

## EXECUTIVE SUMMARY

The **Preliminary Design Report** presents the proposals for implementation of urgent rehabilitation works for the improvement of Georgetown Sewerage System. The technical proposals contained in “Volume 1- Technical Study” are supported by the environmental analyses documented in this **Environmental and Social Assessment** representing the second volume of the Report. The results of the socio-economic study are reported in “Volume 3 - Cost-Benefit Analysis”.

This **Environmental and Social Assessment** has been prepared in compliance with the **IDB** and **GWI** policies concerning environmental protection.

An overall description of present condition of infrastructures and proposed project features is given in **Chapter 1**. Two options have been identified, namely:

- **Option 1.a** including the basic works that have to be given first priority, and
- **Option 1.b**, which is an extension of the first option with the addition of wastewater treatment facilities

Further details on the design of recommended interventions are given in “Volume 1 – Technical Study”

The institutional and legal framework governing the environmental sector in Guyana is thoroughly described in **Chapter 2**, while the main characteristics of study area, with particular attention to the environmental and social conditions in Georgetown central area, are shown in **Chapter 3**.

**Chapter 4** provides a comprehensive assessment of the environmental and social impacts consequent to the implementation of the two options, considering both temporary and permanent impacts. Impacts have been evaluated using the **Environmental Screening Checklist** required by **GWI Environmental Guidelines**.

**Chapter 5** gives a comparison between the two proposed alternatives, in terms of technical advantages and disadvantages, as well as investment costs and O&M annual costs.

A draft structure for the future **Environmental and Social Management Plan** to be elaborated by contractors according to **GWI Environmental Guidelines** is given in **Chapter 6**.

**Chapter 7** proposes actions to be taken for the implementation of awareness campaigns and public disclosure of the project objectives.

The report is complemented with annexes incorporating the **Environmental Screening Checklists** for both options.

VOLUME 2: ENVIRONMENTAL AND SOCIAL ASSESSMENT

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LIST OF ACRONYMS

|             |  |
|-------------|--|
| <b>EAB</b>  | Environmental Assessment Board           |
| <b>EAP</b>  | Environmental Action Plan                |
| <b>EAT</b>  | Environmental Appeals Tribunal           |
| <b>EIS</b>  | Environmental Impact Assessment          |
| <b>EIS</b>  | Environmental Impact Statement           |
| <b>EMP</b>  | Environmental Management Plan            |
| <b>EPA</b>  | Environmental Protection Agency          |
| <b>ESA</b>  | Environmental and Social Assessment      |
| <b>ESC</b>  | Environmental Screening Checklist        |
| <b>ESMP</b> | Environmental and Social Management Plan |
| <b>GNBS</b> | Guyana National Bureau of Standards      |
| <b>GWI</b>  | Guyana Water Incorporated                |
| <b>IDB</b>  | Inter-American Development Bank          |
| <b>ToR</b>  | Terms of Reference                       |
| <b>WWTP</b> | Waste Water Treatment Plant              |

## 1. PROJECT DESCRIPTION

### 1.1 Background

This Environmental and Social Assessment report has been prepared under the contract “Consultancy Services for Update of Master Plan for the Georgetown Sewerage System & Designs for the Rehabilitation of the Production and Distribution of Water Supply Systems in Linden” signed between Guyana Water Incorporated and the Consultant HYDEA S.r.l. in the framework of the Water and Sanitation Upgrade Programme financed by the IDB’s Aqua Fund programme.

The study is part of the **Preliminary Design Report** for Georgetown Sewerage System, composed of:

- Volume 1: Technical Study
- Volume 2: Environmental and Social Assessment
- Volume 3: Cost-benefit Analysis

The overall objectives of the programme are:

- Rehabilitation of the sewage infrastructure in Georgetown
- Reductions of Non Revenue Water levels throughout Guyana

The specific objectives of the Consultancy Services are:

- Modernization of the sewerage infrastructure in Georgetown
- Improvement of the provision of potable water in Linden

This report concerns the Georgetown Component of the Project and in particular the design of priority works for the Georgetown sewerage infrastructure, aimed at the identification and estimation of urgent rehabilitation works to be presented for IDB funding in October 2010.

This ESA has been prepared in compliance with the IDB policies and particularly in conformity with the IDB Environmental and Social Guidance (February 2009) and The GWI Environmental Guidelines for Construction Projects and Environmental Assessment (February 2005). In accordance with those guidelines this ESA comprises a draft structure for Environmental and Social Impact Management Plan to be prepared by selected contractors.

### 1.2 Description of proposed interventions

There exist three piped sewerage systems in Georgetown: Central Georgetown, Tucville and University of Guyana systems. With the exception of Central Georgetown scheme, these are small local networks serving a number of inhabitants comprised between 1,500 and 3,000.

**The Central Georgetown Sewerage System** provides service to approximately 50,000 residents in the service area bounded by the Demerara River in the West, Vlissingen Road in the East, the Atlantic Ocean in the North and Sussex Street in the South.

The Central Georgetown sewerage system was first commissioned in 1929. It was designed by Howard Humphrey and Sons to serve a population of 10,000 residents. It essentially comprises 24 sewerage basins each having a network of gravity sewers draining into a single pumping station. The 24 pumping stations deliver untreated flows into a common ring force main from where they are discharged to the mouth of Demerara River via a short outfall located at Fort Groyne, Kingston. The catchment basins extend over an area of about 460 hectares.

The street sewerage network remains unchanged today since it was first completed in 1929. Some of the yard sewers were changed over the years as buildings were rehabilitated, expanded or whenever foundation work was done for new construction. Additional yard sewers were done with AC pipes in the 1970s and more recently PVC pipes were used for repair works.

As regards the pressurized mains, during the period 1985 – 1988 the old Cast Iron ring was completely replaced with PVC pipes and new pumps and motors were installed. In 2009, thanks to IBD funding, rehabilitation works were done on the pumping stations and 15 pumps were replaced with new ones.

**The Tucville Sewerage System** was constructed in 1970 and benefits approximately 3,000 residents. It is formed by a small network of gravity sewers, draining into treatment works. The collection system comprises of house connections which are generally 100 mm diameter AC pipes or pitch fiber pipes. The sewerage treatment works were designed to realize the physical and biological treatment of domestic waste water by the extended aeration activated sludge process. The treatment works have been out of operation for a number of years. Following the completion of IDB funded works in 2009, the Tucville plant has been transformed into a septage receiving station for the disposal of sludge collected at septic tanks. The station is presently connected to the existing ring through a delivery main and has been effectively integrated the Central Georgetown Sewerage System.

The **priority works** proposed in this *Preliminary Design Report* are focused on the rehabilitation of central Georgetown sewerage scheme. Proposed options are based on current conditions of this same system, which have been assessed through detailed investigations carried out by the Consultant by means of advanced technologies, such as CCTV camera inspections, ultra-sonic flow metering and others (see condition assessment section in *Volume 1 – Technical Study*)

The main problems encountered through the condition assessment analysis can be summarized as follows:

- Infiltration of wastewater from street sewers and manholes due to pipe corrosion and inactivity of pumps for at least 18 hours a day
- Formation of corrosive gas through digestion processes linked to the excessive retention of organic matter into gravity sewers and mains

- Leakage from the ring main, trench crossings and delivery mains, due to pipe age and inadequacy of materials used
- Insufficient use of pumps due to malfunctioning or constraints linked to energy consumption
- Functioning of most of the pressurised pipes as open channel collectors
- Inadequate velocity at outfall diffuser.

Based on the preliminary discussions with GWI and IDB representatives on different alternative solutions, the analysis has been focused on the **rehabilitation of existing ring main**. Within the general approach of this first option, two proposals have been identified and developed from the technical and financial point of view.

The following specific objectives have been considered to orient the preliminary design:

- Reduction of risk of contamination of potable water consequent to infiltration of wastewater
- Considerable decrease of dispersion of pollutants into the aquifers
- Elimination of leakage into canals and trenches
- Reduction of retention time of wastewater into sewers, manholes and raising mains
- Improvement of diffusion of effluent at the outfall

From the technical point of view, the proposed options are based on the substitution of old materials with new and more reliable materials, as well as on the reinforcement of the capacity of existing pumping stations. Hereafter is a brief description of main technical proposals for the priority interventions:

#### Selection of materials

HDPE pipes have been selected for the replacement of the main ring, owing to their excellent flexibility and resistance to corrosion. The main advantage in the use of HDPE pipes for sewerage pressure mains is the jointing method, which is by butt fusion or (for smaller diameters) electro-fusion welding. Properly made fusion joints are essentially leak free. The use of HDPE mains can help eliminate contamination of the external groundwater and soil, as well as infiltration when the pipes are empty.

An additional advantage is the availability of big diameters, up to 1000 mm external (corresponding to about 880 mm internal diameter) and of a wide range of nominal pressures classes.

### Valves and fittings on the ring

The ring must be equipped with gate valves installed in proper locations in order to facilitate the separation in different sections. This intervention is intended to avoid stagnation of sewage in the southern sections of the ring. The optimal location and operation of these valves is to be identified through hydraulic modelling in the phase of final design.

### Trench crossings

For the construction of new trench crossings the use of butt welded steel pipes is strongly recommended, in order to avoid leakage into the canals. These self-supporting pipes shall be raised over the maximum water level in the canals with 45° elbows and possibly fixed to the existing bridges. Side connections to the HDPE mains shall be made with flanged fittings. Air valves and washouts must be provided at each trench crossing.

### Pipe profile

The profile of pressurized mains shall be designed in a way to ensure a minimum cover of **1.6 meters** over the pipe top. This will help reduce contamination of potable water conveyed in the existing PVC mains and avoid interference with underground utilities such as electrical or telephone cables.

Notwithstanding the flat topography, mains shall have a minimum slope towards the trench crossings sites to allow for discharging at washouts during flushing or maintenance operations.

### Pumping stations

It is suggested to ameliorate the capacity of existing pumping stations through the installation of a second pump in each well, in conformity with the original design. The power supply system shall be upgraded with new transformers and control panels. In order to achieve the appropriate hydraulic conditions at the outfall diffuser, all pumping stations shall be run at the same time. The system shall be operated in a way to ensure the periodical transfer of wastewater from the sewers to the ring main and to the outfall. Stagnation of sewage into pipes, manholes or pumping wells shall be avoided

### Outfall

The location of existing outfall has been maintained for both options, as this is deemed to be the most appropriate site for the diffusion of untreated (or partially treated) sewage, due to the particular currents and tidal cycles ensuring appropriate dispersion of the effluent. Technical options based on the construction of a new outfall on the shore north of the seawall have been excluded because of the particular topography of the beach and the negative environmental impact.

The proposed urgent works are summarized hereafter:



**Option 1.a : Rehabilitation of existing ring and pumping stations power increase**

This option includes the following works:

1. Complete reconstruction of ring main with HDPE pipes
2. Installation of gate valves and fittings on the ring, where appropriate
3. Reconstruction of trench crossings, including washouts and air release valves
4. Installation of a second pump in the pumping stations, in accordance with the results of hydraulic simulations
5. Upgrade of power supply equipment at pumping stations
6. Replacement of some sections of delivery mains, where needed.

The location of proposed interventions is illustrated in **Drawing 1** attached to the first volume of this report (*Technical Study*).

Estimated time for the completion of works relevant to **Option 1.a** is eighteen months.

**Option 1.b : Rehabilitation of existing ring, pumping stations power increase and preliminary treatment**

**Option 1.b** is essentially an extension of **Option 1.a** with the inclusion of a primary treatment plant. The main works for rehabilitation of existing ring scheme are the same described above.

The wastewater treatment plant will be designed for a population of 50,000 inhabitants and will be composed of two parallel processing lines for 25,000 inhabitants each. The two lines will be designed in a way to allow for periodical maintenance. The WWTP shall include:

- a double inlet channel equipped with grids for screening and removal of floating solids
- two aeration basins
- two final settlement tanks with recirculation of sludge to aeration basins

The location primarily identified for the treatment plant is at the crossing of Carifesta Avenue with Vlissengen Road, on a small triangular piece of land belonging to the Government of Guyana. In the event Option 1.b will be selected, the effective availability of this parcel of land shall be verified with the governmental Authorities.

The main features and location of works included in **Option 1.b** are illustrated in **Drawing 2** attached to the first volume of this report.

In the proposed scheme, the treated effluent will be conveyed to a low-head pumping station (**PSTP**) that will lift it to the existing HDPE outfall. The 800 mm delivery main, **1,900 m** long, will be laid along the seawall to the connection with the existing pipe. The power installed in this new pumping station shall allow for the attainment of an outlet velocity sufficient for the correct diffusion of effluent into the estuarine waters (minimum 1 m/s). The pumps will work only few hours a day.

Works for rehabilitation of the ring main and pumping stations will be as per Option 1.a. An additional **2,300 m** long main will be laid under Laluni Sreet and Vlissengen Road to convey wastewater from the ring to the treatment plant.

Taking into account the construction of mains and treatment plant, the time for the completion of works relevant to **Option 1.b** is deemed to be twenty-four months.

### **Rehabilitation of gravity sewer networks**

According to the findings of condition assessment, the degradation of street and yard sewers is responsible for a considerable amount of infiltration of wastewater and contaminants in the ground.

Due to the age, poor condition and inadequate diameters of the existing sewers, it would be advisable to proceed with the complete reconstruction of networks instead of replacing some pipe sections. Metal pipes should not be used for this purpose, as they are subject to corrosion.

Considering the cost and characteristics of different materials and taking into account that gravity sewers should never flow under pressure, it is suggested to use PVC pipes with socket joints for the reconstruction of the networks. In order to prevent obstructions and facilitate maintenance, the minimum diameters shall be **225 mm** for street sewers and **160 mm** for yard sewers.

