storage, purchase and transport of water;

- Increase in the number of private water purification systems. Private individuals and groups observing

[10] NDS, 2010

[11] GWI's Health Indicators Project Proposal (2008)

the state of water quality tend to create individual purification plants. However, cleaner water comes at a price, which many households may not be able to afford, and some may refuse to pay because they may have the perception that they are paying twice to get potable water (to the parastatal supplier which is supposed to supply safe water, and then again to the private individuals or groups);

- Increased public health costs. High total coliform levels, particulate matter, iron and the overall low water quality standards, coupled with increased deaths as a result of poor water and sanitation would lead to increased measures to prevent these occurrences;
- Increased water borne diseases and households' medical bills;
- Increased spending on public health care; and
- Production time lost due to illness of workers – especially for the self employed.

The improper and inadequate waste water disposal systems, pollution due to contamination from industries and businesses, inadequate systems for treated and untreated water distribution and poor distribution of potable water in Georgetown has resulted in various impacts to the social and economic systems of this area. There is the threat of increased health risks, especially in women and children, the increased costs for prevention and cure applications, damage to the environment and biodiversity in Georgetown and the overall impact to human welfare in this part of Guyana.

3.1.2 Air

The factors affecting the air quality within Georgetown are likely to lead to a number of health and socio-economic impacts for the residents. The rapid increase of motor vehicles in Georgetown, fast food outlets and industries contribute greatly to reducing the quality of air in this city resulting in increased health risks to the urban population as well as the possible risk of defacing and polluting homes and offices.

Additionally, when spontaneous combustion occurs at the Mandela dumpsite, there is distressed generation of particulate matter which is also likely to induce respiratory disease, especially among the residents of South Georgetown. The burning of sugar cane generates ash which defaces the properties of residents, damages household articles, pollutes yards and homes and can become a road hazard at peak periods of dispersion. The combustion of garbage and sugar cane both decrease the aesthetic quality of the environment and also creates large amounts of smoke that leads to respiratory problems especially to those with special health issues.

In addition to the many health impacts, certain socioeconomic consequences include depreciation of property values as a result of poor air quality, excess costs to repair and maintain property after the air has caused severe damage especially in the area of the Mandela dumpsite and finally the likely costs of seeking medical attention for respiratory infections.

3.1.3 Marine and Coastal Resources

The numerous and diverse socio-economic pressures on the marine and coastal resources in and around Georgetown have created notable impacts. For example, increasing demands for water for various uses severely challenges the availability of this resource. Moreover, the competition between and among various uses of water: irrigated agriculture, the domestic sector, industry and commerce etc. is particularly felt in the dry seasons, during which severe water shortages are experienced throughout the country. *The situation is aggravated by inappropriate water resource management, and inadequate institutional arrangements. Uncontrolled water withdrawal, inadequate water tariffs, and an absence of economic incentives for water*

conservation, all contribute to the wasteful use of the water resource in both domestic and irrigation activities. Moreover, the environmental aspects of water development and urban sanitation are sometimes neglected and result in water contamination.[12] As has been mentioned in earlier sections, regardless of the constant and urgent need for the water resource, there is poor management and steady pollution from various sources (for example, the dumping of raw sewage into the Demerara River and the Atlantic Ocean) which degrades water quality and content.

Other impacts on the marine and coastal resources include overfishing leading to the depletion of fish stocks, especially breeding stock of commercial species; the deforestation of mangrove swamps by uninformed residents (who consider the mangrove as a hindrance to the aesthetics of the Atlantic Ocean); resulting in the loss of habitats and an increase in the danger of flooding in coastal areas; surface water pollution agricultural and industrial wastes; coastal erosion due to various types of engineered structures and activities; and the buildup of solid waste and alteration of urban environmental quality. In addition the table below illustrates the total resources available from the coast, however, as findings suggest, most of the production comes from the Demersal Fish Biomass for industrial and Artisanal Fisheries. This indicates that there is excess pressure on the Demersal Marine resource and if continued over exploitation will result. There is also an observed increase in development of businesses in Georgetown, in particular, restaurants and snackettes on the Sea Walls placing pressure on this fragile area, leading to erosion of the walls and consequent breach in sea defences.

Item	Amount
Resources	
Pelagic fish biomass	300,000 mt
Demersal fish biomass	69,000 mt
Shark biomass	3,000 mt
Squid biomass	2,000 mt
Total estimated biomass	374,000 mt
Production	
Industrial fisheries	10,160 mt
Artisanal fisheries	37,121 mt
Inland fisheries	800 mt
All fisheries	48,681 mt

Table 3.1: *Resource and Production Levels in the Fisheries Sector*
Source: NDS 2010

Special attention is given to the depletion of mangrove forests given their important role in the protection of the coast from inundation by the sea. Mangroves provide habitat for many juvenile species, they act as a breaker to heavy waves reducing the level of erosion of the beach as well as act as a purifier of ground water supplies. However, mangroves have significantly declined over the period 1996 to 1999 due to the increased production of leather which uses tannin obtained from the mangrove as well as the expanding practice by persons of clearing mangroves to occupy the land space as well as for easier access to the Atlantic Ocean. Other human uses of mangroves include: charcoal production, fishing rods, fuel wood and poles for the mooring of boats (FAO, 2005).

In addition to the mangrove destruction, polluted water bodies discharging into the ocean have caused death to many fish and coupled with uncontrolled fishing levels the rate of regeneration of fish species is on the decline. Due to the low level of the coastline, overtopping of the conservancy dams inland result in flooding on the coast in Georgetown, consequently eroding the beaches and sea defences (Plate 3.1).

[12] National Development Strategy (2001-2010), Chapter 15.

Plate 3.1: *Flood Waters Eroding the Sea Defence*
http://www.bryanmaxx.netfirms.com/may2007/P1000647.JPG

3.1.4 Biodiversity

Over the years there has been a decline in the amount of green space, resulting in a decline in both the floral and faunal diversity within the city. Georgetown, which was once considered the 'Garden City of the Caribbean', has recently witnessed the construction of a number of buildings such as hotels, malls, the cricket stadium and other mentionables. With construction comes the loss of habitat and biodiversity. Nevertheless, the loss of biodiversity is not considered a significant impact on Georgetown. Plates 3.2 and 3.3 highlights the change in the environment from the nineteenth century to the twentieth century.

Plate 3.2: *Georgetown in the nineteenth century*

Plate 3.3 *Georgetown in the twentieth century.*

Source: Travel pod, 2009

3.1.5 Humans

With a population of 134,497, Georgetown comprises 17.9 percent of the country's residents, but is only 7.5 percent of the land space. The consequent ratio indicates relative overcrowding in homes, competition for resources and higher levels of pollution from a greater number of motor vehicles and household appliances. In addition, the urban population experiences unemployment and underemployment, congestion and health risks from air and water pollution.

There are a number of well known facts associated with the pollutants identified in the previous chapter. Carbon dioxide, methane and nitrous oxide are greenhouse gases which contribute to global warming. PAHs and dioxins are carcinogens. Sulphur dioxide causes acid rain that corrodes infrastructure and affects the respiratory system in humans. Nitrogen oxides also contributed to acid rain production and affect the respiratory system. Carbon monoxide has the ability to bind with haemoglobin in the blood, thereby impairing its ability to transport oxygen to cells. This can cause increased heart disease. Particulates cause health problems, specifically respiratory health problems, including:

- coughing, wheezing, shortness of breath;
- aggravated asthma;
- lung damage (including decreased lung function and lifelong respiratory disease); and
- premature death in individuals with existing heart or lung diseases.

In addition the solid waste management system in Georgetown is grossly inadequate; as such the urban population is faced with poor collection and disposal processes causing a buildup of waste in their homes. A Solid Waste Sectoral Analysis (2004) stated that Georgetown generates 247 tonnes of solid waste per day of which, 5 percent is disposed of by the municipality and the remaining 95 percent outsourced to private contractors. However, the private contractors do not have the capacity to handle the amount of wastes produced with a ratio of 1:1000 (1 private employee for every 1000 inhabitants of Georgetown). This suggests that on a daily basis there is some waste accumulation above the carrying capacity of the land, and hence certain health risks immediately arise.

Compliance with the health and safety regulations is poor and the enforcement mechanisms ineffectual, placing the population at risk of spread of disease (for example by water borne means as well as by vectors such as rats). Solid waste accumulations create a home for pests and rodents, a source for groundwater and surface water contamination, risk of spontaneous combustion by generating flammable gases. All these factors place the welfare and well-being of the urban population at great risk. Moreover, a review of the five leading causes of cancer deaths for the period 1998 to 2007 in Region 4 revealed that there has been a gradual increase in the number of deaths linked to cancer, see Figure 3.1.

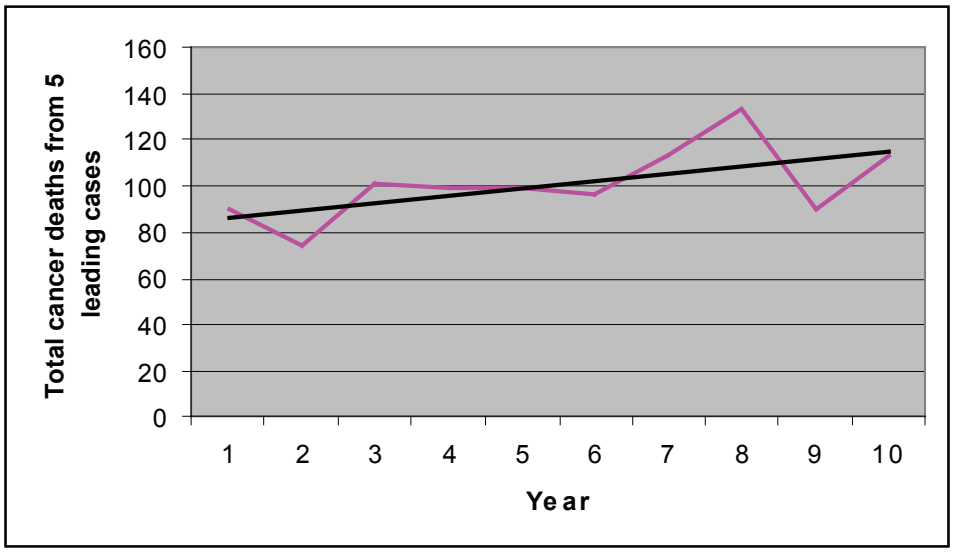


Figure 3.1: *Total deaths from five leading types of cancer deaths (1998 – 2007)*
Source: Based on Statistics from the Ministry of Health

The data shows that:

- Prostate; stomach; breast; cervix uteri; trachea, bronchus and lung; colon; liver and intrahepatic bile ducts; pancreas and ovary are the leading causes of deaths;
- Prostate and breast are the leading cause for cancer deaths (with each being among the five leading causes for cancer deaths every year for the period 1998 to 2007); and
- Cancer of the prostate accounted for most of the deaths occurring.

There are several categories of agents that cause cancer, namely: tobacco, alcohol, infectious agents, diet, medical drugs, occupational exposures, ionizing radiation and environmental pollution. However, to date, there is no evidence of a correlation between deaths caused by cancer and environmental pollution in Guyana.

Even with the growing volume of vehicles and road traffic, little attention seems to have been given to the impact of noise. Noise is created both by the motors, generators and the "relaxed" standards which permit residential areas to incorporate commercial operations; and permit loud music to be played in vehicles, homes and places of entertainment. Noise is not simply a nuisance affecting quality of life; it also affects health and can damage physical structures. Given the type of housing arrangements in Georgetown where homes have open windows, there is little or no protection from noise, and even fully enclosed buildings are at risk from the low frequencies which may not be heard but can certainly be felt by both the human body and physical structures.

3.2 Impacts on the Economy

3.2.1 Public Health Expenses

In 1992, it was found that 12.5 percent of the population did not have access to proper health care[13]. The situation is proportionately more difficult for the lower-income groups. In that same year a national survey found that in the lowest income quintile 24 percent of those who were ill or injured did not seek medical care "due to expense or distance factors." Even with this suppressed demand for public health services the volume of patients visiting health facilities exceeds capacity. As such the unhealthy city environment which adds to the volume of preventable illnesses creates an added burden on the public health system.

[13] NDS 2010

That cost of public health provision, can be measured not just by the health workers and other staff in the facilities, but also by the production time lost by workers that have to spend an inordinate number of hours waiting to be attended. While the direct health costs are not borne directly by the Municipality, but by the central government, the indirect and opportunity costs certain do have a negative impact on the economy of the city.