The average densities of pipes calculated in a representative catchment area (basin F) are:

- Density of street sewer pipes: **130 m /ha**
- Density of yard sewers (including collecting sewers): **380 m /ha**

## 2. INSTITUTIONAL AND LEGAL FRAMEWORK

The legislative and regulatory framework, for the project, is a combination of national, international and regional policies, regulations, legislations and guidelines to which Guyana is a signatory. The environmental and social assessment process for development and operation of the project will be undertaken in accordance with the legislative and regulatory framework detailed below.

### 2.1 National Policies

The importance of the environmental and the social issues in Guyana policies is well expressed and highlighted in the following major documents:

#### 2.1.1 Constitution of Guyana

Article 2:25: *"Every citizen has a duty to participate in activities to improve the environment and protect the health of the nation."*

Article 2:36: *"In the interest of the present and future generations, the State will protect and make rational use of its land, mineral and water resources, as well as its fauna and flora, and will take all appropriate measures to conserve and improve the environment."*

#### 2.1.2 Millennium Development Goals, 2000

In 2000, at the United Nations Millennium Summit, 189 world leaders adopted the Millennium Declaration and agreed to collective commitments to overcome poverty through a set of eight mutually reinforcing interrelated time-bound goals (MDGs) with related targets. Guyana was part of the Nations adopting the MDGs.

The MDGs synthesize the goals of 1990s global UN conferences and provide an accountability framework and global partnership for progressively eradicating poverty in all its dimensions. The MDGs are at the forefront of the global development agenda and represent the international community's commitment to eradicate poverty by 2015.

**Goal 7. Ensure environmental sustainability:**

1. *integrate the principles of sustainable development into country policies and programmes and reverse the loss of environmental resources;*
2. *By 2015, reduce by half the proportion of people without access to safe water;*
3. *By 2020 achieve significant improvements in the lives of at least 100 million slum dwellers. "*

### 2.1.3 National Development Strategy 2001-2010

*“It is important at this early stage to enunciate the “environmental philosophies” on which Guyana’s social and economic development will be based:*

- (i) environmental considerations should underpin all aspects of development, whether physical or social;*
- (ii) where there are threats of serious or irreversible damage, the absence of scientific certainty will not be used as a reason for postponing the formulation and implementation of measures to prevent environmental degradation;*
- (iii) environmental protection is a matter of human survival. Each generation owes it to the next to act responsibly and to ensure that no irreversible damage is done to the environment. No generation has the right to leave future generations with a more limited choice than that which it inherited. Indeed, the current generation has an obligation to expand the range of such choices, and to improve the quality of the environment;*
- (iv) ultimately, the success of a development strategy will depend on the extent to which it integrates, conceptually and operationally, environmental and developmental imperatives;*
- (v) life on earth depends, in the final analysis, on the support provided by the physical environment. This means that to maintain life the integrity of the ecosystem must be preserved. In other words, the capacity to accommodate changes in natural conditions and in the processes which sustain it cannot be exceeded without causing it to collapse, or to lose its identity, with unpredictable consequences; and*
- (vi) sustainability is not merely a question of ethics. There are limits to the extent to which natural systems can be utilised. Beyond these limits their performance becomes impaired. Indeed, they may even be destroyed. Moreover, environmental systems are complex and unpredictable. We do not, therefore, always fully understand and appreciate their dynamics. Accordingly, we must, wherever such knowledge is not available, restrict our activities.”*

*“Guyana’s principal environmental policy objectives are:*

- to enhance the quality of life of the country’s inhabitants by utilising 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.”*

### 2.1.4 Guyana Poverty Reduction Strategy Paper (PRSP), 2001

*“To minimize the impact of environmental degradation, the Government’s principal environmental policy objectives will be to:*

- (i) enhance the quality of life without degrading or contaminating the environment;*
- (ii) ensure sustainable use of natural resources for economic growth; and*
- (iii) protect and conserve unique habitats, natural treasures and bio-diversity.*

To achieve these objectives, Government's strategy will be to:

- (i) enforce rigorously the provisions of the Environmental Protection Act;
- (ii) promote public awareness of the benefits of sound environmental policy; and
- (iii) involve local communities in developing programs to manage vulnerable ecosystems and conserve the resources of protected areas.

In addition, the Environmental Protection Agency (EPA) will monitor and enforce standards for air emissions, effluent discharge, and noise levels of industries; ensure stricter compliance with environmental management plans, conduct regular environmental audits; and promote the training of adequate numbers of technicians to monitor adherence to legal environmental standards.”

“The Government's medium-term strategy in the water sector will be dedicated to improving the quality and delivery of services, ensuring good and effective regulation of the sector, and implementing a subsidy program to help poor households connect to the system and/or pay a portion of their monthly bill. Specifically, the objectives of the water sector will include:

- (i) provision of access to safe water to 95 percent of the population;
- (ii) establishment of a Guyana Water Company to provide economies of scale;
- (iii) streamlining of the activities in the coastal zone with emphasis on treatment of raw water; and
- (iv) implementation of a comprehensive rehabilitation and maintenance plan.”

“The Government's goal in the sanitation sector is to improve the sanitary conditions of the population of Georgetown, and to reduce the current levels of environmental degradation through improvement in the quality and availability of the water supply and sewerage services”.

The environmental protection and safeguard policies were confirmed through a series of acts and regulations, from which the most pertinent to this project are presented here after.

## **2.2 National Environmental Action Plan, 1994:**

The National Environment Action Plan (NEAP) developed in 1994 outlined the Government of Guyana main environmental policy objectives for sound management of the environment and natural resources. Twelve policy objectives were outlined. One of the policy objectives calls for the Government of Guyana to require that environmental assessments are undertaken for proposed development activities that may significantly affect the environment. In keeping with this environmental policy objective, the Environmental Protection Act was made law in June 1996 and the legal framework for undertaking an environmental impact assessment was outlined. Further, the Act established the Environmental Protection Agency and outlined the legal process for undertaking sustainable and effective management of the environment and its natural resources. This plan was updated in 2000 and sets out the environmental development strategy for Guyana for the next five years. It states Guyana's Policy position as 'sustainable development that integrates economic, environmental and social values during planning, and recognizes the need to distribute benefits equitably across socio-economic strata and gender upon

implementation.’ The main goals of protecting the environmental as defined in the plan are:

- (i) The prevention or control of pollution in order to maintain the integrity of the land and the natural purity of the air and water resources;
- (ii) The general preservation and conservation of ecological integrity and the protection of natural habitats and fragile ecosystems in particular;
- (iii) Ensuring sustainability through best practice of the management and use of natural resources for economic development.

### **2.3 Environmental Protection Act 1996**

The Environmental Protection Agency was formed by the Environmental Protection Act (1996), its identified functions consist in providing for the management, conservation, protection and improvement of the environment, the prevention or control of pollution, the assessment of the impact of economic development on the environment and the sustainable use of natural resources.

**The Environmental Protection Agency therefore is the agency under which GWI's environmental activities are regulated.**

The Environmental Protection Act mandated four functions for the EPA which relates to environmental assessment. The four functions of the EPA applicable to this project are:

1. To take such steps as are necessary for the effective management of the natural environment so as to ensure conservation, protection and sustainable use of natural resources;
2. To promote the participation of members of the public in the process of integrating environmental concerns in planning for development on a sustainable basis;
3. To ensure that any development activity which may cause an adverse effect on the natural environment be assessed before such activity is commenced and that such adverse effect is taken into account in deciding whether or not such activity should be authorized.
4. To give development consent which entitles the developer to proceed with the project.

There are five (5) pieces of legislations governing environmental protection which were enacted in 2000 as a consequence of the Environmental Protection Act. These are:

- The Environmental Protection Air Quality Regulations
- The Environmental Protection Water Quality Regulations
- The Environmental Protection Noise Management Regulations
- The Environmental Protection Hazardous Wastes Management Regulations
- The Environmental Protection Authorizations Regulations

**This Act is applicable to the project due to its potential to impact the environment.**

## 2.4 Environmental Protection (Authorizations) Regulations 2000

The project will utilize fuel oils and greases in its operation. Improper discharges of these substances can impact water quality and wildlife. In addition equipment used for excavation and construction will have emissions to air that can potentially impact air quality. Noise from equipment operation may also impair communication.

Regulations on Hazardous Waste Management, Water Quality, Air Quality and Noise Management were established, in 2000, under the Environmental Protection Act. These pollution management regulations, which would be applicable to this project, were developed to regulate and control the activities of development projects during construction and operation.

### 2.4.1 Environmental Protection Air Quality Regulations 2000

Environmental Protection (air quality) regulations were developed in 2000 under the Environmental Protection Act 1996. In accordance with these regulations anyone who emits any air contaminant in the construction, installation, operation, modification or extension of any facility related to industry, commerce, agriculture or any institution shall apply to the EPA for an environmental authorization and shall submit an application to the EPA at least one hundred and eighty days before the date on which the emission is to commence. In accordance with the regulations the EPA shall establish parameter limits with respect to emission of smoke, solid particles, sulfuric acid mist or sulfuric trioxide, fluoride compounds, hydrogen chloride, chlorine, hydrogen sulfide, nitric acid or oxides of nitrogen and carbon monoxide. No parameters limits have been mandated to date.

This project proposes to adhere to a combination of WHO Ambient Air Quality (2007) and World Bank Guidelines. These guidelines (2007) are detailed in **Table 1**.

Table 1: WHO Air Quality Guidelines

| POLLUTANT                               | AVERAGING PERIODS | GUIDELINE VALUE<br>( $\mu\text{g}/\text{m}^3$ ) |
|---|-------------------|---|
| Nitrogen Dioxide ( $\text{NO}_2$ )      | 1-hour average    | 200 $\mu\text{g}/\text{m}^3$                    |
| Particulate Matter ( $\text{PM}_{10}$ ) | 24-hour average   | 70 $\mu\text{g}/\text{m}^3$                     |
| Sulphur Dioxide ( $\text{SO}_2$ )       | 24-hour average   | 125 $\mu\text{g}/\text{m}^3$                    |

### World Bank Guidelines

Concentrations of contaminants in ambient air, measured at the project property boundary, should not exceed the following limits:

**Particulate matter (<10 mm)**

Annual Arithmetic Mean 100 mg/m<sup>3</sup>  
 Maximum 24-hour Average 500 mg/m<sup>3</sup>

Nitrogen Oxides as NO<sub>2</sub>  
 Annual Arithmetic Mean 100 mg/m<sup>3</sup>  
 Maximum 24-hour Average 200 mg/m<sup>3</sup>

Sulphur Dioxide  
 Annual Arithmetic Mean 100 mg/m<sup>3</sup>  
 Maximum 24-hour Average 500 mg/m<sup>3</sup>

**Workplace Air Quality**

Arsenic 0.05 mg/m<sup>3</sup>  
 Carbon Monoxide 29 mg/m<sup>3</sup>  
 Copper 1 mg/m<sup>3</sup>  
 Free Silica 5 mg/m<sup>3</sup>  
 Hydrogen Cyanide 11 mg/m<sup>3</sup>  
 Hydrogen Sulphide 14 mg/m<sup>3</sup>  
 Lead, Dust and Fumes, as Pb 0.15 mg/m<sup>3</sup>  
 Nitrogen Dioxide 6 mg/m<sup>3</sup>  
 Particulate (Inert of nuisance dusts) 10 mg/m<sup>3</sup>  
 Sulphur Dioxide 5 mg/m<sup>3</sup>

With the implementation of this project, the air quality may be affected temporarily during construction phase due to the production of dust during excavation and from the emissions of the construction equipment. If these standards are exceeded mitigation measures will be identified to minimize impacts associated therewith.

**2.4.2 Hazardous Waste Management Regulations 2000**

These regulations outline the rules and procedures for transport, storage, treatment and disposal of hazardous wastes. There are no regulations for the management of hazardous substances. These regulations are intended to ensure, through the environmental authorization process, that all operations that generate, transport, treat, store and dispose of hazardous wastes are managed in a manner that protects human health and the environment. The regulations allow for the provision of information on the types of facilities and quantity of hazardous waste generated, treatment standards and efforts to reduce the waste generated. An emergency preparedness plan is required for anyone who operates a hazardous waste facility. For the purposes of that regulation, hazardous material/waste is regarded as the following:

- Explosives
- Flammable liquids



- Flammable solids or waste solids other than explosives which may be readily combustible
- Oxidising substances
- Organic peroxides
- Poisonous substances
- Infectious substances
- Corrosives
- Toxic gases
- Toxic substances which if inhaled or ingested may cause delayed or chronic effects
- Toxic substances which if released may present immediate or delayed adverse impacts to the environment by means of bioaccumulation and/or toxic effects upon systems
- Materials capable, after disposal, of yielding another material which possesses any of the characteristics specified above

A larger proportion of the hazardous material identified above will not be utilized for the implementation of this project. The fuel used to power equipment can however be classified as a hazardous material. The hazardous waste regulations will therefore apply to fuel oil / used oils at the project site.

#### **2.4.3 Environmental Protection Water Quality Regulations 2000:**

These regulations require registration and environmental authorization by any person whose construction, installation, operation, modification or extension of any facility cause the discharge of effluents. These regulations cover parameter limits of effluent discharges, new sources of effluent discharges, fees for registration and environmental authorization, sampling points, records and reports and general provisions for the registration of water effluent, biological integrity, spills or accidental discharges and standard methods of analysis. Guidelines on the discharge of effluents and disposal of sludge are detailed in these regulations.

In accordance with these regulations the EPA was mandated to establish parameter limits for concentration of constituent of effluent which can be discharged into any inland or coastal waters or lands of Guyana for Ammonical Nitrogen, Sulphate, Chloride, Cobalt, Colour, Detergents, Anionic, Fluoride (as F), Molybdenum, Phosphate 9 as P, Polychlorinated Biphenyls, Selenium, Silver, Beryllium, Vanadium, Radioactive Material, Nitrate Nitrogen, Temperature, Pesticides, Fungicides, Herbicides, Insecticides, Rodenticides, Fumigants or any other Biocides or any other Chlorinated Hydrocarbons. Standards were also to be established for any substance that either by itself or in combination with other waste or refuse may give rise to any gas, fume or odour or substance which causes or is likely to cause pollution. The Guyana National Bureau of Standards (GNBS), along with the EPA, have developed interim industrial effluent standards.

### **World Bank Water Quality Standards**

Tolerable limits have not been established by the EPA for water quality for construction or mining operations which would be applicable to this project, therefore it is proposed to use the World Bank Water Quality Standards.

#### **Liquid Effluents**

The following guidelines for effluent discharged to receiving waters from tailings impoundment, mine drainage, sedimentation basins, sewage systems and storm water drainage are considered applicable to this project.

|  |                       |
|--|-----------------------|
| pH   | 6 to 9                |
| BOD <sub>5</sub>   | 50 mg/l               |
| Oil and Grease   | 10 mg/l               |
| Total Suspended Solids   | 50 mg/l               |
| Temperature-at the edge of a designated mixing zone                | Max 5°C above ambient |
| temperature of receiving waters, Max 3°C if receiving waters >28°C |                       |

#### **Residual Heavy Metal**

The following recommended target guidelines, which are expected to pose no risk for significant adverse impact to aquatic biota or human use are considered applicable to this project.

|                      |            |
|----------------------|------------|
| Arsenic              | 1.0 mg/l   |
| Cadmium              | 0.1 mg/l   |
| Chromium, Hexavalent | 0.05 mg/l  |
| Chromium, Total      | 1.0 mg/l   |
| Copper               | 0.3 mg/l   |
| Iron, Total          | 2 mg/l     |
| Lead                 | 0.6 mg/l   |
| Mercury              | 0.002 mg/l |
| Nickel               | 0.5 mg/l   |
| Zinc                 | 1.0mg/l    |

If natural concentrations exceed these levels, the discharge may contain concentrations up to natural background levels. Concentrations up to 110% of natural background are acceptable if no significant adverse impact can be demonstrated.

The effluent discharged from the site during all operational phases will be required to adhere to the most stringent of the water quality standards detailed above.

#### **2.4.4 Environmental Protection Noise Management Regulations 2000**

Under these regulations operations that emit noise in the execution of various activities such as construction, transport, industry, commerce and any institution are required to apply to the Agency for an environmental authorization. The EPA is responsible for the establishment of standards for permissible noise levels in industry, construction and other areas. The categories for which permissible noise

levels are fixed by the EPA were identified as follows: Residential, Institutional, Educational, Industrial, Commercial, Construction, Transportation and Recreational. The Guyana National Bureau of Standards (GNBS) and the EPA together with other relevant agencies developed Interim Guidelines for Noise Emission into the Environment. Under these guidelines, noise emissions from Industrial and Commercial sources for both day (06:00h – 18:00h) and night (18:00h – 06:00h) would be 75 and 70 decibels (Industrial) and 65 and 55 decibels (commercial) respectively at the property boundary or 15 meters from the source.

**The equipment and work engines are expected to emit noise during working hours. The Consultant will prepare the draft authorization for a permit to emit noise during construction phase.**

## **2.5 GWI and Water and Sewerage Act, 2002**

**The Water and Sewerage Act 2002** is an Act to provide for the ownership, management, control, protection and conservation of water resources, the provision of safe water, sewerage services and advisory services, the regulation thereof and for matters incidental thereto or connected therewith.

Under the Water and Sewerage Act 2002, **The Guyana Water Incorporated (GWI)** was established on May 30, 2002, resulting from the merger of the Guyana Sewerage and Water Commission (GS&WC) and the Guyana Water Authority (GUYWA).

**The mission of the GWI is:**

**“To deliver safe, adequate and affordable water and to ensure safe sewerage systems for improved public health and sustainable economic development”.**

The current project is committed by GWI and has to conform to its regulations. For what environment and social issues are concerned, the project shall follow the following GWI Guidelines:

- GWI Corporate Environmental Guidelines January 2005
- Environmental Guidelines for Construction Projects and Environmental Assessment, Written in Conjunction with the World Bank, February 2005.

### **2.5.1 GWI Corporate Environmental Guidelines - January 2005**

The GWI Corporate Environmental Guidelines are meant to improve the GWI's social and environmental performance. The guidelines are split into three sections:

1. GWI's mandate and environmental and social responsibilities
2. GWI's environmental and social guiding principles
3. GWI employees' roles and responsibilities

The major guiding principles ruling this project are the following:

- GWI will conduct its business in keeping with the Environmental Protection Act and regulations therein;
- GWI will apply to the requisite National Authority for an environmental permit for all projects in excess of G\$ 5M. If deemed necessary, Environmental Impact Assessments (EIAs) will be carried out (new EIAs may not be required if a similar project already has an EIA). Notwithstanding, environmental screening will be carried out for all activities. Projects in excess of G\$ 5m will be guided by environmental management plans (EMPs), describing in detail the steps and actions required to comply with the EPA and regulations therein;
- GWI will implement and maintain a compliance strategy based on environmental audits to verify compliance with GWI environmental policies and specific EMP;
- GWI will implement and maintain an environmental monitoring program to assess the impact of its interventions and continued operation on the environment, and the impact the environment is causing in its works.
- GWI interventions would be designed to: (i) avoid whenever possible or minimize its impact on biodiversity and natural habitats; (ii) reduce potential negative public health risks; (iii) minimize the need for involuntary resettlement; (iv) provide safeguards for physical cultural property; and, (v) reduce the emission of green house gases and implement climate change mitigation measures.
- GWI welcomes community participation and dialogue at all levels. At project level during planning and before implementation GWI will introduce the project, its components, contractor(s), and GWI's contact personnel to the community, and community concerns will be incorporated as appropriate.
- GWI will approach the community utilizing appropriate communication channels and through cultural sensitive expressions.

### **2.5.2 GWI Environmental Guidelines for Construction Projects and Environmental Assessment, February 2005**

This document has been written in conjunction with the World Bank in response to a request by the World Bank to ensure mechanisms were be in place that would take environmental issues into account should the bank decide to fund future capital investment within GWI. The guidelines are now a mandatory component of any

project over GYD 5M carried out either by GWI, or by subcontractors on its behalf. The guidelines are consequently mandatory to the current project.

**2.5.2.1 General Environmental and Social Principles Guiding Guyana Water Inc.**

Guyana Water Inc. (GWI) has established the following environmental principles to serve as a basis for design and construction of civil works (pipelines, pump stations, etc.). Those principles shall be guiding the design and execution of this project, and are then worth to be mentioned in this report:

- The designs should avoid or minimise the need for resettlement of population, as well as the impact on recreational areas and buildings of historical or architectural value. If these impacts are unavoidable, resettlement plans, mitigation and compensatory measures will be included in project costs.
- Access to dwellings and businesses should be guaranteed for both the construction and operational phases. Any restriction or limitation to accessibility to properties should be properly mitigated or compensated.
- All areas and infrastructure affected during construction should be restored to their original condition, especially pavements, gardens, utilities, and side streets impacted by traffic diversion.
- Safe and secure pedestrian and bicycle crossings should be integrated into the design and reconstruction of any road crossings.
- The design should harmonise with urban surroundings in order to minimise negative impacts on environmental quality and property values.
- In cases where significant, irreversible negative impacts are predicted, alternative solutions and final designs should be subject to public and community consultation with special emphasis on the property owners directly affected, local NGOs and community organisations, and business and professional organisations.
- minimise public nuisances, construction activities should follow environmental guidelines developed in this document. Construction schedules and the timing of necessary interruption of public utilities (electricity, water and telephone) should be communicated to the affected community.
- GWI shall perform the preliminary EIA screening in order to determine the environmental impacts expected using the screening templates included herein. The outcome of the EIA shall be incorporated into the bidding documents, in addition to the generic guidelines outlined below for construction.
- Design and construction should minimise negative social and environmental impacts on the community. In all cases several alternatives (layouts, technologies, approaches) will be explored to select schemes that provide efficient water supply and sanitation services, comply with all existing regulations, minimise externalities, and respond to community needs and concerns. During design, due consideration will be given to social and environmental impacts associated with project components.
- Community participation is an important component of all GWI activities. GWI will introduce the project, its components, contractor(s), and GWI's contact personnel to the community before work starts, and community concerns will be incorporated as appropriate.

2.5.2.2 Roles and Responsibilities

For all projects (or sub-projects) greater than G\$5M in contract value, a project specific EIA screen shall be performed and a project specific EMP shall be developed in accordance with guidelines from the Guyana Environmental Protection Agency (EPA). This EMP will address the implementation of the generic construction guidelines as well as the project-specific guidelines as a result of the EIA process. The guidelines define also in a table the roles and responsibilities necessary to fulfil the requirements of these guidelines as follows:

Table 2:

Roles and Responsibilities According to GWI Corporate Environmental Guidelines

| <b>Task</b>   | <b>Timeline</b>                  | <b>Responsible Party</b> | <b>Oversight</b> |
|---|----------------------------------|--------------------------|------------------|
| Identify need for project and rough scope   | Planning                         | GWI                      | None             |
| Develop refined project scope   | Planning                         | GWI or design engineer   | GWI              |
| Develop alternatives  | Planning                         | GWI or design engineer   | GWI              |
| Complete screening checklist for proposed project and alternatives                              | Planning                         | GWI or their agent       | EPA              |
| Select project, prepare bid documents, Notice of Screen bids and award contract                 | Planning                         | GWI or design engineer   | GWI              |
| Public participation meeting: introduce project and contractor, gain input from local residents | Immediately after contract award | GWI, contractor          | Public, GWI      |
| Development of project ESMP   | Before breaking ground           | Contractor               | GWI              |
| Train workers on ESMP practices   | Before breaking ground           | Contractor               | GWI              |
| Audit ESMP implementation   | During construction              | Contractor               | GWI              |

It can be understood from this table that the Consultant’s responsibilities will be from developing refined project scope till the preparation of bid documents. All activities of the responsibility of the Contractor will be included in the bid documents to be prepared by the Consultant.

In the present document, the Consultant has also completed draft screening checklist for proposed project and alternatives for the use of the GWI.

In addition, the *GWl Environmental Guidelines for Construction Projects and Environmental Assessment* define the basic environmental and social considerations to be addressed during the project planning and design phases as well as during construction activities and for environmental and social supervision during construction. It also defines the procedures for public participation, consultation and information activities to be implemented in coordination between the Contractor and the GWl.

Finally specific environmental and social guidelines are defined in the mentioned document for engineering design and for construction planning and execution.

The Consultant shall consider those guidelines to the extent practical during project planning and design and while drafting the bidding documents for construction works.

#### 2.5.2.3 Preliminary Environmental Impact Screening Checklist

A preliminary screening checklist has been developed to identify significant impacts that may warrant a more extensive Environmental Impact Assessment (EIA). For screening purposes, impacts are only assessed as positive versus negative and major versus minor. Negative impacts are characterised as either "minor" or "major". In general, minor impacts are temporarily visible or otherwise notable changes while major impacts generally are permanent and require significant mitigation such as resettlement. Further characterisation of impacts as cumulative, direct and indirect will generally be reserved for more detailed assessment than afforded by the checklist approach.

The EPA will be consulted to identify best practices for all major issues identified through the screening process. Typically, any potential major impacts will require further studies to assess the sensitivity of the issue, extent of impact and best practice for mitigation.

The preliminary environmental impact checklist for the proposed interventions are presented in Appendix 3

## 2.6 Environmental Impact Assessment Guidelines

The Environmental Impact Assessment Guidelines are outlined by the Guyana EPA in the following documents:

- Environmental Impact Assessment Guidelines Volume 1, Rules and Procedures for Conducting and Reviewing EIA's, version 4, dated November 2000

- Environmental Impact Assessment Guidelines Volume 2, Generic, version 4, dated November 2000

As mentioned in the above paragraphs, for water and wastewater projects, EIA are only required in the case of major impacts identified in the preliminary environmental impact screening checklist.

A summary of that EIA process established by the EPA is detailed below.

Commencement of the environmental impact assessment process is preceded by an application for an environmental authorization and a summary of the project including information on the site, design and size of the project, possible effects on the environment and a non-technical explanation of the project. The Environmental Protection Agency would then indicate whether an environmental and social impact assessment is a mandatory requirement for the issuance of an environmental authorization for the operation.

A draft Terms of Reference is prepared and submitted to the EPA. After that submission, the EPA publishes a notice of the project in at least one daily newspaper. A summary of the project is made available to members of the public for a period of 28 days. Within this period the EPA accepts written submissions to the Agency related to the project. These submissions detail questions and matters which members of the public consider relevant to the deliberations of the EIA. A public consultation meeting is held after this 28 day period. Additional concerns of the public are noted at this forum and the EPA provides comments to the ESIA Consultants for finalization of the Terms of Reference (TOR) of the EIA. This meeting is chaired by the Environmental Protection Agency and a member of the Environmental Assessment Board (EAB) is present at that meeting. The Environmental Assessment Board is a body which provides an independent contribution to the development and finalisation of the EIA and makes recommendations which uphold the principles of the EP Act in the context of the interests of the developer, the public and the regulatory agencies. In order to carry out its functions, the EAB is involved in the development of the ESIA from the point of ESIA scoping to establishing conditions for the issuance of an Environmental Permit. During the environmental impact process the Developers and Consultants are required to consult members of the public, interested bodies and organizations and also provide to members of the public on request, and at no more than reasonable cost, copies of information obtained for the purpose of the EIA. The Developer and Consultant must submit to the EPA, the ESIA report along with an Environmental Impact Statement (EIS) for evaluation and recommendations. Every environmental impact assessment is required to contain a description of the project, an outline of the main alternatives studied and reasons for choices, a description of significant effects of the development on the environment, an indication of any difficulties encountered by the developer in compiling information for the ESIA, a description of the best available technology, a description of any hazards or dangers which may arise and a risk assessment of same, a description of mitigation measures for any adverse effects, a monitoring plan and an emergency response/contingency plan and a program for rehabilitation and restoration. The decision by the Agency to grant an environmental authorization for a project shall be subject to conditions, which are reasonably necessary to protect human health and the environment. The ESIA must be completed to conform to the TOR and copies submitted to the EPA for review and public comment. The EPA subsequently publishes a notice in at least one daily newspaper notifying the public of the



submission of the ESIA. The public has 60 days from the publication date of the notice to make submissions to the EPA and/or the EAB related to the EIA. The EPA, along with relevant sector agencies review the EIA during this sixty day period to ensure that the EIA is in line with any plans, guidelines, regulations or codes of practice developed by the EPA and sector agencies. Copies of the EIA and the findings of the review by EPA and sector agencies are passed to the EAB for review and recommendation. A public meeting, chaired by the EPA may be held, if considered necessary, at the end of the 60 days period. Additional comments are provided by members of the public at this meeting. The key objectives of public involvement in the EIA process are to:

- give the public a voice in project planning;
- obtain local knowledge, information and ideas;
- provide information to the people on planned activities to stimulate local interest and involvement in the project;
- ensure early detection of environmental and social impacts arising from the project;
- initiate and establish mechanisms and procedures to enable local people to participate in all phases of the project.