3.2.2 Alleviation of Natural Disaster Projects

As mentioned in previous chapters, due to impacts of climate change the occurrence of natural disasters has been on the increase. As such the disaster prevention system of Georgetown would need to be significantly improved. To date several improvements have been made, and with these improvements come decreased vulnerability in the local economy. According to the National Drainage and Irrigation Authority a total of G$1.965 billion has been budgeted and spent on Disaster Prevention over the period 2008-2009.

Disaster Prevention is of particular importance on the coast that is at risk from rising sea levels, so it is imperative that Georgetown implement Disaster Prevention Measures. During the year 2009, a total of G$985 million was spent on Disaster Prevention. In addition to this total, another G$2.8 billion has been spent purchasing new pumps, maintaining current pumps and building outfalls to assist in drainage on the coast.

Public health spending along with disaster recovery and prevention constitute a large opportunity cost in the total budget for development of the capital city.

3.2.3 Water Collection

Water collection in Georgetown includes treatment and storage of water collected prior to distribution to the urban population. The total accumulated cost for water collection as represented by energy used, and volume of water produced, has been increasing over the past four years, as shown in Table 3.2 below.

	Georgetown- Energy Used, and Water Collected and Treated		
Year	**kWh used**	**Hours Plant Run**	**Water Produced (m^3)**
2005	1,484,804	13,465	5,218,614
2006	2,223,280	9,355	5,582,785
2007	2,484,800	8,460	6,502,649
2008	1,906,896	5,155	8,536,487

Table 3.2: *Volume of Water Collected and Treated for Georgetown (GWI)*

Table 3.2 shows that the amount of water collected and treated in 2008 is much greater than in preceding years, even as the energy used and the hours of plant operation have fallen, indicating that the technology used for treating and collecting water has improved over the years. This improvement comes with an increase in operating costs, impacting the economy of Georgetown, Guyana. In addition to meeting water collection costs GWI has spent an additional G$1.784 billion between 2006 and 2009. These funds were utilised for metering, upgrade of facilities and maintenance and rehabilitation of facilities that assist in water collection, monitoring and distribution.

3.2.4 Restoring Historical and Cultural Patrimony

Georgetown is home to numerous historical and cultural artifacts and monuments. However, the wear and tear of normal use, and time plus the inadequate maintenance has led to a constant decline in the state of the wooden buildings. Although it is recognized that these buildings are much in need of restoration there is little funding available to carry out needed works particularly since the cost of rehabilitation keeps climbing.

On rare occasions, however, some attempt is made by the national authorities to assist, since this is outside of the municipality's capability. For example, in March 2006, the National Trust of Guyana (a department of the Ministry of Culture, Youth and Sport) donated $177,944 in supplies towards the repainting of the new eastern and northern walls of St. Bernadette's Hostel at Lot 105 Lamaha Street, North Cummingsburg, Georgetown. The National Trust has generated an inventory of monuments and landmarks including information on the state of repair and a prioritisation of the monuments and landmarks that need to be upgraded, renewed or restored. It is expected that the cost of these works would be many millions of Guyana Dollars, the source of which is not identified. Sadly the Municipality's role in this is to condemn and demolish buildings that have deteriorated to the point that they have become unsafe for habitation. As such the stock of examples of the vernacular architecture of Guyana is dwindling.

3.3 Vulnerability to Human Induced and Natural Disasters

As noted above, there seems to be persistent occurrences of disasters which are the impact of global warming on the city.

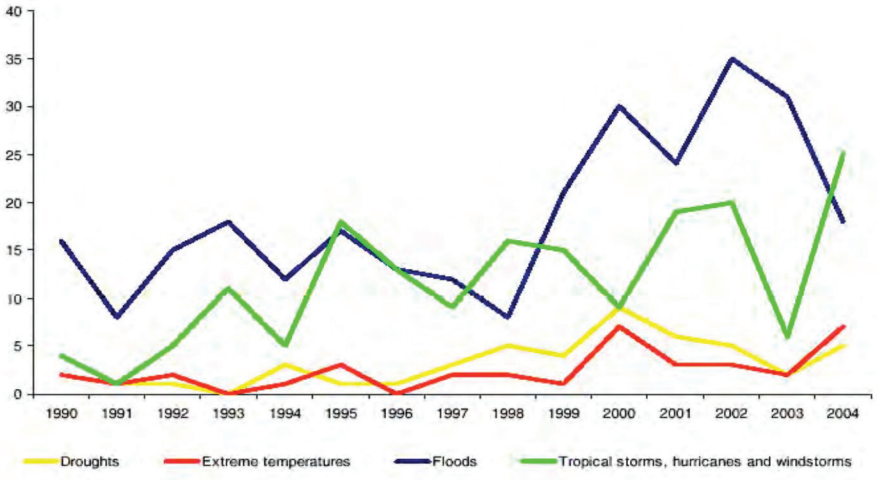


Figure 3.2: *Trends in Natural Disasters in the Caribbean*
Source: ECLAC 2005

The figure above illustrates a gradually increasing trend in occurrences of natural disasters in the Caribbean, including Guyana. What this graph indicates is that in all likelihood there will be an increase in natural disasters as time progresses, for various reasons, and this is very threatening to the population because as will be explained other factors coupled with the increase in these events would cause populations to become even more vulnerable.

Of the many natural disasters that occur, flooding is of particular importance in the context of Guyana. With the impacts of climate change increasing rapidly in the Caribbean, flooding is a major concern for all coastal villages in Guyana, in particular Georgetown. While there are multiple factors responsible for flooding, some key factors are: clogged drains and waterways, climate change and poor infrastructure.

Floods are likely to create serious health risks for residents of Georgetown, due to existing practices. A recent study by Bynoe and Bristol (2008) revealed that in Sophia (D & E fields) 80 percent of residents dispose of sewage via pit[14] latrines and 90 percent of the residents have to dispose of solid waste by burning. Adding to the unsafe practices in Sophia, on average more than 25 percent of residents in each of the other villages sampled also disposed of sewage by pit latrine and burnt their garbage.[15] With this level of uncontrolled sewage and garbage disposal it is clear that the urban population would be exposed to numerous health risks from flood waters. Previous studies indicate that the sewage system used in central Georgetown has become dysfunctional due to its capacity being exceeded and the inadequate treatment of waste water. The study also revealed that 10 percent of households use communal toilet facilities and pit latrines (a health hazard by themselves) which are in a state of disrepair (Pelling, 2002). These factors indicate that waters might be contaminated with household garbage as well as raw sewage and could lead to infections, serious illness and even death.

The uncontrolled waste disposal could be linked to the fact that16 percent of the urban population live below the 1999 poverty line (Pelling, 2002). This poverty rate suggests the existence of some under- and un-employment and an increase in the number of illegal homes (squatting). The population living in illegal homes do not have adequate sewage disposal systems, thus the high incidence of pit latrines. The houses are also not built on stilts, as such during flood events, the population is exposed to a range of health concerns and the loss of household appliances as well as damage to infrastructure. As alluded to earlier, the central drainage system is utilized by businesses and households for solid waste disposal; and with poor maintenance these drains are frequently clogged. Bushes take over many waterways and the storm drains of Georgetown are unkempt. These factors restrict the flow of water, hence at times of heavy rainfall the entire urban population is faced with widespread flooding.

Compounding the contribution to flooding of inadequate solid waste collection and poor drainage is the geographic location of Georgetown, and the soil type. Bernard (1999) classified the soil as pegasse, a soil type that is considered impermeable. This increases the risk from floods, mainly because water does not drain quickly through the soil, resulting in accumulations of surface water, consequently flooding homes and businesses.

In addition to the health risk, floods cause loss of, and damage to physical infrastructure (homes, roads, water systems, health centres etc.) and increased socio-economic vulnerability. Evidence of this is indicated in Table 3.3 which is a summary of the damage and losses caused by the 2005 floods. In 2005, Guyana experienced the worst flooding event in the recorded history of the country as a result of prolonged, high levels of rainfall - the average monthly rainfall was 1108.2 mm (43.6 inches) - six times the 30 year average of 185.2 mm. In Region 4, 80,445 householders and 309,059 persons (approximately 39 percent of Guyana's population) were affected (UNDP/ECLAC Report, 2005). Three weeks after the peak of the flood, 92,000 persons still had water (1.2 m to 1.5 m) in their homes. The floods of 2005 demonstrated the vulnerability of Georgetown to floods as all of the above mentioned factors influenced the water levels and health risks, resulting in Region 4 being the worst hit region in Guyana (ECLAC, 2005). The supporting factor behind the occurrence and the main reason for the duration of these floods was the malfunctioning drainage system, resulting in the urban population being stranded, out of their homes and exposed to a variety of water borne diseases.

[14] Guyana Census Report (2002) shows approximately 58% of the country use pit latrines.
[15] Guyana Census Report 2002

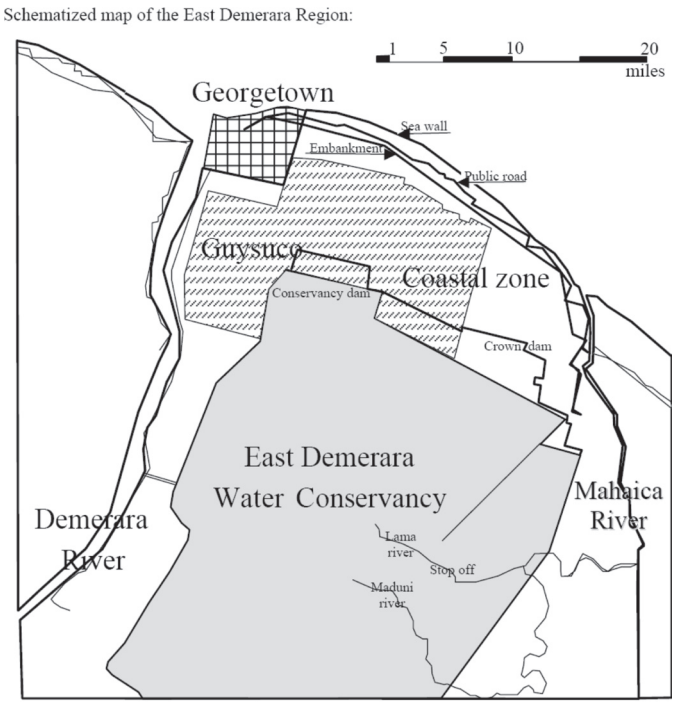


Figure 3.3: *Schematized Map of the East Demerara Region*
Source: ECLAC, 2005

Summary of damage and losses Millions of Guyana Dollars			
Sector	Damage and losses		
and subsector	Total	Direct	Indirect
Total	93,022.9	83,659.5	9,363.4
Social sectors	55,665.9	55,247.2	418.7
Housing	55,120.8	54,842.6	278.2
Education and culture	371.7	352.1	19.6
Health	173.4	52.5	120.9
Productive sectors	27,458.6	20,945.0	6,513.7
Agriculture	10,894.3	10,018.8	875.5
Commerce	14,476.1	10,213.1	4,263.0
Tourism	1,126.8	47.0	1,079.8
Manufacturing	961.5	666.1	295.4
Infrastructure	9,143.3	7,452.2	1,691.1
Drainage and irrigation	1,311.1	194.8	1,116.4
Water supply and water disposal	3,943.7	3,763.7	180.0
Road transport	3,529.0	3,349.0	180.0
Telecommunications	152.7	91.3	61.4
Electricity	206.7	53.4	153.3
Environment	15.1	15.1	
Total emergency relief	740.0		740

Table 3.3: *Summary of Damages and Losses Caused by the 2005 Floods*
Source: UNDP/ECLAC Report, 2005.

The images below illustrate the extent of vulnerability to natural and human induced disasters (in particular, floods) the urban population experienced as a result of various factors, such as poor drainage, poor garbage collection and geomorphology.

Plate 3.4: *Flood waters in the City Streets*

Plate 3.5 *Response to blocked drain*

Plate 3.6 *Debris after the flood*

Plate 3.7: *Challenges faced during the Floods*

Source: Guyana Flood Website

CHAPTER FOUR: RESPONSES

There are capacities at the level of the state, parastatal organizations, the private sector and other civil society groups to respond in ways that can overcome the enormous challenges faced by the municipality. There is room to build partnerships with some of these entities in order to both coordinate and promote decentralization of responses.

The agencies that are, or should be providing interventions in the various areas of impact are as follows:

- Solid Waste and Waste Water Management: Community Groups, Private Sector, the Media, the International Community, Schools, Municipalities overseas.
- Energy: IAST and Guyana Energy Agency for alternative energy,
- Disaster Management: The National Relief Council, Red Cross and International organizations
- Historical and Cultural Preservation: The National Heritage Society, the media, Ministry Culture, Youth and Sport
- Conservation of water and energy: The Media, Youth Groups and Schools
- Pollution (air, water, land and noise): The Media, Schools and Youth Groups,

4.1 Principal and Secondary Stakeholders

The various impacts identified in Chapter 3 may only be mitigated if different environmental regimes are implemented (including policies, plans, programmes, education, technology) and a multi-stakeholder approach is employed involving private sector, community and youth groups, non-governmental organizations, academia, among others.

4.1.1 Private Sector

In Guyana, less than 10 percent of the private sector operations which are located in and around Georgetown can be identified as good examples of environmental stewardship, even though the role of these entities is well recognised. Some companies stand out in the efforts they have made, for example, Banks DIH where the management of waste can be emulated as a best practice. (see Box below for case study).

4.1.2 Community Groups

The few existing community groups involved in environmental management focus almost exclusively on beautification and enhancement activities. Examples of community participation are as follow: (i) Members of the Wortmanville Community, Georgetown were recently engaged in a community clean-up campaign involving the cleaning of drains and clearing of parapets, as well as the painting of bridges and culverts. The work initially began with a resident, who was soon joined by other members of the community. (ii) The Lodge Community Development Council undertook a similar cleanup and beautification campaign within their community, encouraging persons from the community to assist and obtaining funds from the Government. These examples indicate that though community groups are not permanent organisations within the city, the residents are willing to ensure the beautification and image of their communities; all that is required is a little motivation. Unfortunately the vast majority of citizens are apathetic.

Case Study of a Private Sector[16] Firm: Banks DIH (A Manufacturing Industry)

Bank DIH (D'Aguiar Industrial Holdings) Ltd. is a multi-billion dollar company that is very diversified and comprises four (4) major divisions: beverage (including Caribanks Shipping beer, Banko Wines and Cocoa-Cola); Demico (including Arawak Steak House and Kitty Qik Serv); Campsite (including Krystal Dry Cleaners, Ultimate Catering Service, and Processing Centre); and Trisco Division which produces quality biscuits, snacks and cereals for local and overseas markets.

Banks DIH has taken a number of steps to 'green' its activities. Below are a few examples.

Banks DIH's waste management strategy is guided by the 3 R's (reduce, re-use and recycle) of waste management.

Oil and grease are separated by using separators. (See Plate 4.1 below) The cooking oil is sent to the Institute of Applied Science and Technology for the Biodiesel production.

Plate 4.1: *Drain Valve for Oil Water Separator*
Source: Banks DIH

Solid waste is categorized. Plastic bottles are sold to overseas markets for use as building materials, metals and glass are sold to local 'dealers', while cardboard is sold to a local packing company (Caribbean Container Inc).

Plate 4.2: *Colour Coded Waste Receptacle*
Source: Banks DIH

- H^2O scrubbers are used to trap stack emissions in receptacles
- Purchases are only made from suppliers who conform to environmentally friendly packaging.
- Recently, the 1.5 megawatt diesel generator, which produced excessive noise, has been replaced by a generator that generates less noise and is more energy efficient; also 23% less emissions are released into the environment.
- The major challenge for the Company is to establish a wastewater treatment plant. As a result of a partnership that was formed with Cocoa-Cola, a grant has been earmarked for US$ 2.1 million to complete this project by the end of 2007.

[16] Bynoe, P. (2007) Growth, Conservation and Responsibility, Promoting Good Governance and Corporate Stewardship through Impact Assessment Environmental Stewardship, EIAs and the Private Sector in Guyana: An Uneasy Alliance?

- Banks DIH follows ISO 14001 standards.
- The Company focuses on environment, safety and quality at three levels: the supplier, neighbourhood, and customers. In 2006, Banks DIH was issued the National Occupational Health and Safety Award.
- Information received from the Company indicates that approximately $GUY 15 million ($US 60,000) is being saved annually as a result of environmental measures.

Plate 4.3: *Venturi Boiler Emission Scrubber*
Source: Banks DIH

4.1.3 Academics/ Universities

The University of Guyana has been responding to the perceived gap in the disciplines offered by its faculty in relation to the national requirements. As a consequence in response to environmental challenges confronting the nation, including its urban areas, several programmes and initiatives were established. Key among these is the following:

In 1992, UG established a Centre for the Study of Biological Diversity (CSBD), to document, to curate and study the floral and faunal natural history of Guyana. The Centre is the repository for the Guyana National Herbarium and the University of Guyana's Zoological Museum and contains specimens of plants and animals found in Guyana, Suriname and French Guiana. To date, the Centre has been taking several initiatives on matters of scientific research, public education and awareness, and conservation and is considered as one of the most vital biodiversity information repositories in Guyana.

Then in 2005 , the School of Earth and Environmental Sciences (SEES) of the University of Guyana was established to: (i) offer a Bachelor of Science (B.Sc.) Degree in Environmental Sciences and Bachelor of Arts (B.A.) Degrees in Geography, Human Geography and Economic Geography; (ii) facilitate and conduct interdisciplinary research; (iii) offer professional courses in related areas, such as Environmental Management, Conservation Biology, Sustainable Utilization of Biodiversity, and Environmental Technology; (iv) enhance public awareness and education about environmental problems and issues; (v) provide consultancy services for example in the areas of Environmental Management, Environmental Health, Environmental Economics, and Land Use Planning to support the long-term sustainability of the School; (vi) foster linkages with key stakeholder agencies to promote sound environmental research and analysis of issues; (vii) provide technical assistance to natural resource agencies; (viii) assist the Government of Guyana with respect to environmental policy formulation and implementation, and (iv) promote opportunities for continual professional development of School staff to enable them to carry out effectively all of the aforementioned activities. In October 2009, SEES, in collaboration with University of the West Indies, Anton de Kom University of Suriname and University of Amsterdam launched a Post- graduate Professional Diploma Programme on Urban Planning and Management. Currently, 11 professionals are registered for this Programme.

There are as well other faculties and departments within the University of Guyana that offer courses which provide relevant skills, (including Environmental Engineering, Coastal Zone Management and Ecotourism) that are related to the environment.

IAST was created to lead the way in selecting appropriate technologies to maximize use of local resources. It is currently experimenting with biodiesel and has in the past promoted the use of alternative energy.

4.1.4 Youth Groups

Young people are involved in the protection of the environment in and outside of Georgetown through several initiatives-some of which are highlighted below.

Environmental Clubs

Environmental Clubs were established by the Environmental Protection Agency to create an organised body/structure for young people to share ideas, to work collectively and to create sustainable networks and partners in environmental action and management." In fact, environmental clubs were considered a catalyst in schools to focus some attention on environmental issues, and to play an advocacy role for environmental awareness and responsibility in schools. Generally, these clubs have been involved in activities aimed at enhancing the aesthetic quality of the bio-physical surroundings; promoting environmental awareness and education through school talks, signage and nature walks, among other activities. In most cases, activities of Environmental Clubs seem to be concentrated in their immediate environs, although, in some specific cases, members have collaborated on larger community projects (Bynoe and Williams, 2006).

The Guyana Information Youth Project (GIYP)

GIYP was launched on the 21st February 2002 in response to the increasing demand in Guyana for young people to become technologically literate and to acquire the skills and knowledge needed to perform efficiently in a computerized environment. In 1998, VYC coordinated Guyana's first Environmental Youth Consultation that was attended by key decision-makers. The VYC efforts today include awareness programmes and some collaboration with the City Council of Georgetown to clean up the environment.

GuyberNet

GuyberNet describes itself as a not-for-profit Global Sustainable Development Information and Training Centre, which is essentially a facility designed to educate the Guyanese public, particularly young people and children about Agenda 21 and other important global issues, through the use of information technology and other social and educational activities. Training has been provided in several areas including environmental conservation, human rights, gender equality, peace, conflict resolution, personal hygiene, and sustainable enterprise development using sustainable techniques. Guybernet focuses on six (6) areas: environmental education; street children outreach; governance and democracy; advocacy; Small Business & Entrepreneurial Development; and HIV/AIDS Education.

Religious Groups

The relationship of religion to environmental and developmental issues has not escaped the attention of local religious organizations within Georgetown. Organizations such as the Varqa Foundation, a Baha'i based organization, focuses on social issues that may result in environmental ills by instilling moral and spiritual values through training and education. Additionally, the Seventh Day Adventists have, in collaboration with the Ministry of Health, established a mobile health clinic to better provide health services to those that may not otherwise have access. At the individual level, persons have utilized their religion as a means to the improve the environment, but the effort is not collective.

4.2 Environmental Management and Planning

4.2.1 National Coordination Mechanisms/Committee

The Government of Guyana has established a number of mechanisms to respond appropriately to environmental pressure. Chief among these, and at the highest decision making levels, are: the establishment of (a) the Guyana Parliamentary Sub-Committee on Natural Resources with responsibility for monitoring the operations of ministries, as well as their administrative structures; and (b) a Cabinet sub-committee on Natural Resources and Environment which is chaired by the Head of the Presidential Secretariat. The Cabinet sub-committee addresses issues regarding sustainable development, and specifically related to natural resources use, which requires policy decisions.

Below the policy level is a technical group, the Natural Resources and Environment Advisory Committee (NREAC). The NREAC is a high-level committee comprising directors of natural resource institutions (for example, forestry, mining, water, agriculture, land use, energy) and the Guyana Environmental Protection Agency. This committee has been tasked with examining environmental and resource policies and issues and making recommendations to the Cabinet sub-committee for approval.

Additionally, Guyana has established (a) the National Biodiversity Advisory Committee whose function is to advise the EPA on issues related to Biodiversity Management and Research; (b) the Integrated Coastal Zone Management Committee with responsibility for the development of an integrated coastal zone management plan and coordinating the activities of the various sectoral agencies with some involvement in management of coastal resources; (c) the National Biosafety Committee to review the Protocol on Bio-safety and develop guidelines, regulations, and recommendations on policy; (d) the National Climate Committee; and (e) the Pesticides and Toxic Chemicals Board that is tasked with the formulation and implementation of the Pesticide and Toxic Chemicals Act and Regulations for the regulation of pesticide use, pesticide effluent discharge standards, storage, disposal and transportation requirements, among others.

4.2.2 Implementing Environmental Policies

The National Environmental Action Plan (NEAP) 2001-2005, expresses the country's commitment to achieving sustainable development through the implementation of socio-economic programmes. This intent is to be realised by integrating economic, environmental and social goals and plans and equitable implementation of such plans across gender, location and cultures. This NEAP also declares that continuous development would not affect the availability of resources to the future generation. In keeping with this declaration the Government of Guyana recognised the importance of environmental protection in the developmental processes within each of the country's sectors.

In this context, the NEAP identified five cross-sectoral areas of environmental concerns: (i) climate change and vulnerability assessment (sea level rise, flood forecasting and warning); (ii) water management (water supply, distribution, wastewater disposal, drainage and irrigation); (iii) solid waste management (solid waste collection, disposal (landfill), recycling environment health/pollution); (iv) socio-economic impacts of land use change (agriculture, demand for housing); and (v) development of ecotourism.

The National Development Strategy suggests that Guyana's principal environmental policy objectives are: to enhance the quality of life of the country's inhabitants by utilizing its natural resources, while neither degrading nor contaminating them; to ensure that the natural resource base for economic growth continues to be available in the future; and to intensify and widen the dimensions of our living standards through the conservation of unique habitats, natural treasures, biodiversity and our cultural heritage.

4.2.3 Framework Environmental Legislation

Guyana's Environmental Protection Act, 1996 mandates that the Environmental Protection Agency established in June 1996 protects and manages its environment. This Act provides for the management, conservation, protection and improvement of the environment, the prevention and control of pollution, the assessment of the impact of economic development on the environment and the sustainable use of natural resources.

Such objectives are achievable through proper land-use planning, a process which has proven to be an essential component in the conservation and wise use of natural resources since it creates a suitable framework within which these uses can occur. In Guyana, a National Land Use Policy is in existence and provides the policy context for all land uses, including conservation land uses.