A final EIA is then prepared to address the comments of the EPA, the sector agencies, the public and the EAB to address issues in the TOR initially agreed to but excluded from the EIA. The EAB will then recommend to the EPA whether the EIA is acceptable and the conditions to be attached to the Environmental Permit, should it be granted. The EPA takes into account the recommendations of the EAB and sectoral agencies, comments of the public and its own review, and decides whether or not the project should be approved. For approved projects, the EPA issues an Environmental Permit with the terms and conditions necessary to effectively manage the environment. If an Environmental Permit is not granted, the developer can file an appeal within 28 days with the Environmental Appeals Tribunal (EAT). The EAT is a superior court of record and has in addition to the jurisdiction and powers conferred by the EP Act, all the powers inherent in such a court. The Tribunal has the power to enforce its own orders and judgements and the same power to punish contempt as the High Court of Justice. The EAT has the jurisdiction to hear and determine appeals against:

1. The refusal of an Environmental Permit;
2. The requirement of an Environmental Permit;
3. Cancellation or suspension of an Environmental Permit.

## **2.7 IDB Policies and Regulations**

### **2.7.1 IDB Environment and Safeguards Compliance Policy (January 16, 2006)**

The Inter-American Development Bank was the first Multilateral Development Bank to adopt an Environment Policy in 1979 (OP-703), broadly mandating the institution to ensure the environmental quality of its operations and support environmental projects in the region.

The 1994 Eighth Replenishment of Resources declared the Environment, together with poverty reduction and social equity, as priority areas for Bank support and included a number of specific environmental mandates that have guided Bank work up to the present. These mandates included provisions for:

- (i) strengthening environmental legal and regulatory frameworks;
- (ii) strengthening environmental institutions;
- (iii) improving the environmental quality of operations financed by the Bank;
- (iv) promoting the conservation and efficient use of energy in the Bank's projects;
- (v) improving the urban environment;
- (vi) promoting sustainable management of natural resources with specific references to environmentally sustainable practices for water resources, forestry, biological diversity, marine resources, and agriculture;
- (vii) addressing issues of transparency and access to environmental information, and stakeholder consultation;
- (viii) quality control and environmental impact assessments (EIAs); and
- (ix) fostering environmental education and training.

The goal of this Policy is to advance the Bank's mission in Latin America and the Caribbean toward achieving sustainable economic growth and poverty reduction goals consistent with long term environmental sustainability. The specific objectives of the Policy are:

- (i) to enhance long-term development benefits to its members countries by integrating environmental sustainability outcomes in all Bank operations and activities and strengthening environmental management capacities in its borrowing member countries;
- (ii) to ensure that all Bank operations and activities are environmentally sustainable as defined in this Policy, and
- (iii) to foster corporate environmental responsibility within the Bank.

The Bank will act to achieve these specific objectives by adopting measures to mainstream the environment into overall economic and social development, and to safeguard the environment in all Bank activities.

The Bank applies safeguards throughout the project cycle to ensure the environmental sustainability of all Bank-financed operations. In line with sustainable development practices, the Bank takes a general precautionary approach to environmental impacts. The Bank favors avoiding negative environmental impacts; when impacts are unavoidable, Bank-financed operations require mitigation measures; and for impacts that cannot be fully mitigated, compensation or offsets should be implemented. The Bank will work with borrowers to manage environmental risks effectively and to help develop environmental management capacity, as agreed. Where in the opinion of the Bank the environmental risks are deemed to be too great, the Bank would support the proposed investment only once the plan for mitigation of the risks is agreed.

As part of the safeguard Policies and Directives, policy B.3. Screening and Classification requires:

“All Bank-financed operations will be screened and classified according to their potential environmental impacts. Screening will be carried out early in the preparation process. The screening process will consider potential negative environmental impacts whether direct, indirect, regional or cumulative in nature, including environmentally related social and cultural impacts, of the operation and of its associated facilities if relevant. Bank operations will be classified according to their potential impacts so that the appropriate environmental assessment or due diligence requirements are selected for the operation. The operation’s environmental impact classification will be disclosed according to the Bank’s Disclosure of Information Policy (OP-102).”

The water and sanitation project are classified by the IDB as Category “B”: “Operations that are likely to cause mostly local and short-term negative environmental and associated social impacts and for which effective mitigation measures are readily available” These operations will normally require an environmental and/or social analysis, according to and focusing on, the specific issues identified in the screening process, and an environmental and social management plan (ESMP).

Furthermore, as W&S operations cover a wide variety of projects, thus proving to be difficult to cover such a wide range of situations with such a single classification W&S projects/programs can be classified as:

- **High impact / risk B (B-H):** operations that are likely to cause significant negative environmental and/or social impacts, or involve relatively high risks, though not enough to be classified as “A” projects.
- **Medium impact / risk B (B-M):** operations that are likely to cause mostly local and short-term negative environmental and associated social impacts and for which effective mitigation measures are readily available.
- **Low impact / risk B (B-L):** operations involving very low environmental and/or social impacts or risks, but still requiring some mitigation measures and an environmental and social management scheme.

According to the above mentioned classification, the proposed interventions can be classified as:

- **Option 1.a :** Category B-M (medium impact)
- **Option 1.b:** Category B-H (high impact as the project includes a wastewater treatment plant serving a population of more than 10,000).

In the framework of the IDB Environment and Safeguards Compliance Policy, an Environmental and Social Guidance was published in February 2009.

### **2.7.2 IDB Guideline for the Preparation of Environmental and Social Analysis**

The Inter-American Development Bank (Bank) policy requires that an Environmental and Social Analysis (ESA) is carried out by the project sponsor/borrower for all projects to be financed by the Bank with potentially impacts on the natural and human environment. Bank policy also requires that the project ESA be made available in the borrowing country at some public place accessible to affected groups and local NGOs and available to various Bank offices. Associated with a project ESA, there are other environmental, health and safety documents that may need to be developed to ensure adequate protection and controls related to the natural and human environment.

The specific objectives of an ESA of a Bank financed project are:

1. to identify the positive and/or negative alterations of the human and natural environment which may affect the quality of life as well as present and future options for sustainable social and economic development in the operations area of influence;
2. to identify preventive or mitigation measures to minimize the negative impacts and enhance the positive impacts of project design alternatives;
3. to determine whether the proposed operation is the optimal or at least a viable solution to the development needs it addresses after the costs and benefits of impacts, mitigated or not, are internalized; and
4. after comparing the alternatives, including that of no action, to recommend a course of action including preventive or mitigation measures.

This report follows the generic outline proposed by the IDB guidelines for the preparation of ESA.

### 3. ENVIRONMENTAL AND SOCIAL CONDITIONS

This chapter provides a description of the existing environmental and social conditions at the project site.

#### **3.1 Project location**

The interested area for the priority works rehabilitation project covers the zone served by the central Georgetown sewerage system, bounded by the Demerara River in the West, Vlissengen Road in the East, the Atlantic Ocean in the North and Sussex Street in the South.

The ring main to be rehabilitated is laid under the following streets (proceeding clockwise):

- Sussex Street on the southern side
- Charles St., Smyth St., Sendall St., Wellington St. and Waterloo St. on the western side
- New Market St. and Second St. on the north
- Light St., Winter Place, Louisa Row on the eastern side.

The proposed WWTP location is at the angle between Carifesta Avenue and Vlissengen Road, close to the sea protection wall.

The study area is illustrated in the following figure.

**Fig. 1 A3: Study Area Localisation**

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### **3.2 Morphology**

The area covered by Georgetown is basically flat from the southern neighbourhoods limited by Mandela Avenue to the northern coastline. The results of the topographical survey performed in the framework of the project indicate that ground levels range between a minimum of 15.91 m on Princess Street and a maximum of 16.90 m on Cowan Street, 15.56 m being the conventional value assumed for average sea level.

This conventional value originates from a stage located at the estuary of Demerara River for the measurement of sea levels. It has been adopted for the purpose of the topographical study in order to avoid negative figures in the record of manhole bottom levels. If this value is deducted from the ground levels measured, it becomes evident that the whole town is located between 0.30 and 1.40 meters above the mean sea level.

This flat morphology characterizes the estuarine zone of lower Demerara River and extends many kilometres South of the town.

### **3.3 Sea level and tides**

According to studies on geodetics and coastal evolution carried out in the past years, the average high tide level is 17.22 m, that is 1.66 m above mean sea level. This figure indicates that before the construction of the river harbour and the town the area presently occupied by Georgetown was subject to inundation at times of high tides and severe hydrologic events in the river.

The normal range between high and low tide is about 3 meters, and two high tides occur daily.

With the development of the port activity during the 18<sup>th</sup> century, the level of the right bank of the river was raised in order to protect the docks from overflowing, and a seawall about 2.5 m tall was erected along the northern seashore to protect the town from the effects of flooding due to high tide levels. This wall is part of an extensive system of sea defences constructed by the Dutch during the colonial period, consisting of massive concrete seawalls designed to protect the densely inhabited coastal plains. Through the years more concrete, earth and stone embankments, drainage canals, pumping stations and outfall sluice gates were added to the system. Coastal erosive processes over time, however, have severely damaged the sea defences. Lack of maintenance has caused breaches in the dikes, resulting in occasional inundation of the coastal plains.

The drainage of rainwater in the urban Georgetown is ensured by a network of low-gradient canals controlled by penstock gates located on the river bank or at the seawall. In case of concomitance of heavy rains and high tide, the major canals flowing to the ocean can be emptied by means of high-capacity pumps installed close to the seawall.

### **3.4 Climatic conditions**

The climate is tropical with two wet and two dry seasons. Along the coastal lowland region comprising Georgetown area, rain falls an average of 200 days a year, with 50% of average precipitation occurring from mid-April to mid-August. The second wet season is from December to January.

Average annual rainfall in the coastal lowlands is about 2,300 mm. In this region, temperatures range from 20 to 33 degrees Celsius.

### **3.5 Hydrogeology of coastal region**

Fresh groundwater is the most important and reliable source of water for public use and is abundant along the coastal lowlands and foothills. The coastal aquifers supply water to the 90% of the population residing in the coastal area region, with surface water supplying the remaining 10 percent.

The coastal aquifer system is composed by a series of three separate but hydrogeologically connected aquifers. This hydrogeologic reservoir has been providing water to the coastal inhabitants for the last century. Due to the excessive dewatering of these aquifers, saline water intrusion became a concern in recent years.

The coastal aquifer system occupies a subsurface area of about 20,000 square kilometres, extending about 250 kilometres along the Atlantic coast and 40 to 150 kilometres inland. Sediments reach a thickness of 1,800 meters onshore and become progressively thicker offshore and towards the East.

The three aquifers are named, from upper to lower, the “Upper Sands”, the “A Sand” and the “B Sand”. Overlying layers of clays confine the lower two aquifers, protecting them from contamination from external sources.

The “Upper Sands “ aquifer is 30 to 60 meters deep and ranges in thickness from 15 to 120 meters, being 15 meters the thickness under the capital town. It is the shallowest of the three aquifers of the coastal system. It was first developed in 1931 and has been for many decades the main source of water supply for Georgetown. However, due to a high iron content and intrusion of brackish water, withdrawals from the aquifer ceased in 1913. In the area corresponding to Georgetown the piezometric head of this aquifer is about 10 meters below ground level.

Within 15 kilometres of the coast, groundwater in this formation is confined by the Demerara Clay, a stratum of marine clay. This impermeable geologic layer has an average thickness of about 30 to 60 meters under the capital town.

The “A Sand” aquifer was first developed in 1913 and is presently considered the main source of water for Georgetown and the coastal region. There is an intermediate clay formation separating it from the upper aquifer. The “A Sand” aquifer is 150 to 220 meters deep and 12 to 27 meters thick. When it was first used, its piezometric head was 4.5 meters above ground level, but progressive dewatering of the aquifer caused the head to fall to 14 meters below ground level.



The “B Sand” aquifer lies below the two above mentioned aquifers at depths of 350 to 800 meters. The piezometric head of this aquifer, which was first used for domestic water in 1962, exceeds those of the “A Sand” aquifer.

The following **Figure 2** illustrates the geologic cross section of the coastal area and the aquifer system.