The Town and Country Planning Act (1948) provides a mechanism for physical development planning and land use control. Under this Act, development schemes may be prepared for cities, towns and other areas. Such schemes may provide for preservation of areas of natural beauty, forests, trees and plants and for regulation of waste disposal. Provisions are made in this Act for public participation in the planning process before any scheme is approved; however, Georgetown is the only area with an approved system. The Act also provides for the interim control of development in declared planning areas.

There is no specific land use legislation in Guyana and a collection of other land use instruments is being used.

Under the Environmental Protection Act, regulations on hazardous waste management, water quality, air quality, and noise management were established in 2000. These were made in an effort to regulate and control the activities of developmental projects during construction and operation. These regulations provide for the development of effluent standards, air quality standards, and noise level standards. Interim standards have been developed by the Guyana National Bureau of Standards which have been adopted by the Environmental Protection Agency.

4.3 Environmental Institutional Framework

In Guyana both public and private agencies are involved in promoting and facilitating the development of policies, programmes and plans which are related to the management and protection of biological resources and ecosystems. These agencies have legislative and administrative responsibilities which include the achievement of environmental and biodiversity conservation.

Complementing the Committees and mechanisms that function at the level of policy and strategy described in Section 4.2.1 above, the GoG has established the following institutions that address directly or indirectly issues highlighted in Chapter 3:

- The Guyana Environmental Protection Agency (EPA) which is the regulatory body overseeing implementation of the environmental laws is also tasked with the responsibility of reviewing environmental and resource policy prior to submission for approval by the Cabinet. The Agency also coordinates "environmental management" and undertakes activities related to the management, conservation, protection and improvement of the environment. Additionally, the Agency participates in the prevention and control of pollution and assessment of the impacts of economic development activities on the environment.

The Ministry of Agriculture has created a number of bodies to undertake specific tasks. For example, the NDIA which has responsibility for drainage and irrigation structures and works; the Hydrometeorology Division, that monitors surface and ground water resources; and the Mahaica-Mahaicony-Abary Agricultural

Development Authority, which manages and monitors the agricultural development of West Coast Berbice. The Ministry of Public Works and Hydraulics not only sets policy but also implements sea and river defense works through the Sea and river Defence Board.

- The Sea and River Defence Board manages and maintains the nation's sea defences and collaborates with GFC and EPA in the management of mangroves and the implementation of the Mangrove Management Plan.

- The Ministry of Agriculture activates its responsibility for D&I through its NDIA. The NDIA and its Board provides effective management of the country's Drainage and Irrigation Systems and the Regional Democratic Boards (RDB) are responsible for maintenance of the conservancies, water allocation from the conservancies, operation of the reservoirs, and maintenance of the dams and head regulators. As a result of its large land holdings, GuySuCo's estates are deemed D&I areas.

- The Ministry of Health has authority over environmental health and pollution control, which it exercises through the Environmental Health Unit and the Regional Environmental Health Services. It also monitors the quality of potable water provided by the GWI, and monitors the activities pertaining to sewage and sanitation issues. The Minister of Housing and Water appoints a Board which reports to him and has the responsibility for policy design and supervision of the GWI operations.

The Central Housing and Planning Authority (CHPA), which exercises development, planning, and control authority over Housing and the development of towns.

4.4 Planning

Discussions are ongoing in the CH&PA to formulate a National Spatial Development Strategy that would facilitate the integration of climate change with further settlement planning activity and additionally the National Bureau of Standards has a building code initiative that can allow for the imposition of building controls relevant to the issue of floods in the city. Moreover, the CH&PA intends to use geographic information systems (GIS) to monitor land use and for spatial analysis for more informed planning interventions in the City.

4.5 Water Supply, Sewerage and Waste Disposal

The Water and Sewerage Act (2002) has enabled the delivery of the National Water Policy. Through this Act, a new legal, institutional and regulatory framework has been created including the introduction of national water standards and a National Water Council, to direct water resource management policy. The Act in addition deals with issues covering water supply and connection, water regulations, wastewater and sewerage matters, drought orders and all hydro-meteorological matters.

GWI was established following a merger of the Guyana Water Authority (Guywa) and the Georgetown Sewerage and Water Commissioners on May 30, 2002. GWI is responsible for the construction, operation and maintenance of water distribution systems in order to supply potable water to the country. GWI provides potable water to the citizens of Georgetown via eight (8) pumping stations and 2 storage facilities and one water treatment facility at Shelter Belt.

In April 2009, under the UNCCD project, 20 participants representing key natural resources agencies benefited from a training workshop on Watershed Modeling and Management. The training sessions aimed at producing a cadre of public officers capable of assessing watersheds and making appropriate decisions given the current threats to water quality within and beyond the boundaries of the city.

4.6 Coastal Management and Flood Defence

The legislative regime surrounding wider coastal management in Guyana represents a fragmented regulatory framework. This is because the coastal zone is managed in a fragmented fashion responding to specific issues which fall under various sectors in an ad hoc way. The various pieces of legislation that govern the different issues are, for example:

Sea Defence Act (1933);
Forests Act (1953);
Town and Country Planning Act (1948) (land use control);
Municipal and District Councils Act (land use control); (1969)
Public Health Act (land us e control);
State Lands Act (land use control); (1903)
Housing Act – (land use control); (1948)
Drainage and Irrigation Act; (1964)
East Demerara Water Conservancy Act; (1935)
Mining Act (1991);
Geology and Mines, Petroleum (Exploration and Production) Act; 1939
Water and Sewerage Act (2002);
Fisheries Act (1957); and,
Maritime Boundaries Act (1977).

According to the Municipal and District Councils Act (1970) any natural or artificial accretion of the foreshore will be the responsibility of the Council.
In recognition of the need to protect the natural sea defence (that is, the mangrove vegetation) a Mangrove Action Plan was developed in 2001. This Plan aims to:

- establish the administrative capacity for the management of mangroves in Guyana
- promote sustainable management of mangrove forest
- obtain local community support in the management of mangroves
- support research and development of Guyana's mangrove forest; and
- increase public awareness and education on the benefits of the mangrove forests.

4.7 Biodiversity

In keeping with its commitments as a State party to the United Nations Convention on Biological Diversity, Guyana developed a National Strategy and Action Plan. Generally known as the National Biodiversity Action Plan (NBAP), it was presented in November 1999 and proposed to integrate the implementation of the convention into national development. This 1999 NBAP was reviewed in 2004 to identify achievements and set- backs, and to plan for a second action plan – National Biodiversity Action Plan (2007-2011). The NBAP II is a continuation of the NBAP and focuses on four main thematic areas: forests; agriculture; coastal resources; and marine and freshwater resources.

4.8 Human Health

The Ministry of Health developed a National Health Plan (NHP) 2003-2007 which outlined a strategy for the health sector over five years. The goal of the Plan which focused on primary health care was to achieve major improvements in services and the nation's health by involving all players in the process of improving and maintaining health. The Plan has been rolled over for another five years – to 2012.

There have been a number of other targeted public health programmes, for example the Filariasis Elimination Initiative through which cooking salt is fortified with therapeutic additives before distribution (known as DEC

salt); the provision of locally produced antiretroviral drugs for HIV+ persons and the PMTCT++ program, and the registration process for laboratories and the Hospital Inspectorate.

4.9 National Disasters

In 1982, the Civil Defence Commission of Guyana (CDC) was established to develop plans and conduct operations to respond to all types of disasters in Guyana. A comprehensive National Disaster Preparedness Plan was drafted in 1985 and there are imminent plans to revise this plan.

There were two recent initiatives directed at improving coastal zone management and disaster risk management. The IDB in 2007 approved a grant to support the design and implementation of an Integrated Disaster Risk Management Plan. This grant is to support identification of country risk indicators and flood risk evaluation; development of a National Integrated Disaster Risk Management plan and instructional strengthening and capacity building at national and local levels; and design of an investment programme in flood prevention and mitigation. To complement this, the UNDP approved a project that aims at "Strengthening National and Local Capacities for Disaster Response and Risk Reduction."

A Low Carbon Development Strategy was launched in June 2009 which proposes to stimulate the creation of a low-deforestation, low-carbon, and climate resilient economy. The underlying policy of sustainable development seeks to balance ecological sustainability through management and protection of forests while meeting economic and social needs of the Guyanese people.

CHAPTER FIVE: FUTURE PERSPECTIVES (SCENARIOS)

5.1 Definition of Scenarios

Part of the methodology utilizes scenarios to aid in prioritizing the most critical environmental problems in Georgetown and to devise and apply strategies and plans to improve urban environmental management of Georgetown. The Scenarios represent descriptions of journeys to possible futures (UNEP 2002). They aim to chart the course of past and present/existing management strategies for Georgetown and their impact on the city, what improvements need to be made to address critical uncertainties and what new factors the city's managers should expect given the latest social, economic, environmental and political situations being experienced both globally and locally. These scenarios are utilized to chart an internally consistent path from the present to various futures. Scenarios can accomplish this because they articulate concretely what might otherwise be just an intuitive sense of likely outcomes of present situations and so help to explore not only the implications of what developments can come to pass, but also what alternative paths might lead us to particular outcomes, desirable or not. Of critical significance is the fact that they provide information and guidance/direction pertinent to current decisions that are being made. It is hoped that with knowledge of the scope of the possible, the role of human activities in shaping the future, and the links among issues, Georgetown can become a healthy city that significantly improves in a holistic manner the quality of life of its inhabitants.

5.2 Environmental themes for Scenarios

The scenarios developed focus on three themes: disaster preparedness, urbanization, and solid waste management. These interlinked priority areas, were identified by stakeholders of the GEO Georgetown during a workshop in July 2007. Guyana is currently plagued with infrastructure management problems and weather extremes that make the city prone to flooding. Flooding is exacerbated by the indiscriminate dumping of garbage throughout the city that accumulates in the waterways hindering drainage of an already poorly maintained and challenged system. Flooding itself increases the quantity of waste requiring disposal which places further demands on the overburdened services of the city. The dump site that serves as a waste disposal facility for the city was scheduled for closure more than a decade ago. Together these issues impact negatively on the health and well being of the citizens and economy of Georgetown.

5.2.1 Disaster Preparedness

Disaster preparedness as a precautionary approach is new to Guyana given the traditional focus on response and relief, as was evident during the 2005 and 2008 floods. Given the range of projected global temperature increases of between 1.1 and 6.4 °C[17] during the next 100 years, the consequent results of warming of this magnitude will be unprecedented and impacts such as increased periods of drought on a global scale are likely. In Guyana sea level is projected to rise by approximately 40 cm by the end of the century and when melt water contributions from land ice are included this projection increases to 60 cm. The rapidly changing global climate attributed to the continuing emissions of greenhouse gases will have detrimental impacts on low-lying coastal countries like Guyana that are highly vulnerable to sea level rises and changes in rainfall patterns. This is particularly so as effective management of the drainage system in Guyana depends on sea levels. The impact of climate change is far reaching for Guyana generally and Georgetown in particular.

[17] Source: http://www.ipcc.ch/pdf/assessment-report/ar4/wg1/ar4-wg1-spm.pdf

According to Guyana's National Vulnerability Assessment (2002), a doubling of global carbon dioxide emissions is expected to decrease monthly rainfall by 10 mm/month. Estimates from climate models developed by the United Kingdom's Meteorological Office's Hadley Centre, support the prediction that Guyana will be confronted with a general drying out. In fact these models demonstrate that Guyana will be among the most affected countries in the world, with average precipitation decreasing by roughly 1 mm/day by 2050 (GoG, 2006). While there is a possibility of the number of rainy days per annum declining, there is an expectation that the daily intensity of precipitation will increase, which implies not only an increase in the frequency of droughts in the future but floods as well (Lal et al 1999). Moreover, increased daily rainfall intensity, will place enormous pressure on Guyana's water management system including the conservancies.

The floods of 2005 and 2008 brought to light the extreme importance to the city, and its extreme vulnerability to the East Demerara Water Conservancy system. These events also demonstrated that Georgetown/Guyana remains underprepared to deal with such disasters. Continued deterioration of the system would have catastrophic consequences; potentially displacing 75 percent of the country's population. The impact would include loss of the capital city, the livelihoods of most citizens and the loss of the country's principal export products, particularly, its agricultural products, including sugar and rice. The cost of ameliorating the 2005 floods exceeded G$200M, an opportunity cost representing 59% of Guyana's gross GDP for the year. Figures are not yet available for 2008 floods, but it is evident that Guyana can ill afford a recurrence of 2005.

What is also evident, because of the centralisation of many services, is the fact that disasters that impact on the capital city, also impact the country. This reality should inform decisions over initiatives to be taken to improve the administration's state of readiness with a view to protecting Georgetown. These initiatives would include a comprehensive information system that provides early warning, estimates the magnitude of the impact expected, monitors maintenance of coastal defence structures, improves the level of information sharing and coordination between and among institutions of government and non-government organizations as well as the improvements in human resource capacity.

The following three scenarios for disaster preparedness may be considered:

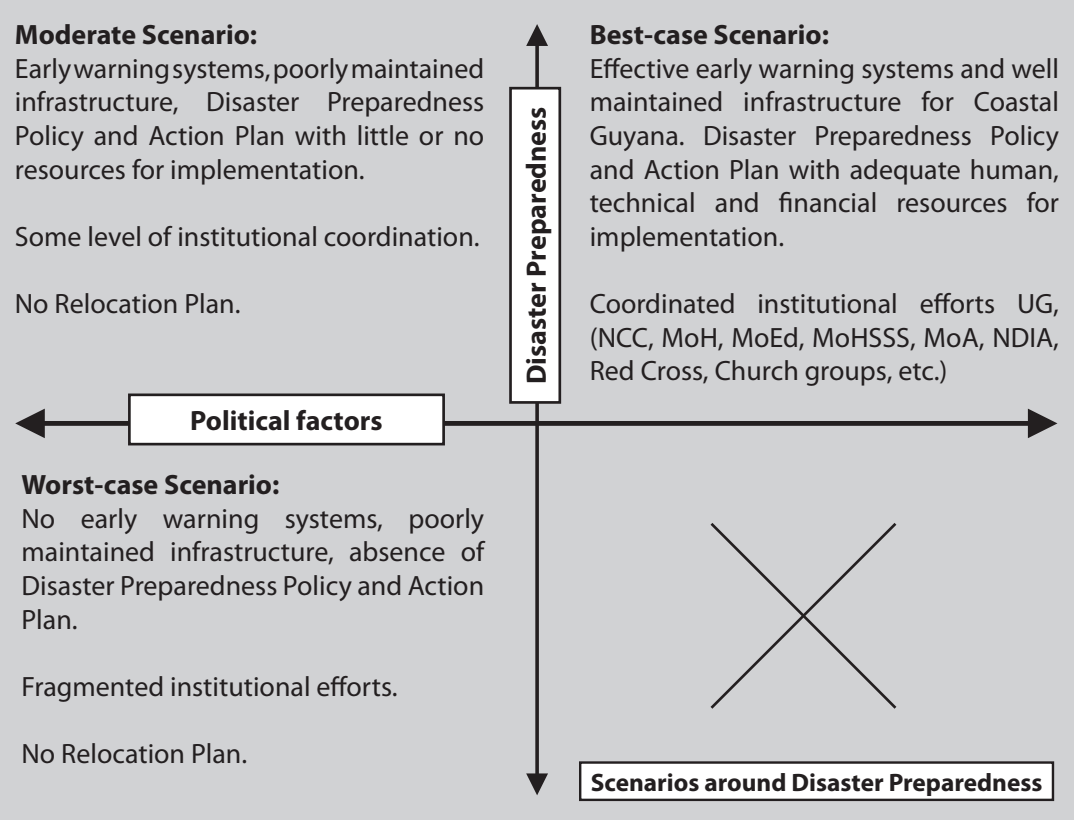
5.2.1.1 Worst-case Scenario

There are no early warning systems for Georgetown to relay information on impending disasters. Further, there are no systems to ensure timely delivery of data and information on natural hazards or emergencies (such as flooding events from rainfall, sea level rise or droughts caused by lack of rainfall) to the citizens of Georgetown, nor any disaster preparedness training for individuals who are at risk. The infrastructure, including the sea defences, drainage pumps, sluice gates and drains in and around the City, are poorly maintained, and such poor maintenance could result in the city becoming inundated with waters from the Atlantic Ocean, Demerara River and the EDWC. The end result is extensive exposure of the citizens of Georgetown to the effects of natural disasters and emergencies.

There is no Disaster Preparedness Policy and Action Plan. No planning for a response to disasters has occurred. Thus, in the event of a natural disaster or emergency, there is no arrangement to assign roles to individuals and institutions nor do the citizens know how to respond. In addition, institutions involved in managing the city, managing drainage, and disaster and climate-related work are functioning independently of each other, so that there are no opportunities for the sharing of information among them which could enhance their operations. Furthermore, there is no Relocation Plan for Georgetown, even though relocation may become an important option for Guyana given the impending sea level rise associated with climate change.

Under this scenario, the citizens of Georgetown are placed at high risk due to their exposure to natural hazards and emergencies. Among notable impacts are: damage to citizens' housing and personal belongings; reduced access to clean water; severely compromised quality of health care, and the loss of livelihoods. The frequency of disasters is expected to increase with continued climate change, thus making the citizens even

more susceptible to the disasters. Guyana, and more particularly Georgetown, faces severe environmental and social consequences of disasters.



5.2.1.2 Moderate Scenario

Early warning systems are developed, but they are limited and do not involve the citizens sufficiently. As a result, these systems are ineffective and unable to ensure timely delivery of data and information on natural hazards and emergencies (such as flooding events from rainfall, sea level rise or droughts caused by lack of rainfall) to the citizens of Georgetown. There is also limited disaster preparedness training of individuals who are at risk. In addition, there is a lack of maintenance of infrastructure, including the sea defences, drainage pumps, sluice gates and drains in and around the City. The infrastructure is poorly maintained (which is similar to the Worst-case scenario), and administrative capacity is overwhelmed.

There is a Disaster Preparedness Policy and Action place with little or no resources for implementation. This is an indication that planning has occurred so that in the event of a natural disaster or emergency, it is known which actions may be advisable, which institution and who is responsible for action, what role the community plays, what should be done, when action should be taken, and what resources are required. However, insufficient resources for implementation would render the plan ineffective.

Some level of institutional coordination and data and information sharing occurs among institutions involved in managing the city, managing drainage, and disaster and climate-related work, enhancing their operations. There is still no Relocation Plan for Georgetown.

With this scenario, the citizens of Georgetown are at medium risk due to their exposure to natural hazards and emergencies. However, this exposure is reduced, in comparison to the previous scenario, because there is a relatively higher level of preparedness. With the reduction of exposure, there could be a reduction in the severity of the adverse effects for the citizens, for instance the number of persons affected could be smaller,

the damage to property and life could be reduced and/or the death toll could be lower. Therefore, this scenario has unfavourable characteristics, but environmental and social consequences for Guyana, and more particularly Georgetown, are less critical.

5.2.1.3 Best-case Scenario

Effective early warning systems are developed to deliver information on impending disasters. Elaborate systems are in place to ensure timely delivery of data and information on natural hazards or emergencies to the citizens of Georgetown and disaster preparedness training of individuals who are at risk. There is implementation of a planned maintenance schedule for coastal Guyana's infrastructure resulting in the correction of defects and the optimal functioning of drains, drainage pumps, sluice gates, sea defences and dams to drain the city of effluent whilst protecting the city from the Atlantic Ocean and the EDWC. This reduces the likelihood of flooding from blocked drains and flooding from inundation due to breaches in the sea defence and dams.

There is a Disaster Preparedness Policy and Action Plan with adequate human, technical and financial resources for implementation. Thus, there is optimal coordination between the provision of resources and the course of actions. Planning, with the allocation of the adequate resources, ensures that in the event of a natural disaster or emergency, individuals are able to respond effectively. Emergency drills are conducted to practice the plan and thus the citizens are capable of responding.

There are coordinated institutional efforts among institutions that are responsible for managing the city, managing drainage, and disaster and climate-related work. Therefore, before, during and after natural hazards or emergencies, these agencies share information to ensure that they plan for these events and respond to them appropriately, that is without gaps or duplicating efforts.

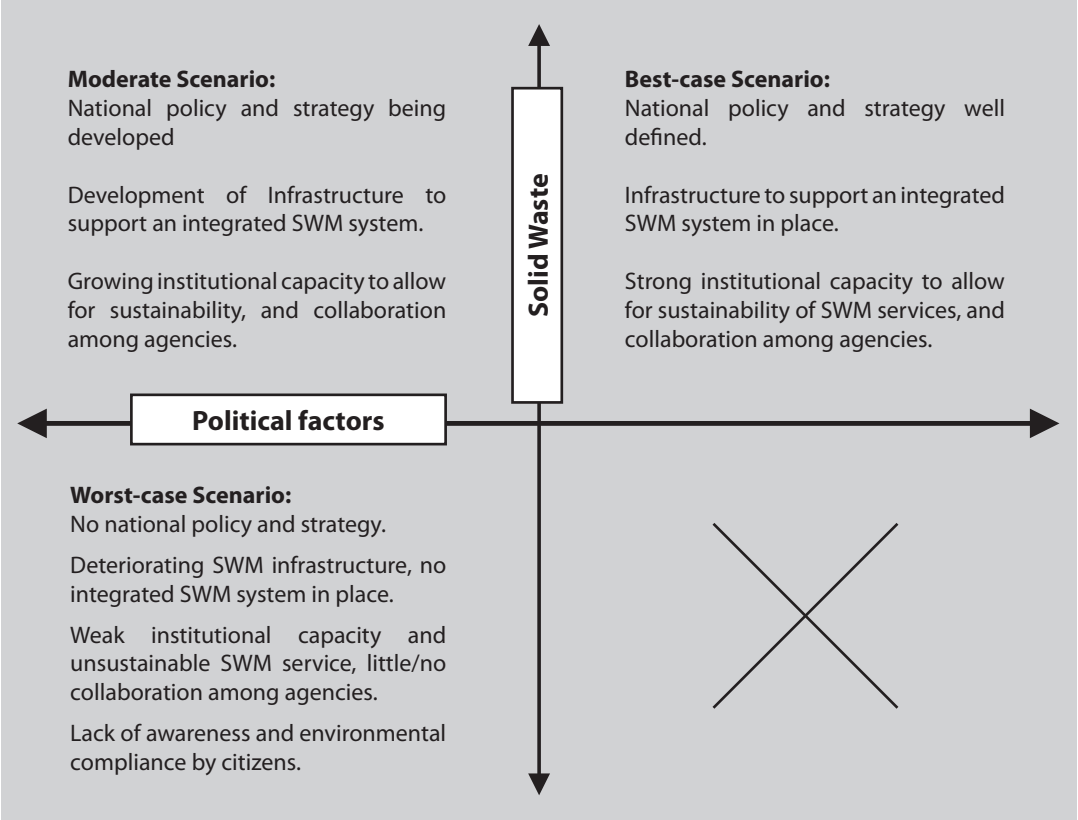
Moreover, there is Relocation Plan for Georgetown. This Plan is developed because of the vulnerability of coastal Guyana and the impending sea level rise associated with climate change. It sets out the various actions, timelines and resources required to facilitate a phased relocation of Georgetown to further inland. Any preliminary work, such as research and feasibility studies, is detailed in the Plan.

With this scenario, the citizens of Georgetown are at low risk due to their minimal exposure to natural hazards and emergencies. While the frequency of natural hazards and emergencies are expected to increase, exposure of the citizens is reduced to a minimum because the relevant institutions and the citizens are prepared and have the resources to respond to hazards or emergencies; they are informed in a timely manner in the event of occurrence of a natural hazard or emergency; and the drainage infrastructure is functioning without extended 'down-periods' and/or breaches Thus, there is minimal adverse consequences for the citizens of Georgetown. Therefore, with this scenario the environmental and social effect on Georgetown is minimal.

5.2.2 Solid Waste

According to an IDB report (2005) the impacts of improper solid waste management have become the critical environmental problem in Georgetown. Further, it was noted that this problem has become more severe over time, and has not only created unpleasant aesthetic conditions, but also poses a serious health threat to the urban population from the vermin and other by-products. The negative impacts of improper waste disposal methods were heavily felt during the January 2005 flood when the waste filled canals did not drain as fast as expected.

This situation did not always exist. Many citizens refer to a time when Georgetown was referred to as the "Garden city" with a clean, healthy environment. The Georgetown Municipal Authority has provided solid waste management services for more than half a century. However, with increased urbanization expansion of the city and technological developments influencing changes in the packaging materials utilized (Georgetown is estimated to generate 1.83 kg/capita/day of waste currently), weakened institutional capacity to maintain services in the city and poor health and safety compliance on the part of citizens, this problem has evolved.