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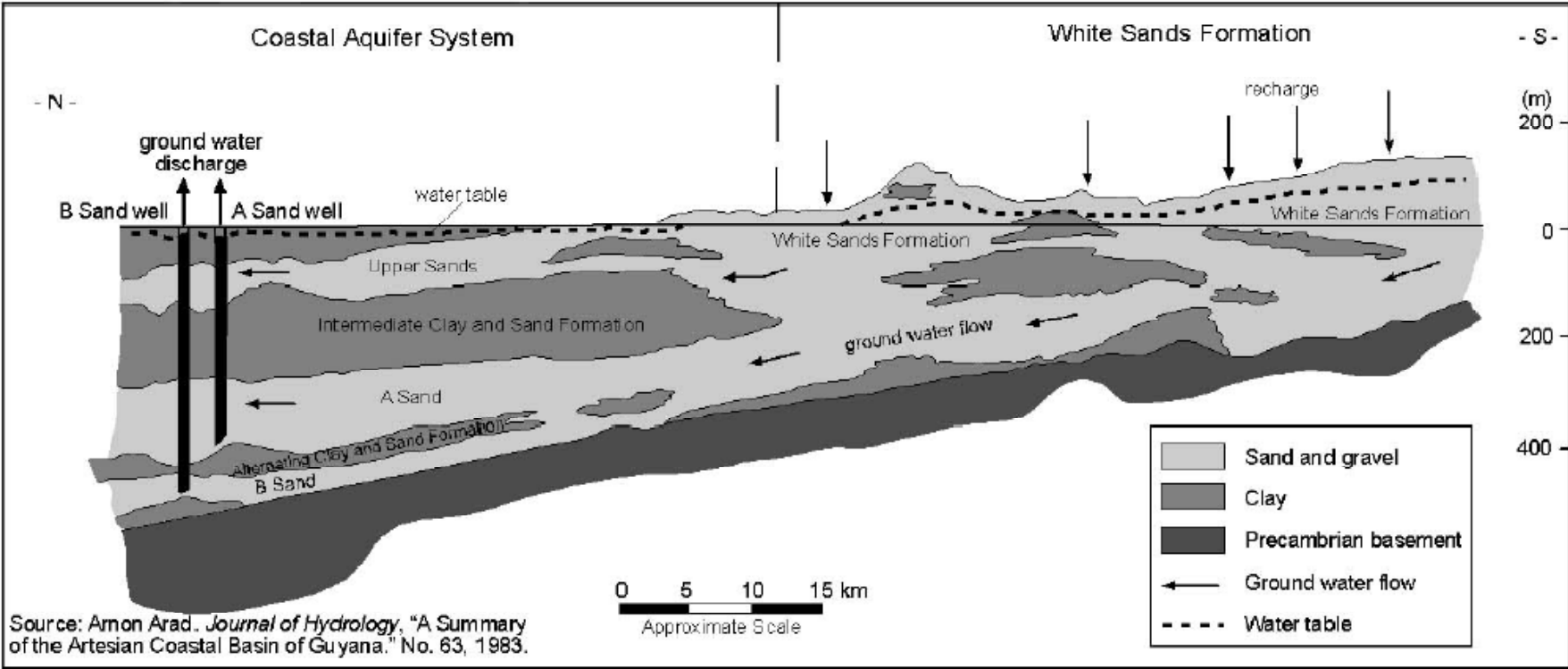


Figure 2: Geologic Cross Section in the Georgetown Area

### **3.6 Infiltration**

The basic geologic data indicate the existence of a 30 to 60 m thick clay stratum under Georgetown area, confining the “Upper Sands” aquifer. Permeability in this formation is supposed to be very low and the number of natural fractures very limited.

Over the clay there exists a superficial soil layer through which infiltration of rainwater (or wastewater) may locally take place, particularly in the areas that are not covered by asphalt. The bed of the several unlined drainage canals existing in Georgetown is a natural source of infiltration. This phenomenon is likely to have a direct effect on the sewerage system and particularly on sewer pipes and manholes corresponding to cavities where seepage can occur.

This local infiltration usually displays a seasonal variation with the sequence of wet and dry seasons.

### **3.7 Demography**

The demographic data received from the Guyana National Bureau of Statistic (GNBS) correspond to the information extracted from the 2002 Census, this being the last census effectuated in Guyana. The total number of households connected to the centralized sewer system in 2002 was 9,358, corresponding to about 35,500 inhabitants. For the design purpose, the Consultant has estimated the population of Georgetown in year 2010 to 48,115 inhabitants and the projection to year 2030 to 49,086 inhabitants (see *Volume 1 – Technical Study*). The average ratio of inhabitants per household was estimated at 3.8.

### **3.8 Population and social conditions**

The central Georgetown urban area is composed globally of two-storey colonial buildings mainly of residential use, while non domestic buildings include institutional, commercial and industrial uses. The only industrial activities existing in central Georgetown are some saw mills cutting and selling lumber for building purposes, while the important industries (such as Banks DIH L.td And Sanata Textiles L.td) are located in the Ruimveldt industrial area in the South of the city. The other activities typically include shops, offices, small restaurants and bars, worship centers. Buildings including a considerable number of employees are administrative buildings, ministries and banks.

The central commercial zones are considered to be Bourda, Lacytown, Cummingsburg and Albertown.

The number and density of commercial customers and offices have been estimated through visits of the different wards, analysis of the city map and scrutiny of GWI customers' data base. The highest percentage of non domestic customers over the total number of GWI contracts is encountered in the ward of Bourda (19%), in other wards the density varies from 1% to 6%. of total GWI connections.

### **3.9 Problems and nuisances related to the sewerage**

The socio-economic survey carried out on a sample of more than 500 inhabitants living in the 24 catchment areas was intended to reveal, among others, possible problems

experienced by the population in relation to the malfunctioning of sewerage system. It appears in general that overflowing of foul water into the toilets is not perceived as a major problem, with the exception of few cases. On the other hand, overflowing onto the yards or in ditches and canals, as well as bad odors, constitute a concrete nuisance for most of the interviewed people living in the poor southern neighborhoods.

Other data on complaints of residents about the sewerage system can be extracted from a social survey carried out by the University of Guayna. Compared with the results of Consultant's research, this survey documents a more critical perception of the sewerage service.

The residential wards of Albouystown and Wortmanville are considered to be the worst affected areas of the city with regard to broken house connections. This is mostly linked to the age and fragility of yard sewer pipes, as well as the habit of some residents to dispose of kitchen wastes and other litter into the inspection chambers.

According to the technical list prepared by GWI on the base of maintenance reports, the prevailing problems related to the misuse of the sewerage system from residents are:

1. Frequent damage to motor-pump assembly and associated fitting due to solids (rags, pieces of wood etc.. coming into contact with pump impeller).
2. Constant misuse of the sewer system by errant persons dumping unwanted materials such as cans, rags, sanitary napkins, condoms, plastic bags and other solid wastes into the chambers.
3. Vandalism of electrical equipment at sewer stations
4. Excavation and construction of chambers for plugging of illegal house connections.

Occasional sewage overflows into the yards might be related to the clogging or breaking of small bore pipes, mainly at the level of yard sewers and small connection chambers. A programme for repairs of yard sewers was commenced by the M&CC in the early 1970s in the densely populated ward of Albouystown. Many other programmes of such kind were proposed by ESI and other consultants in the 1980s but they were never implemented due to the lack of funds.

Direct sewage infiltration in the storm water drains can be put in relation to the existence of emergency outlet manholes constructed as part of the original 1929 system. The Consultant was unable to locate any of these structures, due to the presence of grass and solid waste on the canals' banks.

Other problems can be put in relation with external factors independent from the resident's attitude or the inadequacy of maintenance, such as the unstable and unreliable voltage supply and electrical faults along sewer electrical ring main. These factors are responsible for the frequent damage of electrical pump motors and control panels.

The inspections effectuated on some manholes located close to the pumping stations gave evidence of the critical status of the whole street sewers network. The observations resulting from the inspections and computations indicate that a considerable volume of wastewater infiltrates into the ground through openings disseminated all along the sewer networks. The rate of infiltration is increasing with the hydraulic head in the manholes, and is expected to be maximum at the beginning of the day, before the operation of pumps has started. This same rate of infiltration is positive provided the wastewater level is higher than local groundwater level. This same rate of infiltration is directed from the sewers to the soil provided the wastewater level is higher than local groundwater level. This was the case of most levels observed into manholes during the inspections: In some cases the wastewater level was found to be higher than the surface water level in roadside drains.

Possible causes of infiltration from the sewer network to the soil are:

- Outflow from pipes cracked due to the corrosion and traffic load stresses. The continuous contact with aggressive water and soils might cause corrosion of C.I. sewers, particularly on the invert of pipes. After 80 years without any intervention or repairs, corrosion might have attained devastating levels.
- Leakage from socket joints where the original lead seal has been cracked or displaced due to the pressure of water.
- Seepage from the walls of non-watertight manholes.

As a consequence of the lack of maintenance, the inspections of manholes revealed the presence over wastewater of a semi-solid cake of floating objects, including rags, plastics, condoms and other wastes that might represent a risk of clogging and a danger for the integrity of pump impellers.

**The continuous surcharging of sewer networks and the consequent infiltration of crude sewage can engender contamination of groundwater and soils, as well as inflow to potable water mains.**

### **3.10 Results of wastewater analyses**

As part of basic preliminary studies on the current environmental conditions of study area, two water quality tests have been carried out to assess the presence of possible abnormal values of wastewater parameters.

The first sample was taken at **pumping station n°8** (Basin J): The pump of this station was removed some months ago, therefore the sewage contained in the wet well is supposed to be representative of worst concentration of pollutants. Obtaining sewage samples from the bottom of the wet well was impossible, due to the presence of wastewater up to the ground level. A sample was taken at a depth of about 60 cm from the road level. Moreover, at the moment of sampling this wastewater was probably mixed with rainwater, due to a period of continuous storms.

The second sample was taken from the estuarine water close to the existing outfall, in the direction of dominant stream. Obtaining an effluent sample directly from the outfall mouth would be problematic, as the pipe outlet is located 6 meters under mean water level.

The results of analyses on the most common parameters from the laboratory of *Guyana Sugar Corporation* are given in the following page (measurement of *fecal coliforms* is not included within the laboratory routines). All measured values are within the Guyana permissible limits for potable water, with the exception of Dissolved Oxygen for **PS8**. A low content of DO is a sign of physical, chemical and biochemical activity in water. In sewage water, it mostly indicates the presence of biochemical contaminants.

The very low values of pollutants and suspended solids registered are probably related to the particular conditions of dilution present in the water at the time of sampling, as well as to the practical difficulty for the collection of deep sludge samples. In general, few samples cannot ensure a realistic evaluation of the distribution of pollution in time and space in the different parts of a sewerage system, particularly at the outfall into estuarine or sea waters.

In order to identify all the measures that should be taken to improve the surface waters and groundwater quality, a comprehensive water analysis programme, like the one defined in the 1995 Master Plan, should be implemented by GWI , EPA or other governmental bodies.

DRAFT

Wastewater analyses

DRAFT

#### 4. ENVIRONMENTAL AND SOCIAL IMPACTS

The environmental and social impact of the proposed works has been evaluated using the preliminary environmental screening checklist required by the GWI Environmental Guidelines for Construction Projects and Environmental Assessment.

The screening checklists were completed for both **Option 1.a** and **1.b** and are presented in **Annexes 3** and **4**.

##### **4.1 Option 1.a**

As previously mentioned in paragraph 3.7.1, **Option 1.a** proposal can be classified according to the classification of the IDB as **Category B, risk B-M** (medium impact), being an operation that is “likely to cause mostly local and short-term negative environmental and associated social impacts and for which effective mitigation measures are readily available”.

This classification is confirmed by the GWI format preliminary screening checklist, where all potential negative environmental and social impacts identified are related to the construction phase, are localized and of temporary impact with possibility of mitigation actions.

##### During construction phase:

The major identified potential negative impacts during the construction phase are summarized hereafter:

- Temporary disposal of wastewater in the drainage channels during the phase of connection between the old and new ring.
- Traffic congestion and temporary road closures;

While the minor impacts or risks are:

- possible storage of fuels and lubricants on site;
- Pumping and discharging of storm water off-site during trenching;
- Presence of groundwater table within 3 meters of the soil surface necessitating dewatering;
- Air quality problems due to smoke emissions from the use of machines and dust production while excavating;
- Construction and excavation material storage and transportation,
- Noise pollution during construction;



All the mentioned possible negative impacts and risks will be prevented or reduced to the extent possible through the definition of the ESMP, the implementation of mitigation measures and monitoring and follow up during construction phase.

Special attention shall be paid for the planning and notification of the works phases in order to reduce the traffic disruption and road closures for residents and businesses, and in particular for the sections crossing public services like the Public Hospital Georgetown at New Market Street and the different schools at Charles Street, Smyth Street, Waterloo Street and Second Street.

Also particular consideration shall be taken for the works of the section crossing Le Repentir Cemetery.

#### During operation phase

The key **positive** environmental impacts expected from this project are:

- Reduction of leakage into the ground and superficial groundwater;
- Reduction of risk of contamination of potable water consequent to infiltration of wastewater;
- Elimination of leakage into canals.
- Consequent improvement of the public health and sanitary conditions of central Georgetown residents.

The **negative** impact during the operation phase derives from the fact that the collected sewerage will be discharged into the Demerara River estuary without any preliminary treatment. This situation corresponds to the current situation, however one can expect that after the rehabilitation of the sewer system, the quantity of effluent to be discharged will increase considerably. Analysis on the dilution factor and water quality monitoring will be required during the operation phase.

This long term impact can be mitigated only by the construction when possible of a wastewater treatment plant for the pre-treatment of the effluent before its discharge.

#### **4.2 Option 1.b**

**Option 1.b** is the complementation of Option 1.a by the construction of the preliminary WWTP and the force main transmitting wastewater from the ring to the WWTP and from there to the outfall, therefore the screening checklist of Option 1.b refers only to the construction of these additional works.

Consequently **Option 1.b** entails the same potential negative and positive impacts of the first option as regards the reconstruction of the ring main component, and allows reducing the negative impact of discharging the raw sewerage directly into the sea.

The **negative** impact of the construction of the WWTP during the operation phase can consist in air quality problems deriving from odour emissions that might be generated and transmitted to the adjacent zones by the coastal winds.

In the case this option is chosen, detailed impact assessment shall be developed for the WWTP and the relevant site selection. An option for the inclusion of odour control devices in the treatment works should be considered at the stage of final design.

### Odour Control

Odour control systems can be used to minimise odours from the inlet works of sewage treatment plants. The inlet works are completely covered to contain odorous gases produced in the sewerage tanks within the structure. An extraction fan removes the odour from within the inlet works to the odour control unit.

Air is also extracted from the pumping station and sludge management facility. The odour control unit treats the odour in a two stage process involving a biological trickling system followed by an activated carbon system. This system is designed to remove 99.9% of all odours within the system.

## 5. ANALYSIS OF ALTERNATIVES

The two options presented are substantially based on the same concept focusing on the existing ring main. The urgency of these works is linked to the actual risk of dispersion of contaminants and pollution of drinkable water in the most densely populated area of Georgetown. Based on the findings of condition assessment, it is estimated that about 40% to 50% of the crude sewage pumped in the ring main is dispersed into the ground through leakage.

**Option 1.a** incorporates the basic works that have to be given first priority:

- Replacement of ring mains for the elimination of leakage
- Amelioration of the capacity and operational flexibility for pumping stations
- Replacement of some sections of force mains from pumps, where needed

The obvious advantage linked to **Option 1.b** is the addition of a treatment facility which can improve the quality of the effluent. Moreover, the low-head pumping station at the outlet of treatment plant might provide constant flow and high velocity to the sewage contained in the outfall pipe, thus ameliorating the dilution of treated (or partially treated) water into the estuary.

The second option represents an enhancement of the advantages of the first one in terms of environmental impacts; the choice between the two depends essentially on the available funding and the structure of the investment plan.

It should not be underestimated that, among potential risks at the final design stage, serious difficulties might be encountered for the selection of a site for the WWTP, due to the considerable impact of such plant on the environment. Furthermore, it should be observed that Operation and Maintenance costs would be almost doubled with the adoption of **Option 1.b**, compared to the first alternative.

It is then recommended that **Option 1.a** be initially implemented, incorporating in the design a gated outlet for the **successive connection to the treatment plant**.

With regard to the rehabilitation of **streets and yard sewers** in the 24 catchment areas, it is suggested that these works be included in a long term investment plan involving the gradual reconstruction of the whole network, working on two or three of these catchments per year.

The overall cost estimation for the construction works together with the relative capacity building and works supervision activities for the proposed works and the Operation and maintenance costs are summarized in the following tables:

| <b>Table 3 – Summary of preliminary cost estimates for proposed works</b> |   | <b>GY\$</b>    | <b>US\$</b> |
|---|---|----------------|-------------|
| <i>Option 1 a :</i>   | Rehabilitation of existing ring and pumping stations power increase<br>Direct discharge through the new outfall                 | 1,453,140,269  | 7,265,701   |
| <i>Option 1 b :</i>   | Rehabilitation of existing ring and pumping stations power increase<br>Discharge after treatment and pumping to the new outfall | 3,195,031,816  | 15,975,159  |
| <i>Street and yard sewers:</i>  | Complete rehabilitation on a typical basin  | 785,578,880    | 3,927,894   |
|   | Total for 24 basins   | 18,853,893,126 | 94,269,466  |

| <b>Table 4 – Summary of estimated annual O&amp;M costs for proposed options</b> |   | <b>GY\$</b> | <b>US\$</b> |
|---|---|-------------|-------------|
| <i>Option 1 a :</i>   | Rehabilitation of existing ring and pumping stations power increase<br>Direct discharge through the new outfall                 | 47,062,007  | 235,310     |
| <i>Option 1 b :</i>   | Rehabilitation of existing ring and pumping stations power increase<br>Discharge after treatment and pumping to the new outfall | 86,077,983  | 430,390     |
| <i>Current condition</i>  | No action   | 50,496,869  | 252,484     |

## 6. ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

According to the GWI Environmental Guidelines for Construction Projects and Environmental Assessment the project ESMP shall be developed by the Contractor after contract award and before breaking ground. Contractor shall also train workers on ESMP practices and audit the ESMP implementation. The project ESMP shall incorporate the requirements of an environmental manual and specifications included in the bid documents. Aspects to be addressed in the environmental specifications shall include:

- (i) pedestrian safety and traffic congestion during construction due to the increase of heavy traffic (for the construction itself and from traffic detours);
- (ii) dust and particulate materials, causing nuisances to surrounding families and businesses, especially to vulnerable people (children, elderly);
- (iii) undesirable noise levels due to the machinery and equipment especially in areas with hospitals, homes for the elderly, schools;
- (iv) degradation of streets due to heavy equipment machinery and traffic detours;
- (v) the interruption of services (water, electricity, telephone, etc) during construction;
- (vi) the adequate disposal of garbage, metals, used oils, and excess material, generated during construction;
- (vii) the need to inform the population about construction and work schedules, interruption of services, traffic detour routes; and
- (viii) pedestrian security measures, especially for school children, during construction.

In all cases the project ESMP shall incorporate the GWI environmental and Social Guidelines for Construction Planning and execution as needed. Those guidelines are well defines and detailed and are worth to be repeated here-after:

### ***Occupational Health and Safety***

1. The contractor should comply with all existing regulations related to Health and Safety.
2. The contractor shall ensure that workers are fitted with all necessary equipment and protective clothing to safeguard their health and safety. This includes:
  - i. Hearing protection for working around machinery where the noise exceeds 60 dB;
  - ii. Dust masks and eye protection against dust, splinters, debris etc. Dust suppression methods such as wetting materials or slowing work should be employed as needed to avoid visible dust;

- iii. Personal protective equipment including steel-toed boots and a hard hat are recommended when working around heavy equipment;
  - iv. Gloves when working with sewage and / or other toxic material;
  - v. Gas masks / respirators when working in closed areas such as access manholes, sewage pump chambers, etc. Proper training and fit testing for respirators should be provided to each employee prior to initial use and periodically thereafter. When possible, employees should be assigned their own respirator to encourage proper maintenance and ensure fit.
3. The contractor shall maintain sanitary bathroom facilities on site for workers' use.
  4. First aid kits shall be maintained on-site at all times.
  5. Safe access and thoroughfare must be provided on site at all times. Dangerous areas shall be clearly identified with appropriate signs.
  6. Legible warning signs, barriers and signals shall be placed at strategic locations in sufficient number and spacing for all prominent access ways to the sites. Warning signs and other protective barriers shall be erected to prevent accidents to citizens due to open ditches, heavy machinery and construction vehicles etc. Also see item 9.

#### ***Excavations***

7. Workers should not enter a trench more than waist deep without appropriate safety precautions such as shoring.
8. If there is reason to believe that excavated soils may be chemically impacted (i.e., visible sheen or odour), soils should be either be disposed of in accordance with local regulations or tested via laboratory analysis prior to replacement to ensure suitability of fill material.
9. Excavated areas and trench crossings shall be clearly marked and temporary fencing, bridges, access routes, signage, etc. shall be constructed to facilitate access and avoid accidental falls into these areas.

#### ***Traffic Management***

10. All traffic management will be coordinated with authorities
11. Outside of working hours, especially at night, all barriers and signs will remain at sites, with lighting and / or lighted signs placed as required to warn both vehicular and pedestrian traffic. Residents within a construction zone should be notified. Also see items 14 and 15.
12. Flagmen shall be used to warn and direct vehicle traffic around construction sites and hazards during working hours.

13. The Contractor shall restore the project environment to the state to which it was or better, prior to construction. In the case of road cuttings, the contractor shall restore all roadways to their original state prior to project implementation.

### ***Social Impact Management***

14. The Contractor shall advise citizens in advance concerning road closures, rerouting of vehicle and pedestrian traffic and interruptions in water and sewerage services. The contractor should notify citizens and collect their concerns to minimise negative reactions according to public notification procedures to be included in the EMP.

15. Closures and interruptions shall be announced according to the following:

- i. Announcements will be placed in local newspapers by GWI for two consecutive days before beginning construction activities.
- ii. Signs announcing the closure of roads and / or temporary shutoff of services will be placed in the vicinity of the intended construction sites and include a telephone number and contact address for further information.
- iii. The Contractor shall advise residents when reconnected water supplies are safe to use.

### ***Construction Materials and Waste Management***

16. The Contractor shall handle construction materials and waste in accordance with procedure in the approved ESMP. Sites for temporary piles should be agreed with GWI, and described in the ESMP. The community should be aware of constraints imposed on the contractor for waste collection, storage and disposal.

17. The Contractor shall contain excavated materials in the vicinity of the worksite within berms to prevent dispersion and sedimentation of canals, streets and adjacent properties.

18. Materials that are capable of generating dust when stockpiled must be wetted with water and / or covered in order to prevent dispersion. Stockpiles that remain in place more than 6 months may be seeded with vegetation to prevent erosion.

19. If material enters drainage canals, it should be removed and properly stored. No material shall be stored in such a way as to be carried away by rains or drainage canals.

20. The Contractor shall maintain all liquid and solid construction waste in appropriate receptacles and dispose of these at legal dump sites. No inappropriate liquid or solid wastes shall be disposed of in drainage canals.

21. The Contractor shall ensure that disposal of asbestos containing material (ACM) is carried out in accordance with the guidelines of the Environmental Protection Agency and the Occupational Health and Safety Department of the Ministry of Labour.

22. The Contractor shall ensure that all hazardous (ignitable, flammable, reactive, corrosive, toxic) material is stored in appropriate, clearly labeled containers. Hazardous materials shall always be stored in such a way as to minimise exposure to the hazard. In particular, fuel, lubricants and water treatment chemicals must always be stored in an appropriate manner.
23. The Contractor shall ensure that chlorine-contaminated water used to disinfect the distribution lines prior to use is collected and disposed of in an appropriate manner. The method of final disposal will vary depending on project location and will be agreed upon with GWI. Under no circumstances shall the contractor dispose of the chlorine effluent in the drainage canal.

### ***Emergencies/Accidents***

24. The Contractor shall develop a contingency plan to deal with accidents, spillage and dealing with complaints, to be approved by GWI. The plan should include:
- i. Procedures for dealing with occupational accidents, both to workers and citizens.
  - ii. Procedures for dealing with accidental water, sewage and/or chemical spills, including clean-up and remediation.
  - iii. Procedures for dealing with complaints from citizens in relation to construction areas.
25. Record keeping shall be maintained for all accidents and injuries. These records shall be made available to GWI, EPA, their agents and contractor employees upon request of the interested party.

### ***Involuntary Resettlement***

26. If displacement of persons is unavoidable, GWI will develop, in collaboration with the relevant authorities and the Contractor, a resettlement plan, which ensures that affected people receive fair and adequate compensation and rehabilitation.

### ***Community Complaints***

GWI has established procedures for dealing with customer complaints.

More specifically, the proposed mitigation measures for the potential environmental and social impacts identified in the screening checklists or generally foreseen for this kind of projects are presented in the following table.



| Potential Environmental/Social Impacts  | Proposed Mitigation measures  | Institutional responsibilities to implement mitigation measure | Cost Estimates  |
|---|---|--|---|
| <b>Construction Phase</b>               |   |  |   |
| Disruption and damage to public service | <ul style="list-style-type: none"> <li>- The Contractor shall restore the project environment to the state to which it was or better, prior to construction. In the case of road cuttings, the contractor shall restore all roadways to their original state prior to project implementation</li> <li>- The Contractor shall advise citizens in advance concerning road closures, rerouting of vehicle and pedestrian traffic and interruptions in water and sewerage services.</li> <li>- The Contractor should notify citizens and collect their concerns to minimise negative reactions according to public notification procedures to be included in the ESMP</li> <li>- Works phasing shall be established in a way to reduce the disruption time.</li> <li>- works will be effectuated on lots of limited length, in a way to minimize closure of main streets stretches</li> <li>- Closures and interruptions shall be announced according to the GWI guidelines as follow:               <ul style="list-style-type: none"> <li>➢ Announcements will be placed in local newspapers by GWI for two consecutive days before beginning construction activities.</li> <li>➢ Signs announcing the closure of roads and / or temporary shutoff of services will be placed in the vicinity of the intended construction sites and include a telephone number and contact address for further information.</li> <li>➢ The Contractor shall advise residents when reconnected water supplies are safe to use.</li> </ul> </li> </ul> | Contractor/ GWI/ different public utilities                    | Relocation of existing utilities and road reinstatement are foreseen in the project design, planning and budget. In the <b>preliminary cost estimate</b> the cost for road reinstatement is included in pipe laying unit rate (per meter )<br>The cost for relocation of underground services is given as a lump sum depending on the location of works |