Possibly due to the native frugality of its citizens, reuse and recycle efforts are very evident at the household level. There is no such institutional initiative and little evidence of awareness of the importance of such efforts.

5.2.2.1 Worst-case Scenario:

There is currently no national policy on solid waste management, though some work has been done to prepare a draft Solid Waste Management Act, and the National Development Strategy does identify the construction of new landfill sites as a necessity. Failure to move beyond this point has not facilitated improvements in the current solid waste management systems; there is no integrated management system and the existing infrastructure is deteriorating. Additionally institutional capacity has been weakened by increasing costs but a static revenue base, resulting in the financial viability of providing solid waste management services becoming further compromised. With the existing institutional arrangements, there is little collaboration among responsible agencies, leading to a duplication of efforts at times, but more particularly the inefficient utilization of limited resources. This has created a situation of rent-seeking among officials, low awareness among citizens of their roles and entitlements in SWM and hence poor enforcement of bylaws and environmental compliance by many citizens.

5.2.2.2 Moderate Scenario:

The development of a national policy and strategy would provide the framework within which significant advances could be made in developing the required infrastructure to support an integrated solid waste management system. It would also facilitate better urban planning and improve the mechanisms for monitoring waste generation trends resulting from commercial and industrial activities. Some work is currently being done to allow the development of such policy and strategies. Improved institutional capacity of the agencies responsible of solid waste management in the city would contribute to the delivery of better service and the development of a sustainable system, with collaboration among agencies so as to allow for

efficient use of the resources available. The foregoing will provide an environment in which awareness can be increased among citizens as to their role and thus lend to greater environmental compliance on their part.

5.2.2.3 Best-case Scenario:

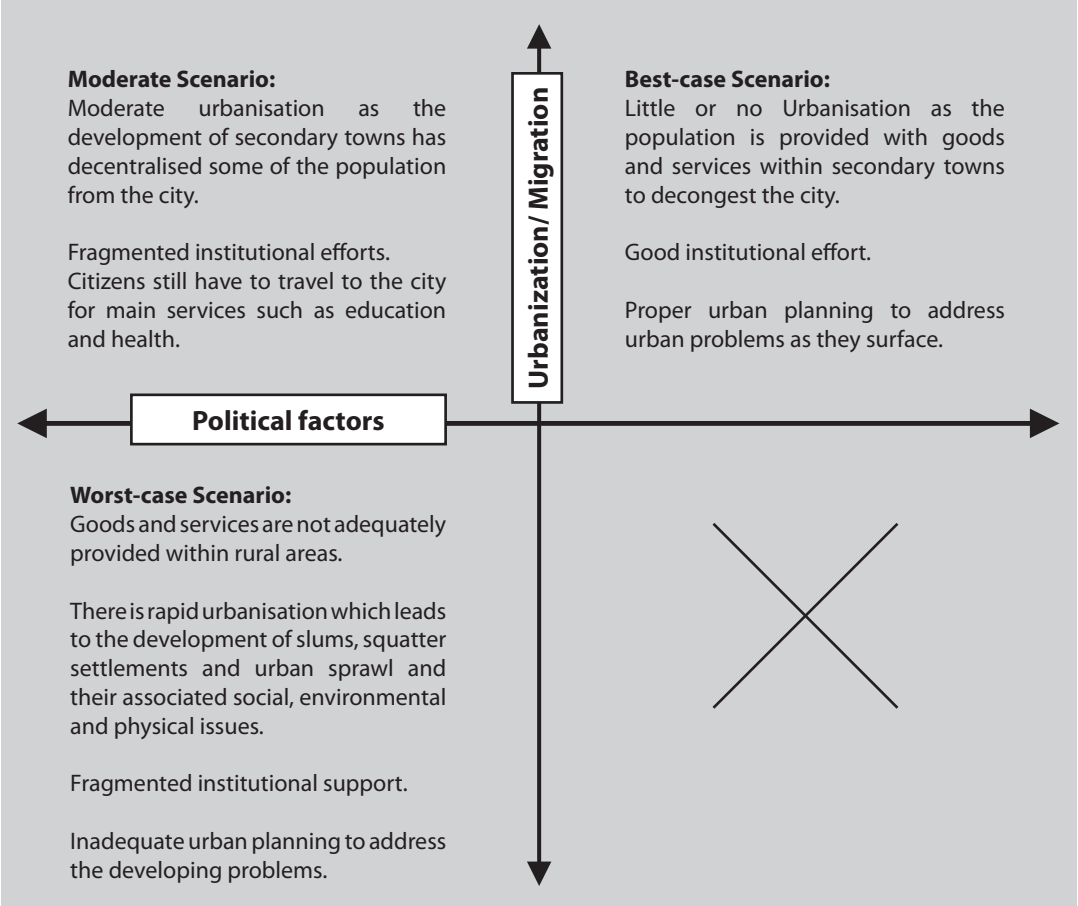
Georgetown has a well defined national policy and strategy that allows the city to address local solid waste management practices vis-à-vis such global issues as climate change. A well-maintained solid waste management infrastructure is a key element of the integrated solid waste management system, which also builds on household initiatives in the areas of waste reduction, reuse and recycling. Waste "sorting" by waste pickers at the disposal site, would become a more formalised, organised and scientific process. As a result, land-filling becomes a last resort in treatment options for solid waste management. Strong institutional capacity has facilitated strategic planning for sustainable solid waste management services, as well as intersectoral collaboration with such sectors as energy and trade. It is also promoting the model of producers' responsibility and helping movement towards the implementation of such concepts as zero waste. Greater awareness among citizens has not only allowed for environmental compliance but the development of advocates for the environment among the citizenry.

5.2.3 Urbanisation

Urbanisation was chosen as one of the scenarios because of its growing and profound impacts on cities such as Georgetown. This phenomenon is a two-way process which involves not only movement from village to cities and change from agricultural occupation to business, trade, service and profession but it also involves change in the migrants' attitudes, beliefs, values and behavior patterns. The facilities like education, healthcare system, employment avenues, civic facilities and social welfare are pull factors attracting people to urban areas. This movement of the population to the city results in a number of physical, political, social and economic issues exacerbating two of the most pressing problems facing Guyana and the world today - poverty and environmental degradation.

In Guyana urbanisation is influenced by the location of services (education, health care, electricity, commerce, security, etc), employment opportunities, recreation (cricket clubs, table/lawn tennis, parks, gardens, zoological park, squash) and transportation that are readily available and easily accessible within the city of Georgetown. Improved education leads to expectations of the type of work acceptable, and such jobs are in limited supply in rural areas. Added to this are the consequences of a small and dispersed population, which makes it difficult to provide services cost-effectively in the absence of a critical mass of clients. As citizens migrate to the urban centre in search of jobs, goods and services the process of urbanization begins to surface as there is growth in household formation and the need for many new homes. This has encroached on the available land spaces and services which eventually result in overcrowding and creates a further strain on the city's already overstretched service delivery capacity.

Overcrowding of the city has created a number of spatial, social and environmental issues such as the development of slum and squatter settlements (e.g. Riverview), the fostering of urban sprawl (e.g. Sophia), crime and improper solid waste disposal which has been linked to a number of health issues; overburdened facilities for provision of water, education, public health services, waste and soil water disposal and even jobs – leading to a growing informalisation of employment with hucksters crowding city streets The streets are also plagued with stray animals, beggars, street dwellers, and pick-pockets. Citizens' sense of security is low. Traffic congestion and a general air of neglect and decadence pervades the central business district as well as the residential areas, where drains and parapets may be maintained by the residents. The green belt shrinks with indiscriminate building practices, and runoff of storm water increases as does the propensity to flood. The negative impact of the foregoing on the environment is compounded by the inability of the city to respond to the challenges, and by the pervasive apathy of citizens.



Three scenarios for Urbanisation may be considered:

5.2.3.1 Worst-case Scenario

The lack of or inadequate provision of goods, services and jobs within the rural communities of Guyana, as well as natural disasters has influenced rural to urban migration as rapid urbanization occurs within Georgetown. Services such as education, healthcare system, employment avenues, civic facilities and social welfare within the city are factors which have influenced the intensive urban growth. This creates a congested city with a major squatting population and puts a strain on the relationship among the national-regional, and local governments, which will lead to fragmented and inefficient services to its citizens.

The city attracts citizens with various economic problems which in turn can develop urban poverty and its associated social and environmental issues such as crime, poor air and water quality, insufficient water availability, waste-disposal problems, and high energy consumption are exacerbated by the increasing population density and increase of diseases and health concerns.

The lack of implementation of urban planning strategies exacerbates the situation as the urban population continues to increase and the citizens are forced deeper and deeper into poverty as job avenues are closed and there is an increase in unemployment and underemployment. This has led to an inefficient tax collection system and in turn limited capital to develop infrastructure and services within these areas.

5.2.3.2 Moderate Scenario

Urban planning has commenced with the development of secondary towns within the rural regions. These include communities such as Lethem, Charity, Parika and Bartica which will provide the citizens with the required goods, services and jobs. However, there is inadequate collaboration among national, regional and local governments and the services provided to the citizenry are inefficient. All this results in a further disintegration in the quality of services. For example, citizens still have to journey to or migrate to the city to obtain certain services such as immigration, health, housing, tertiary level education and judicial that are still located in the primary city. Hence, despite the development of vibrant secondary towns, urbanisation still continues at an alarming rate.

5.2.3.3 Best-case Scenario

Secondary towns established and are able to decongest and relieve the primary city of its overgrowing population. The relationships among national, regional and local government are well established and there is open communication among these agencies. Tertiary institutions, such as universities and technical institutes, are established, and major health care facilities (hospitals), commerce (banking, retail and wholesale activities) and employment opportunities are readily available and easily accessible to the population within the secondary towns. These activities will encourage and sustain the provision of jobs, goods and services within these towns and influence the citizens to remain there.

CHAPTER SIX: PROPOSALS, CONCLUSIONS AND RECOMMENDATIONS

This final chapter of this report presents the emerging themes, recommendations and conclusions coming out of the stakeholder consultations on GEO Georgetown. In short, the stakeholders propose urgent action with regard to SWM, specifically:

- To create a policy for the formulation and execution of a ten year Guyana National Solid Waste Plan (NSWP), and;
- To initiate institutional changes to modernize the sector at both the national and the local levels which is necessary for the National Plan to be implemented.

Given that:

1. Georgetown will have achieved universal satisfactory SWM coverage in 5 years.
2. 60% of the Georgetown municipality will be provided with adequate SWM services. Universal coverage would be reached in ten years.
3. In 5 years 25% of the communities will have environmental clubs for children and teenagers with corresponding recycling facilities. In ten years 50% of the communities would be covered.

In order to achieve these, substantial institutional changes are necessary at national and local government levels.

6.1 Proposals

Table 6.1: *Proposal of Priority Themes*

Goals	Actions	Instruments	Institutional & Financial Resources
Orderly development of Secondary Towns	-Prepare Development Plan for secondary towns -Prepare implementation schedule	National Development Strategy Draft National Housing Policy National Land Use Plan* Local Government Reform	CH & PA, Ministry of Local Government, RDCs and NDCs, EPA, GLSC, and utility companies (GPL, GWI etc.) International Financial Institutions (IADB, EU, World Bank, CIDA); Central Government
Greater intra and inter agency coordination	-Harmonisation of legislation that created institutions that duplicate functions -Sharing of work programmes and plans -Identification of synergies between work programmes -Development of Plans of Action for effective coordinating mechanisms	-Legislation -Organizational plans -Plan of Action -MoUs	Budget allocation from Central Government for Ministries and Agencies

Goals	Actions	Instruments	Institutional & Financial Resources
High public awareness and ongoing education about the environment.	-Revise existing National EE Strategy with view to incorporating new environmental challenges (e.g. climate change) -To mainstream public environmental education and awareness in all environmental projects -Increase budgetary allocation for EE	National EE Strategy and Action Plan	International Financial Institutions (IADB, EU, World Bank, CIDA)
Disaster Preparedness	-Prepare community and National Disaster Preparedness and Management Plans - Develop and implement an early warning system -Installation of early warning infrastructure -Identify and prepare emergency housing sites	National and Community Disaster Preparedness and Management Plans	International Financial Institutions (IADB, EU, World Bank, CIDA Central Government
Updated and appropriate Legislation and Enforcement	-Review and harmonise existing legislation -Drafting of new legislation -Strengthening of institutional enforcement capability through training, provision of financial and material resources, among others.	Existing and new legislation	International Financial Institutions (IADB, EU, World Bank, CIDA Central Government
To build institutional capacity	-Assessment of current institutional capacity -Provide training for identified persons -Review and make appropriate adjustment to organizational structures to improve service delivery and overall organisation performance -Strengthen resource base to ensure sustainability, for example, through a more efficient revenue collection and prudent spending	-Strategic plans for organisations	Central Government International Financial Institutions (IADB, EU, World Bank, CIDA

Goals	Actions	Instruments	Institutional & Financial Resources
Improved political support and will	-Political endorsement of all plans, programmes and policies for urban improvement -Stakeholder consultations on issues -Increased budgetary allocations	National Development Strategy	National Budget

* Not in place

6.2 Conclusion and Recommendations

Environmental issues in Georgetown have gained increasing attention from both the policy makers and the general public over the past decade or more. Most of the issues have been created by the lack of institutional capacity, weak enforcement of legislation; inadequate financial resources, poor governance and a lack of appreciation for the bio-physical surroundings as evidenced by the attitudes of some citizens.