|  |   |                                    |  |
|--|---|------------------------------------|--|
| Alteration of traffic                                    | <ul style="list-style-type: none"> <li>- All traffic management will be coordinated with authorities</li> <li>- Outside of working hours, especially at night, all barriers and signs will remain at sites, with lighting and / or lighted signs placed as required to warn both vehicular and pedestrian traffic</li> <li>- Residents within a construction zone should be notified</li> <li>- Flagmen shall be used to warn and direct vehicle traffic around construction sites and hazards during working hours</li> </ul>  | Contractor/ GWI/ local authorities | Included in Contractor's costs as above  |
| Difficulties of access to houses, businesses and schools | <ul style="list-style-type: none"> <li>- works will be effectuated on lots of limited length, in a way to minimize disturbance;</li> <li>- Excavated areas and trench crossings shall be clearly marked and temporary fencing, bridges, access routes, signage, etc. shall be constructed to facilitate access and avoid accidental falls into these areas</li> <li>- Prior consultation and notification to the interested entities</li> </ul>   | Contractor/ GWI                    | Included in Contractor's costs as above  |
| Emission of particles, gases and dusts                   | <ul style="list-style-type: none"> <li>- Dust masks and eye protection against dust, splinters, debris etc.</li> <li>- Dust suppression methods such as wetting materials or slowing work should be employed as needed to avoid visible dust</li> <li>- Gas masks / respirators when working in closed areas such as access manholes, sewage pump chambers, etc.</li> <li>- Proper training and fit testing for respirators should be provided to each employee prior to initial use and periodically thereafter.</li> <li>- When possible, employees. should be assigned their own respirator to encourage proper maintenance and ensure fit.</li> </ul> | Contractor                         | Included in Contractor's costs as above  |
| Noise generation   | <ul style="list-style-type: none"> <li>- Hearing protection for working around machinery where the noise exceeds 60 dB</li> </ul>   | Contractor                         | Included in Contractor's costs   |
| Construction material and waste management               | <ul style="list-style-type: none"> <li>- The contractor shall handle construction materials and waste in accordance with procedure in the approved EMP.</li> <li>- Sites for temporary piles should be agreed with GWI</li> <li>- The community should be aware of constraints imposed on the contractor for waste collection, storage and disposal</li> <li>- The contractor shall contain excavated materials in the vicinity of the worksite within berms to prevent dispersion and sedimentation of canals, streets and adjacent properties</li> </ul>  | Contractor                         | In the <b>preliminary cost estimate</b> the cost for disposal of excavation material is included in pipe laying unit rate (per meter ) or excavation costs (per cubic meter) |

|   |   |   |   |
|---|---|---|---|
| Storing of lubricants on site, risk of ground water and soil contamination in case of spill | <ul style="list-style-type: none"> <li>- Secondary containment for fuels to avoid spill contamination and inspection during operation</li> </ul>  | Contractor                              | Included in Contractor's mobilization cost (10% of works price)                                     |
| Safety risks due to excavations and construction site                                       | <ul style="list-style-type: none"> <li>- Safety conditions in the trenches during construction phase shall be ensured through the use of appropriate shoring systems and dewatering</li> <li>- Workers should not enter a trench more than waist deep without appropriate safety precautions such as shoring</li> <li>- Safe access and thoroughfare must be provided on site at all times. Dangerous areas shall be clearly identified with appropriate signs</li> <li>- Excavated areas and trench crossings shall be clearly marked and temporary fencing, bridges, access routes, signage, etc. shall be constructed to facilitate access and avoid accidental falls into these areas</li> <li>- Legible warning signs, barriers and signals shall be placed at strategic locations in sufficient number and spacing for all prominent access ways to the sites. Warning signs and other protective barriers shall be erected to prevent accidents to citizens due to open ditches, heavy machinery and construction vehicles etc.</li> </ul> | Contractor                              | Shoring and dewatering costs are included in the unit price for the trench excavation / pipe laying |
| Discharge of storm water offsite  | <ul style="list-style-type: none"> <li>- storm water will be pumped from pipe trenches to the ditches and canals existing beside the roads. These are the natural recipients currently used for rainwater drainage</li> </ul>   | Contractor/ GWI                         | Included in Contractor's dewatering costs as above  |
| Wastewater discharge into existing canals   | <ul style="list-style-type: none"> <li>- The existing ring will be kept in operation during the construction of the new mains. During the phase of connection between the pumps and the new ring, wastewater will be temporarily discharged into canals. Measures shall be taken to minimize the reconnection time and negative impacts</li> </ul>  | Contractor/ GWI                         | -   |
| Conflicts over location of treatment plant  | <ul style="list-style-type: none"> <li>- further investigations of WWTP location shall be done and public consultation and information shall be performed before the final selection of site location</li> </ul>  | Contractor/ GWI/ Local authorities/ EPA | Costs shall be borne by the implementing agencies   |

| <b>Operation Phase</b>   |  |     |  |
|--|--|-----|--|
| Risk of surface water contamination due to the crossing of the project of canals and ditches | <ul style="list-style-type: none"> <li>- Projected mains will follow the existing ring layout overcrossing some canals and minor ditches. The new crossing pipes will be constructed in a way to avoid leakage of foul water into the canals. Leakage detection and repairs will be part of ordinary GWI maintenance procedures</li> </ul>                           | GWI | Costs for leakage detection and repairs will be part of ordinary GWI maintenance procedures (see Annex 2)  |
| Pollution of receiving water bodies  | <ul style="list-style-type: none"> <li>- The sewerage will be discharged at the existing outfall at the estuary of Demerara river as it is the current situation (Option 1.a) in this case analysis on the dilution factor and water quality monitoring will be required during the operation phase</li> <li>- Option 1.b, the WWTP will reduce this risk</li> </ul> | GWI | Cost for water quality monitoring programmes (weekly water analyses) : approximately 1 Million GY\$ / year |
| Odor generation at WWTP  | <ul style="list-style-type: none"> <li>- Specific Management Plan shall be defined for potential impacts of the WWTP at the stage of <b>final design</b> in case this option is adopted and taking in consideration the selected site location. Specific odor reduction devices can be installed in the WWTP</li> </ul>  | GWI | Energy Cost included in operation costs for WWTP (see Annex 2)   |
| Proliferation of pathogenic organisms  | <ul style="list-style-type: none"> <li>- Proliferation of pathogenic organisms will be possible only at pumping stations (already existing) and WWTP (if this option is retained). These sites will be accessible only to authorized GWI staff</li> </ul>  | GWI | -  |
| Infiltration into the groundwater due to leaks   | <ul style="list-style-type: none"> <li>- Infiltration will be reduced / eliminated with the use of butt welded pipes. Periodic inspections shall be carried out by GWI staff to verify the presence of leakage. Leakage detection and repairs will be part of ordinary GWI maintenance procedures</li> </ul>   | GWI | Costs for leakage detection and repairs will be part of ordinary GWI maintenance procedures (see Annex 2)  |

|  |   |    |   |
|--|---|----|---|
| Proliferation of insects, rodents or other annoying or harmful organisms         | Proliferation of insects or other harmful organisms will be possible only at pumping stations (already existing) and WWTP (if this option is retained). As the whole town is drained by canals and ditches, there will be no substantial increase of the number of flying insects and rodents due to the WWTP | GW | -   |
| Visual impact  | There will be no visual impact caused by the pipes, except for the trench crossing pipes which will be apparent: these might be painted in blue or some other color to ameliorate the visual impact   | GW | Cost included in trench crossing construction price           |
| Risk of accidents due to entry of unauthorized persons and vehicles to the plant | if the WWTP option is retained, the plant will be fenced and guarded day and night, like all the existing GW plants   | GW | Security guards cost : approximately 3 Million GY\$ /year     |
| Fire risk  | Fire risk might concern the electrical switchboards at pumping station and WWTP. Accurate work supervision shall ensure that the installations are made according to security standards. The plant will be fenced and guarded day and night.  | GW | Work supervision costs as per Annex 1. Security cost as above |
| Noise and vibration generation (pumping stations)                                | No significant noise can be perceived from existing pumping stations (the pump is submersible). As regards WWTP pumping stations, this will be also equipped with submersible pumps. The WWTP site (if this option is retained) will be far from private or public buildings                                  | GW | -   |
| Improper management of wastewater treatment sludge                               | If the WWTP option is retained, existing (or proposed) GW sludge disposal sites shall be reactivated / rehabilitated / constructed  | GW | -   |

## 7. PUBLIC PARTICIPATION

In accordance with the application requirements of the Cohesion Fund, for obtaining the environmental protection permits, the population must be informed about the project, in order to obtain the required level of support. The concerned population may get knowledge about the necessity of the investment, as well as its expected environmental, economic and social impacts in various forums, and through the media.

As part of this preliminary stage of the project, the Consultant has conducted a socio-economic survey aimed at the information of the residents about the advantages linked to the rehabilitation of the existing sewerage system and the assessment of their willingness to pay for improved service. The survey has been carried out over more than 500 households in the area served by the piped sewerage.

Results of the socio-economic survey are detailed in *Volume 3 – Cost-benefit analysis*.

Following the identification from GWI and IDB of a viable option having the adequate prerequisites of technical and financial feasibility, public disclosure meetings should be organized by GWI and local authorities.

The purpose of these meetings will be to inform the residents on the improvements expected as a consequence of the rehabilitation of the sewerage system, and the potential positive and negative impacts associated to the works. It is anticipated that negative impacts for local population will regard only the construction phase, therefore they will be only temporary.

The active participation of Georgetown Municipal and City Council in this process is strongly recommended.

BIBLIOGRAPHY :

- *Corporate Environmental Guidelines – GWI- January 2005*
- *Environmental Guidelines for Construction Projects and Environmental Assessment-, GWI- February 2005*
- *Environment and Safeguards Compliance Policy- IDB - January 19, 2006*
- *Guideline for the Preparation of Environmental and Social Analysis- IDB- February 2009*
- *Guyana, Act No. 11 of 1996, Environmental Protection Act 1996*
- *Guyana Poverty Reduction Strategy Paper (PRSP), 2001*
- *Guyana Water and Sewerage Act, 2002*
- *UNDP Millennium Development Goals, 2000*
- *Water Resources Assessment of Guyana – U.S. Army Corps of Engineers 1998*

## ANNEX 1 : Preliminary Costs Estimates for Option 1.a and Option 1.b



*Option 1.a - Rehabilitation of existing ring and pumping stations power increase*

A. works

A.1 : Complete reconstruction of pressure ring

| <i>investment</i> |          | <i>unit</i>   | <i>quantity</i> | <i>unit price or lump sum (GY\$)</i>       | <i>total cost (GY\$)</i> | <i>total cost (US\$)</i> |  |
|-------------------|----------|---|-----------------|--|--------------------------|--------------------------|--|
| <b>A.1</b>        | <b>1</b> | <b>Sussex Street pipe from PS X (22) to PS Y (23)</b>                                     |                 |  |                          |                          |  |
|                   |          | HDPE pipe PN 10, dia. 280 mm, including trench, sand bed, welding, road reinstatement     | m               | 364  | 28,240                   | 10,279,360               |  |
|                   |          | pipe fittings, including gate valves, TEEs, air vent valves, washouts, dismantling joints | unit            | 3  | 1,800,000                | 5,400,000                |  |
| <b>A.1</b>        | <b>2</b> | <b>Sussex Street pipe from PS Y (23) to PS Z (24)</b>                                     |                 |  |                          |                          |  |
|                   |          | HDPE pipe PN 10, dia. 280 mm, including trench, sand bed, welding, road reinstatement     | m               | 237  | 28,240                   | 6,692,880                |  |
|                   |          | pipe fittings, including gate valves, TEEs, air vent valves, washouts, dismantling joints | unit            | 2  | 1,800,000                | 3,600,000                |  |
| <b>A.1</b>        | <b>3</b> | <b>Charles Street pipe from PS Z (24) to PS V (20) crossing</b>                           |                 |  |                          |                          |  |
|                   |          | HDPE pipe PN 10, dia. 355 mm, including trench, sand bed, welding, road reinstatement     | m               | 389  | 45,533                   | 17,712,337               |  |
|                   |          | pipe fittings, including gate valves, TEEs, air vent valves, washouts, dismantling joints | unit            | 4  | 1,800,000                | 7,200,000                |  |
| <b>A.1</b>        | <b>4</b> | <b>Smyth Street pipe from PS V (20) c.sing to PS S (17) crossing</b>                      |                 | <b>(incorporating trench crossing TC5)</b> |                          |                          |  |
|                   |          | HDPE pipe PN 10, dia. 355 mm, including trench, sand bed, welding, road reinstatement     | m               | 393  | 45,533                   | 17,894,469               |  |
|                   |          | steel pipe trench crossing PN 10, dia. 300 mm, including anchor blocks, air vent, elbows  | m               | 8  | 360,000                  | 2,880,000                |  |
|                   |          | pipe fittings, including gate valves, TEEs, air vent valves, washout, dismantling joints  | unit            | 4  | 1,800,000                | 7,200,000                |  |
| <b>A.1</b>        | <b>5</b> | <b>Smyth Street pipe from PS S (17) c.sing to PS O (13) crossing</b>                      |                 | <b>(incorporating trench crossing TC3)</b> |                          |                          |  |
|                   |          | HDPE pipe PN 10, dia. 450 mm, including trench, sand bed, welding, road reinstatement     | m               | 451  | 72,881                   | 32,869,331               |  |
|                   |          | steel pipe trench crossing PN 10, dia. 400 mm, including anchor blocks, air vent, elbows  | m               | 16   | 400,000                  | 6,400,000                |  |
|                   |          | pipe fittings, including gate valves, TEEs, air vent valves, washout, dismantling joints  | unit            | 4  | 2,600,000                | 10,400,000               |  |
| <b>A.1</b>        | <b>6</b> | <b>Wellington Street pipe from PS O (13) c.sing to PS K (9) crossing</b>                  |                 | <b>(incorporating trench crossing TC2)</b> |                          |                          |  |
|                   |          | HDPE pipe PN 10, dia. 450 mm, including trench, sand bed, welding, road reinstatement     | m               | 401  | 72,881                   | 29,225,281               |  |
|                   |          | steel pipe trench crossing PN 10, dia. 400 mm, including anchor blocks, air vent, elbows  | m               | 16   | 400,000                  | 6,400,000                |  |
|                   |          | pipe fittings, including gate valves, TEEs, air vent valves, washout, dismantling joints  | unit            | 4  | 2,600,000                | 10,400,000               |  |
| <b>A.1</b>        | <b>7</b> | <b>Waterloo Street pipe from PS K (9) crossing to PS H (6) crossing</b>                   |                 |  |                          |                          |  |
|                   |          | HDPE pipe PN 10, dia. 560 mm, including trench, sand bed, welding, road reinstatement     | m               | 376  | 112,823                  | 42,421,448               |  |
|                   |          | pipe fittings, including gate valves, TEEs, air vent valves, washout, dismantling joints  | unit            | 4  | 3,200,000                | 12,800,000               |  |
| <b>A.1</b>        | <b>8</b> | <b>New Market Street pipe from PS H (6) cr.ing to PS G (5) crossing</b>                   |                 |  |                          |                          |  |
|                   |          | HDPE pipe PN 16, dia. 560 mm, including trench, sand bed, welding, road reinstatement     | m               | 186  | 112,823                  | 20,985,078               |  |
|                   |          | pipe fittings, including gate valves, TEEs, air vent valves, washout, dismantling joints  | unit            | 4  | 3,200,000                | 12,800,000               |  |
| <b>A.1</b>        | <b>9</b> | <b>New Market - Second Street pipe from PS G (5) crossing to PS F (4) crossing</b>        |                 |  |                          |                          |  |
|                   |          | HDPE pipe PN 10, dia. 560 mm, including trench, sand bed, welding, road reinstatement     | m               | 645  | 112,823                  | 72,770,835               |  |
|                   |          | pipe fittings, including gate valves, TEEs, air vent valves, washout, dismantling joints  | unit            | 6  | 3,200,000                | 19,200,000               |  |