The creation of the Environmental Protection Agency, the Solid Waste Management Unit of the Georgetown Mayor and City Council, and the Environmental Health Unit within the Ministry of Health are appropriate institutional structures for prudent management of the city. However, the current rate of human capital flight from the country undermines the 'good' intentions of these entities and weakens their monitoring and enforcement capability more often than not. Additionally, the apparent lack of an integrated institutional approach to addressing the underlying issues is a source of concern.

The results of these issues, as highlighted in the report, are:

- Growing disorder and civil disobedience: squatting, street vending, street dwelling, victimless crimes and dumping of garbage.
- Increased vulnerability of the City to disasters, such as flood events, droughts, fires and even epidemics.
- Increased vulnerability of the citizens to chronic illnesses, disease, and a daily assault on the senses.
- Damage to (at best) and loss of (at worst) ecosystems some of which are critical to the protection of the coastal zone such as the mangrove swamps.
- Depletion of economic resources.
- Increased production costs due to frequent worker sick days and lack of family support systems.
- Increased public health costs.
- Increased household expenses as they try to compensate for shortcomings of the municipality
- And finally, The loss of the "Garden City" Image and consequent demoralization and alienation of residents.

Resolving or mitigating current environmental issues facing the city would incur a huge economic cost that the nation can ill-afford given its current social developmental needs. Therefore, the general view of stakeholders of this GEO Georgetown Study is that the 'end product' will draw attention to the plight of the city and propel positive actions toward its environmental restoration, for example, the allocation of new and additional financial resources by local, regional and international institutions.

6.2.1 Emerging Themes

The following themes have emerged from the Stakeholders Consultation for the GEO Georgetown Study:

Themes	Issues
Inter-agency coordination	• Better institutional collaboration • Reduce duplicated efforts
Institutional capacity building	• Increase in number of technical officers employed • Increase in financial resources
Legislation and enforcement	• Update legislation to deal with current and future issues • Improved institutional capacity to deal with enforcement
Political 'buy-in'	• Policies created to improve the management of the town. • Greater interaction among political actors and major stakeholders
Disaster preparedness	• More pro-active thinking/approach • Preparation and implementation of disaster preparedness plans
Public awareness education and access to information	• Change of social behavior detrimental to the environment • Change of attitude of citizens from apathy to proactivity. • Sound environmental data and information to inform action

6.2.2 Recommendations for Concrete Actions

Having examined the issues arising out of the GEO Georgetown consultations, the completion of development plans for secondary towns is seen as being critical for the continued development of Georgetown, in an orderly fashion. In addition, the following objectives are viewed as pivotal to the city's well being.

- Greater intra and inter agency coordination since it is recognized that there is a duplication of functions. As a result it is recommended that the legislation that created the very institutions be harmonized. Additionally, the sharing of work programmes and plans, identification of synergies between work programmes and the development of Action Plans for an effective coordinating mechanism is recommended.

- Revise the existing National Environmental Education Strategy with a view to incorporating new environmental challenges (e.g. climate change) and to mainstream public environmental education and awareness in all environmental projects.

- Development of a national policy and strategy to comprehensively address the issue of proper waste management.
- Development/improving of the appropriate infrastructure to collect and treat solid waste, and support an integrated waste management system.
- Strengthening of institutional capacity (human resource, financial, legislative) to provide services and allow for collaboration among institutions.
- Increased awareness of citizens' roles, so as to facilitate greater compliance on their part with environmental regulations.
- Preparation of community and national Disaster Preparedness and Management Plans, and identify and prepare emergency housing sites.
- Political 'buy-in' is essential for the orderly transition of the city to a sustainable urban center. It is recommended that there is political endorsement of all plans, programmes and policies for urban improvement and there be stakeholder consultations on issues.
- Application of Strategic Environmental Assessments to all policies, plans and programmes related to the development of Georgetown to ensure sustainability.
- More accurately assess the impact of sea level rise and climate change;
- Strengthen disaster risk management institutions, including re-orienting toward emphasis on ex ante risk reduction;
- Incorporate sea level rise and climate change in the design of sea defence and flood protection works;
- Manage flood risk within the context of a comprehensive development framework which integrates climate change adaptation planning, disaster risk management, coastal zone management, and environmental and watershed management; and
- These needs are in line with those expressed in Guyana's National Communication to the United Nations Framework Convention for Climate Change (UNFCCC).

APPENDICES

Appendix 1
PSIR Methodology: Matrix of Core Indicators

Environment / Resources / Interaction patterns	Water		Air	
	Indicator	**Source**	**Indicator**	**Source**
Pressure	- Reduced vegetation cover	- UNCSD, PARC21 - UNCSD	- Reduced vegetation cover	- UNCSD, PARC21 - UNCSD
	- Area and population in authorized and unauthorized urban settlements		- Area and population in authorized and unauthorized urban settlements	- OECD
	- Annual extraction of subterranean and surface water	- CEROI	- Emission of acid rain producing gases (NOx, SO2)	
	- Total volume of untreated domestic waste water	- PARC21	- Emission of CO2	- CEROI, ICLEI
	- Total volume of untreated industrial liquid waste		- Modal distribution	- CEROI, HABITAT
	- Loss of water in the distribution system.	- PARC21	- Motorization rate	- PARC21
			- Per capital energy consumption	- UNCSD
		- ICLEI, Dobris.	- Emission of substances that damage the ozone layer	- CEROI
State	- Shortage/availability of water to meet demand (frequency, extension, duration).	- OECD	- Concentration of CO2	- CEROI, ICLEI
		- UNCSD	- Concentration of particulate material	- UNCSD
	- Shortage of water (population with water and sanitation.		- Concentration of greenhouse effect gases	
	- BOD in bodies of water (index of water quality according to BOD, COD, heavy metals and coli forms).	- UNCSD	- Concentration of ozone in the atmosphere	- OECD
			- N° of days under air quality patterns	- Dobris + 3
	- Concentration of faecal coli forms	- PARC21		- Dobris + 3
	- Concentration of heavy metals in bodies of water			- CEROI
Impact (effects on each of the following aspects)	*Ecosystem:* - Loss of biodiversity - Impact on fragile ecosystems (mangroves). *Quality of life:* - Increase in water-borne diseases - Less leisure time linked to the aquatic environment *Urban economy:* - Increased costs of collecting and treating water - Negative impact on productive activity - Increase in price of water - Increased public health costs - Loss of urban attraction		*Ecosystem:* - Biodiversity loss - Acid rain - Changes in rainfall *Quality of life:* - Increase in respiratory and cardiovascular diseases - Incidence of skin cancer and cataracts *Urban economy:* - Reduced work productivity/ absenteeism - Deterioration of built-up environment - Increases in public health costs - Loss of urban attraction	

Environment / Resources / Interaction patterns	Water		Air	
	Indicator	**Source**	**Indicator**	**Source**
Response (existence and effectiveness of the following instruments)	- Environmental education. - Environmental NGOs /Local Agenda 21 procedures available - Investments in environmental restoration - Urban Director Plan - Spring protection legislation - Industrial chemical waste control legislation - Public and private investment in sewage treatment - Taxes based on the principle of "the polluter pays" - Control and fines for dumping untreated chemical waste	- PARC21 - ARC21, CEROI - PARC21 - PARC21 - PARC21 - PARC21 - PARC21 - PARC21 - PARC21	- Environmental education. - Environmental NGOs /Local Agenda 21 procedures available - Investments in environmental restoration - Urban Directive /Plan - Fines for violating fixed-source emission standards - Change in toxicity of products and processes (gasoline quality). - Public investment in green areas - Regulating/Monitoring fixed and mobile sources emissions - CFCs recovery rate - Investment in public transport - Energy efficiency rate	- PARC21 - PARC21, CEROI - PARC21 - PARC21 - PARC21 - OECD - CEROI - PARC21 - OECD - CEROI - PARC21
Pressure	- Reduced vegetable cover. - Authorized and unauthorized urban settlements area and population - Volume of solid waste without adequate disposal - Change in soil use - Production of industrial and domestic waste - Solid waste disposal - Variation in urbanization rate - Waterproofing rate - Spatial population distribution	- UNCSD, PARC21 - UNCSD - PARC21 - CEROI - UNCSD - HABITAT - Dobris + 3, PARC21 - PARC21 - Dobris + 3	- Reduced vegetable cover. - Authorized and unauthorized urban settlements area and population - Change in soil use - Modification of habitat and natural soil cover. - Emission of acid rain producing gases (NOx, SO2). - Noise - Inadequate waste disposal - Illumination index	- UNCSD, PARC21 - UNCSD - CEROI - OECD - OECD - CEROI - PARC21 - PARC21
State	- Polluted areas - Eroded areas - % of instable geological areas occupied (risk areas)	- CEROI - PARC21 - PARC21	- Extinct or endangered species of total known species	- OECD
Impact (effects on each of the following aspects)	*Ecosystem:* - Loss of biodiversity - Pollution of bodies of water - Increase in disease vectors *Quality of life:* Incidence of diseases caused by poisoning and pollution - Urban vulnerability - Floods - Landslides - Loss of human life *Urban economy:* - Property value depreciation - Loss of patrimony - Increased cost of Works and civil defence - Increased spending on public health - Loss of urban attraction *Politico-institutional level* - Drop in taxes collected		*Ecosystem:* - Loss of biodiversity - Change in the food chain - Increase in harmful species - Decrease in bodies of water *Quality of life:* - Increase in zoonosis - Microclimate change: islands of heat, change in hydrological cycle - Urban vulnerability *Urban economy:* - Increased public health costs - Spending on environmental engineering - Loss of urban attraction	

Environment / Resources / Interaction patterns	Water		Air	
	Indicator	**Source**	**Indicator**	**Source**
Response (existence and effectiveness of the following instruments)	- Environmental education. - Environmentalist NGOs / Local Agenda 21 procedures available - Investments in environmental restoration - Urban Director Plan - Volume of solid waste recycled from total waste collected - Total areas restored from the total of degraded areas - Preventive warnings and fines for ignoring waste disposal regulations - Private investments in industrial waste management programmes - Volume of adequately disposed of solid waste	- PARC21 - PARC21, CEROI - PARC21 - PARC21 - Dobris + 3 - OECD - PARC21 - PARC21 - PARC21	- Environmental education. - Environmentalist NGOs / Local Agenda 21 procedures available - Investments in environmental restoration - Urban Directive/Plan - Protected area as percentage of total area - Public investment in green areas - Environmental conservation tax inducements - Investments in final waste disposal - Re-using and recycling waste.	- PARC21 - PARC21, CEROI - PARC21 - PARC21 - CEROI, UNCSD, OECD - CEROI - PARC21 - CEROI, HABITAT, DOBRIS, Dobris + 3 - Dobris + 3

Sources Cited:

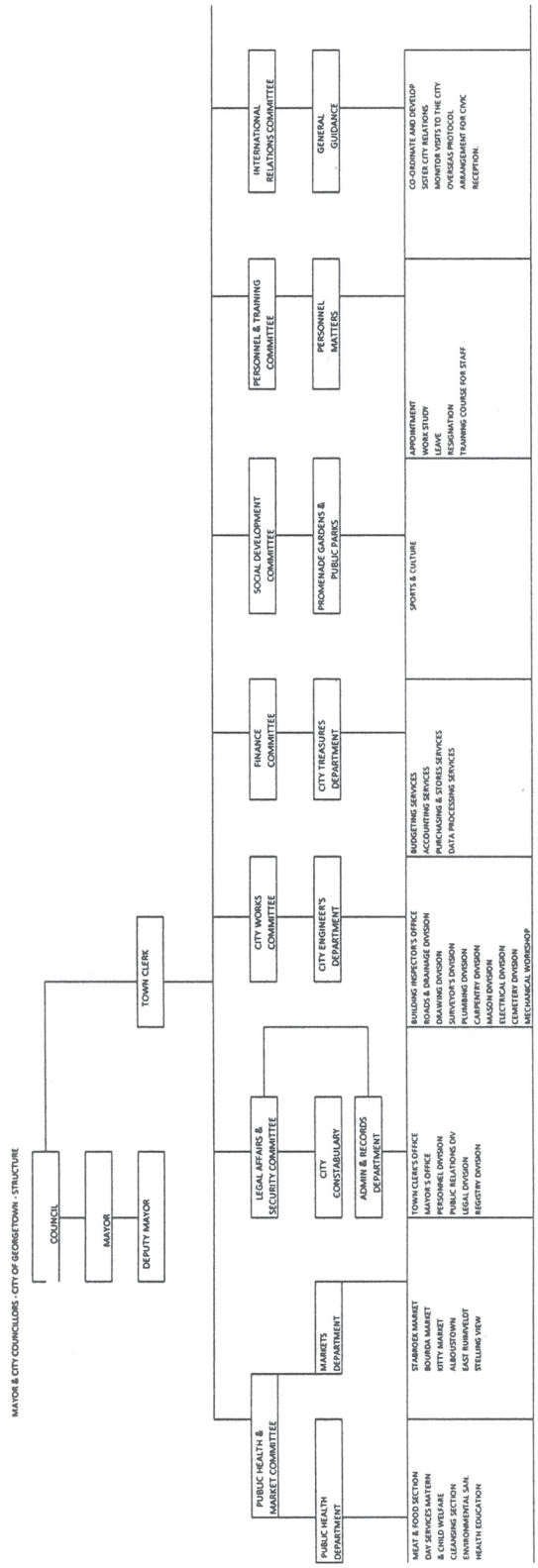
UNCSD: United Nations Commission on Sustainable Development.
PARC21: Consortium Parceria 21 (consortium of 3 Brazilian NGOs responsible for developing a methodology for the GEO Cities project).
CEROI: Cities Environment Reports on the Internet Programme.
ICLEI: International Council for Local Environmental Initiatives. In 1998 carried out a pilot Project known as Cities 21.
Dobris: "The Dobris Assessment 1995" : was the first report on the state of the environment for all European countries prepared by the European Environmental Agency. **Dobris + 3: Dobris + 3 Report (1998)**: is the second report that assesses environmental conditions in Europe.
OECD: Organisation for Economic Co-operation and Development.
HABITAT: United Nations Human Settlements Programme.

Appendix 2
GEO Georgetown: TABLE OF CORE INDICATORS

Environment / Resources / Interaction patterns	Water		Air	
	Indicator	**Source**	**Indicator**	**Source**
Driving Forces	URBANISATION • Growing demand/extraction rates • Level of contamination and incidence of disease • Increasing imermeability of surfaces from construction	GWI MOH & GWI CHPA/ M&CC	• Socio-political connotations of sugar industry, leading to the tradition of Guyana economy and its foreign exchange earning that is based on the industry. • Life style change • Rural-urban migration • Lack of technical and financial capacities in key authorities/ institutions	BOG UG BOS
Pressure	• Lack of adequate processing capacity to supply demand • Loss of water in the distribution system • Pollution in the distribution system • Lack of inadequate resources to maintain distribution systems	• GWI • MoH&W • EPA • UG • GNBS	• Burning of sugar cane fields (twice/ year, outside of Georgetown in the south). • Burning from the land fill site • Burning of household wastes in yards • Increase in waste generation • Improper waste disposal at the landfill site • Change in the composition of waste • Traffic congestion in the central Georgetown • Unauthorized small-scale industrial activities (e.g. paint shops) • Presence of the Guyana Power Light for electricity generation.	
State	• Inadequate quality and quantity of water Quality: concentration of faecal coliforms and concentration of heavy metals in bodies of water Quantity: Shortage/availability of water to meet demand (frequency, extension, duration) and shortage of water (population with water and sanitation.	• GWI • MoH&W • EPA • UG • GNBS	• Ash in south Georgetown, related to burning of sugar cane **(Increase in the level of suspended particulates/PM10?).** • Odour, smoke in south Georgetown, around the land fill site • Noise, fume, dust in the central Georgetown • GHGs emission **(Emission of CO_2)**	(No air quality monitoring station in Georgetown. Some ad-hoc testing done in other locations within Guyana).

Environment / Resources / Interaction patterns	Water		Air	
	Indicator	**Source**	**Indicator**	**Source**
Impact (effects on each of the following aspects)	• Increased costs of collecting and treating water • Increased cost to the consumer (storage and purchase of water) • Industries are affected by the increase cost of water and availability. • Increase in the number of private water purification systems. • Increased public health costs • Increased water-borne diseases.	• GWI		
Response (existence and effectiveness of the following instruments)	• Merging of GSWC and GWA into GWI for proper water management in Georgetown. • Introduction of water meters to replace fixed rates. The tariff and efficiency of the equipment installation process should be improved. • Monitoring at the source of distribution. • Report of leakages. • Public education. • Polluter pay principles are considered by the EPA, but not enforced. • Ministry of Health increased surveillance. • Increase to health facilities (public and private). The affordability of this impact has to be revised.		• 2000 EPA Air, Noise, Water and Hazardous Waste Regulations • Environmental education through Eco-clubs (EPA) – Note: No environmental curriculum in the formal education policy • Guyana Constitution, supporting environmental awareness • UG, SEES • EPA Environmental Management Division to address complaints • Installation of traffic lights • Environmental Health Officers at the Min. of Health	

Appendix 3


MAYOR & CITY COUNCILLORS - CITY OF GEORGETOWN - STRUCTURE
COUNCIL
MAYOR
DEPUTY MAYOR
TOWN CLERK
PUBLIC HEALTH & MARKET COMMITTEE
LEGAL AFFAIRS & SECURITY COMMITTEE
CITY WORKS COMMITTEE
FINANCE COMMITTEE
SOCIAL DEVELOPMENT COMMITTEE
PERSONNEL & TRAINING COMMITTEE
INTERNATIONAL RELATIONS COMMITTEE
PUBLIC HEALTH DEPARTMENT
MARKETS DEPARTMENT
CITY CONSTABULARY
ADMIN & RECORDS DEPARTMENT
CITY ENGINEER'S DEPARTMENT
CITY TREASURES DEPARTMENT
PROMENADE GARDENS & PUBLIC PARKS
SPORTS & CULTURE
PERSONNEL MATTERS
GENERAL GUIDANCE
MEAT & FOOD SECTION
DAY SERVICES MATERN & CHILD WELFARE
CLEANSING SECTION
DAHOMEY HOSPITAL
HEALTH EDUCATION
STABROEK MARKET
BOURDA MARKET
KITTY MARKET
ALBOUYSTOWN
LAST MARKET EST
STELLING VIEW
TOWN CLERK'S OFFICE
MAYOR'S OFFICE
PERSONNEL DIVISION
PUBLIC RELATIONS OFF
LEGAL ADVISOR
REGISTRY DIVISION
BUILDING INSPECTOR'S OFFICE
ROADS & DRAINAGE DIVISION
DRAWING DIVISION
SURVEYS DIVISION
PLUMBING DIVISION
CARPENTRY DIVISION
MASON DIVISION
ELECTRICAL DIVISION
CEMETERY DIVISION
MECHANICAL WORKSHOP
BUDGETING SERVICES
ACCOUNTING SERVICES
PURCHASING & STORES SERVICES
DATA PROCESSING SERVICES
APPOINTMENT
WORK STUDY
LEAVE
RESIGNATION
TRAINING COURSE FOR STAFF
CO-ORDINATE AND DEVELOP SISTER CITY RELATIONS
SOCIAL ASPECTS TO THE CITY
OVERSEAS PROTOCOL
ARRANGEMENT FOR CIVIC RECEPTION.

References

- Atkins Consultants Limited. (2006) Guyana Country Environmental Profile, final report.
- Bernard, D. M. (1999) A New Geography of Guyana. Macmillan Caribbean.
- Bishop, A. (2003) Country Experience in land Uses- Guyana Country Experience Report.
- Bureau of Statistics. (2006). Statistical Bulletin, Vol. 15, No. 1.
- Bynoe P. (2006) Urban Dynamics and Environmental Sustainability (MDG # 7): A Case Study of Seven Squatting Areas in Georgetown Guyana. Paper presented at Seminar on the Population and Environment in Pan-Amazon.
- Bynoe, Mark, (1997). Georgetown's Urban Blight. Guyana Review. Guyana.
- Bynoe, P and Williams P. (2006) Assessment of the Effectiveness of Environmental Education Interventions in Schools. Report Submitted to the Environmental Protection Agency. Government of Guyana. IADB Project.
- Bynoe, P. and Williams, P. (2007) Biodiversity Country Study. Report done for ACTO. Brasilia.
- Central Housing & Planning Authority. (1951) Greater Georgetown Planning Area: Report and Draft Scheme.
- Central Housing & Planning Authority. 2004. Greater Georgetown Development Plan.
- Daniel, J. R. K. (2001) Geomorphology of Guyana- An Integrated Study of Natural Environment. 2nd Ed. Occasional Paper N0. 6 department of Geography, University of Guyana.
- ECLAC (2005) Guyana Flood Reports, March 2005.
- Environmental Management Consultants. (2008). Georgetown Marriott Hotel, Casino and Entertainment Complex: Draft Social and Environmental Impact Assessment Report.
- Government of Guyana. (2002). Guyana Initial National Communication.
- Government of Guyana (2007) National Biodiversity Action Plan II (2007-2011). Environmental Protection Agency, Georgetown.
- Government of Guyana (2005) Poverty Reduction Strategy Paper.
- Guyana Housing and Population Census, 2002.
- Guyana Climate Change Action Plan, 2001.
- Guyana Sugar Corporation Inc. (2007). GuySuCo and the Guyanese Community [online]. Available from: http://www.guysuco.com/about_gsc/gsctoday/ gsc_comm/Default.asp [Accessed: February 3, 2008].
- Guyana Water Inc. (2005-2006). Guyana's Water Resource - Guyana Coastal and Hinterland Geohydrology [online]. Available from: http://www.Guyana Water Incorporated (GWI) - Guyana coastal hydrogeology. htm [Accessed: February 14, 2008].
- Integrated Coastal Zone Management Action Plan. Environmental Protection Agency, December, 2000.
- Khan, M. (2001) National Climate Change Adaptation Policy and Implementation Plan for Guyana. National Ozone Action Unit of Guyana/HydrometeorologicalService, Georgetown.
- Mackintosh. B. March 21st 2008, The Guyana Flood Update viewed on 1st July, 2009 < http://www.bryanmaxx.netfirms.com/21-03-2008.htm>
- National Biodiversity Action Plan (NBAP) II (2007-2011).
- National Development Strategy (2000) A Policy Framework: 2001-2010, Eradicating Poverty and Unifying Guyana, A Civil Society Document.
- Peak, Linda, (1997). From Cooperative Socialism to a Social Housing Policy? Declines and Revivalism in Housing Policy in Guyana in Self-Help Housing, the Poor and the State in the Caribbean (Robert Potter & Dennis Conway, Eds.). The Press University of the West Indies: Jamaica.
- Pelling M (2002) Participation, Social Capital and Vulnerability to Urban Flooding in Guyana. In Journal of International Development (469-486), University of Liverpool, Published by John Wiley and Sons, Ltd.
- Scott, Neberne (2000). Dimensions of Squatting on the Reserves of the City of Georgetown, Guyana. Central Housing and Planning Authority. Ministry of Housing. Guyana.
- ENES Consultants Ltd. (2006). State of the Environment Report for the Demerara Watershed, third report.
- World Health Organization. (2008). Guidelines for drinking-water quality: incorporating 1st and 2nd addenda, Vol.1, Recommendations, 3rd ed. Geneva: WHO Press.

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