|                               |    |  |          |     |            |                    |                  |
|-------------------------------|----|--|----------|-----|------------|--------------------|------------------|
| A.1                           | 10 | <b>Light Street pipe from PS F (4) crossing to PS I (7) crossing</b>                                       |          |     |            |                    |                  |
|                               |    | HDPE pipe PN 10, dia. 560 mm, including trench, sand bed, welding, road reinstatement                      | m        | 325 | 112,823    | 36,667,475         | 183,337          |
|                               |    | pipe fittings, including gate valves, TEEs, air vent valves, washout, dismantling joints                   | unit     | 3   | 3,200,000  | 9,600,000          | 48,000           |
| A.1                           | 11 | <b>Light Street pipe from PS I (7) crossing to Regent St. crossing (incorporating trench crossing TC1)</b> |          |     |            |                    |                  |
|                               |    | HDPE pipe PN 10, dia. 560 mm, including trench, sand bed, welding, road reinstatement                      | m        | 391 | 112,823    | 44,113,793         | 220,569          |
|                               |    | steel pipe trench crossing PN 10, dia. 500 mm, including anchor blocks, air vent, elbows                   | m        | 16  | 600,000    | 9,600,000          | 48,000           |
|                               |    | pipe fittings, including gate valves, TEEs, air vent valves, washout, dismantling joints                   | unit     | 4   | 3,200,000  | 12,800,000         | 64,000           |
| A.1                           | 12 | <b>Light Street - Winter Place pipe from Regent St. c.sing to PS R (16) crossing</b>                       |          |     |            |                    |                  |
|                               |    | HDPE pipe PN 10, dia. 450 mm, including trench, sand bed, welding, road reinstatement                      | m        | 360 | 72,881     | 26,237,160         | 131,186          |
|                               |    | steel pipe trench crossing PN 10, dia. 400 mm, including anchor blocks, air vent, elbows                   | m        | 16  | 400,000    | 6,400,000          | 32,000           |
|                               |    | pipe fittings, including gate valves, TEEs, air vent valves, washout, dismantling joints                   | unit     | 4   | 2,600,000  | 10,400,000         | 52,000           |
| A.1                           | 13 | <b>Louisa Row pipe from PS R (16) c.sing to PS U (19) crossing</b>   |          |     |            |                    |                  |
|                               |    | HDPE pipe PN 10, dia. 355 mm, including trench, sand bed, welding, road reinstatement                      | m        | 489 | 45,533     | 22,265,637         | 111,328          |
|                               |    | pipe fittings, including gate valves, TEEs, air vent valves, washout, dismantling joints                   | unit     | 5   | 1,800,000  | 9,000,000          | 45,000           |
| A.1                           | 14 | <b>Louisa Row - Cemetery Rd. pipe from PS U (19) c.sing to PS X (22) crossing</b>                          |          |     |            |                    |                  |
|                               |    | HDPE pipe PN 10, dia. 280 mm, including trench, sand bed, welding, road reinstatement                      | m        | 508 | 28,240     | 14,345,920         | 71,730           |
|                               |    | pipe fittings, including gate valves, TEEs, air vent valves, washouts, dismantling joints                  | unit     | 5   | 1,800,000  | 9,000,000          | 45,000           |
| A.1                           | 15 | lump sum for relocation of existing utilities (pipes, cables, etc..)                                       | lump sum |     |            | 50,000,000         | 250,000          |
| A.1                           | 16 | contractor's mobilization costs (10% of works)   | unit     | 1   | 61,596,100 | 61,596,100         | 307,981          |
| <b>total works</b>            |    |  |          |     |            | <b>677,557,104</b> | <b>3,387,786</b> |
| contingencies 10%             |    |  |          |     |            | <b>67,755,710</b>  | <b>338,779</b>   |
| <b>TOTAL (without duties)</b> |    |  |          |     |            | <b>745,312,815</b> | <b>3,726,564</b> |

A.2 : Installation of second pump and upgrade of power supply in the pumping stations

|                               |   | <i>investment</i>  | <i>unit</i> | <i>quantity</i> | <i>unit price or lump sum (GY\$)</i> | <i>total cost (GY\$)</i> | <i>total cost (US\$)</i> |
|-------------------------------|---|--|-------------|-----------------|--------------------------------------|--------------------------|--------------------------|
| A.2                           | 1 | supply and install 15 KW submersible pumps, including control panel and level control          | unit        | 8               | 7,800,000                            | 62,400,000               | 312,000                  |
|                               |   | supply and install 18,5 KW submersible pumps, including control panel and level control        | unit        | 16              | 8,600,000                            | 137,600,000              | 688,000                  |
|                               |   | supply and install 35 KW transformer, including circuit breaker, supports and all connections  | unit        | 8               | 6,500,000                            | 52,000,000               | 260,000                  |
|                               |   | supply and install 45 KVA transformer, including circuit breaker, supports and all connections | unit        | 16              | 8,400,000                            | 134,400,000              | 672,000                  |
| A.2                           | 2 | lump sum for relocation of existing utilities (pipes, cables, etc..)                           | lump sum    |                 |                                      | 6,000,000                | 30,000                   |
| A.2                           | 3 | contractor's mobilization costs (10% of works)   | unit        | 1               | 39,240,000                           | 39,240,000               | 196,200                  |
| <b>total works</b>            |   |  |             |                 |                                      | <b>431,640,000</b>       | <b>2,158,200</b>         |
| contingencies 10%             |   |  |             |                 |                                      | <b>43,164,000</b>        | <b>215,820</b>           |
| <b>TOTAL (without duties)</b> |   |  |             |                 |                                      | <b>474,804,000</b>       | <b>2,374,020</b>         |

A.3 : Replacement of some sections of delivery mains from pumping stations

| <i>investment</i>             |          | <i>unit</i>   | <i>quantity</i> | <i>unit price or lump sum (GY\$)</i> | <i>total cost (GY\$)</i> | <i>total cost (US\$)</i> |        |
|-------------------------------|----------|---|-----------------|--------------------------------------|--------------------------|--------------------------|--------|
| <b>A.3</b>                    | <b>1</b> |   |                 |                                      |                          |                          |        |
|                               |          | HDPE pipe PN 10, dia. 160 mm, including trench, sand bed, welding, road reinstatement     | m               | 200                                  | 9,287                    | 1,857,400                | 9,287  |
|                               |          | pipe fittings, including gate valves, TEEs, air vent valves, washouts, dismantling joints | unit            | 2                                    | 1,800,000                | 3,600,000                | 18,000 |
| <b>A.3</b>                    | <b>2</b> | lump sum for relocation of existing utilities (pipes, cables, etc..)                      | lump sum        |                                      |                          | 2,000,000                | 10,000 |
| <b>A.3</b>                    | <b>3</b> | contractor's mobilization costs (10% of works)  | unit            | 1                                    | 745,740                  | 745,740                  | 3,729  |
| <b>total works</b>            |          |   |                 |                                      | <b>8,203,140</b>         | <b>41,016</b>            |        |
| contingencies 10%             |          |   |                 |                                      | <b>820,314</b>           | <b>4,102</b>             |        |
| <b>TOTAL (without duties)</b> |          |   |                 |                                      | <b>9,023,454</b>         | <b>45,117</b>            |        |

B. *capacity building and works supervision*

| <i>investment</i>  |  | <i>unit</i>                          | <i>quantity</i> | <i>unit price or lump sum (GY\$)</i> | <i>total (GY\$)</i> | <i>total (US\$)</i> |         |
|--|--|--------------------------------------|-----------------|--------------------------------------|---------------------|---------------------|---------|
|  |  | works supervision                    | month           | 18                                   | 9,000,000           | 162,000,000         | 810,000 |
|  |  | capacity building                    | month           | 6                                    | 9,000,000           | 54,000,000          | 270,000 |
|  |  | information, communication, seminars | lump sum        | 1                                    | 8,000,000           | 8,000,000           | 40,000  |
| <b>TOTAL INSTITUTIONAL SUPPORT AND SERVICES (without duties)</b> |  |                                      |                 |                                      | <b>224,000,000</b>  | <b>1,120,000</b>    |         |

|               |                      |                  |
|---------------|----------------------|------------------|
| overall total | <b>1,453,140,269</b> | <b>7,265,701</b> |
|---------------|----------------------|------------------|

*Option 1.b - Rehabilitation of existing ring, pumping stations power increase, preliminary treatment*

A. works

A.1 : Complete reconstruction of pressure ring

| <i>investment</i> |           | <i>unit</i>  | <i>quantity</i> | <i>unit price or lump sum (GY\$)</i> | <i>total cost (GY\$)</i> | <i>total cost (US\$)</i> |
|-------------------|-----------|--|-----------------|--------------------------------------|--------------------------|--------------------------|
| <b>A.1</b>        | <b>1</b>  | <b>Sussex Street pipe from PS X (22) to PS Y (23)</b>  |                 |                                      |                          |                          |
|                   |           | HDPE pipe PN 10, dia. 280 mm, including trench, sand bed, welding, road reinstatement                        | m               | 364                                  | 28,240                   | 10,279,360               |
|                   |           | pipe fittings, including gate valves, TEEs, air vent valves, washouts, dismantling joints                    | unit            | 3                                    | 1,800,000                | 5,400,000                |
| <b>A.1</b>        | <b>2</b>  | <b>Sussex Street pipe from PS Y (23) to PS Z (24)</b>  |                 |                                      |                          |                          |
|                   |           | HDPE pipe PN 10, dia. 280 mm, including trench, sand bed, welding, road reinstatement                        | m               | 237                                  | 28,240                   | 6,692,880                |
|                   |           | pipe fittings, including gate valves, TEEs, air vent valves, washouts, dismantling joints                    | unit            | 2                                    | 1,800,000                | 3,600,000                |
| <b>A.1</b>        | <b>3</b>  | <b>Charles Street pipe from PS Z (24) to PS V (20) crossing</b>  |                 |                                      |                          |                          |
|                   |           | HDPE pipe PN 10, dia. 355 mm, including trench, sand bed, welding, road reinstatement                        | m               | 389                                  | 45,533                   | 17,712,337               |
|                   |           | pipe fittings, including gate valves, TEEs, air vent valves, washouts, dismantling joints                    | unit            | 4                                    | 1,800,000                | 7,200,000                |
| <b>A.1</b>        | <b>4</b>  | <b>Smyth Street pipe from PS V (20) c.sing to PS S (17) crossing (incorporating trench crossing TC5)</b>     |                 |                                      |                          |                          |
|                   |           | HDPE pipe PN 10, dia. 355 mm, including trench, sand bed, welding, road reinstatement                        | m               | 393                                  | 45,533                   | 17,894,469               |
|                   |           | steel pipe trench crossing PN 10, dia. 300 mm, including anchor blocks, air vent, elbows                     | m               | 8                                    | 360,000                  | 2,880,000                |
|                   |           | pipe fittings, including gate valves, TEEs, air vent valves, washout, dismantling joints                     | unit            | 4                                    | 1,800,000                | 7,200,000                |
| <b>A.1</b>        | <b>5</b>  | <b>Smyth Street pipe from PS S (17) c.sing to PS O (13) crossing (incorporating trench crossing TC3)</b>     |                 |                                      |                          |                          |
|                   |           | HDPE pipe PN 10, dia. 450 mm, including trench, sand bed, welding, road reinstatement                        | m               | 451                                  | 72,881                   | 32,869,331               |
|                   |           | steel pipe trench crossing PN 10, dia. 400 mm, including anchor blocks, air vent, elbows                     | m               | 16                                   | 400,000                  | 6,400,000                |
|                   |           | pipe fittings, including gate valves, TEEs, air vent valves, washout, dismantling joints                     | unit            | 4                                    | 2,600,000                | 10,400,000               |
| <b>A.1</b>        | <b>6</b>  | <b>Wellington Street pipe from PS O (13) c.sing to PS K (9) crossing (incorporating trench crossing TC2)</b> |                 |                                      |                          |                          |
|                   |           | HDPE pipe PN 10, dia. 450 mm, including trench, sand bed, welding, road reinstatement                        | m               | 401                                  | 72,881                   | 29,225,281               |
|                   |           | steel pipe trench crossing PN 10, dia. 400 mm, including anchor blocks, air vent, elbows                     | m               | 16                                   | 400,000                  | 6,400,000                |
|                   |           | pipe fittings, including gate valves, TEEs, air vent valves, washout, dismantling joints                     | unit            | 4                                    | 2,600,000                | 10,400,000               |
| <b>A.1</b>        | <b>7</b>  | <b>Waterloo Street pipe from PS K (9) crossing to PS H (6) crossing</b>                                      |                 |                                      |                          |                          |
|                   |           | HDPE pipe PN 10, dia. 560 mm, including trench, sand bed, welding, road reinstatement                        | m               | 376                                  | 112,823                  | 42,421,448               |
|                   |           | pipe fittings, including gate valves, TEEs, air vent valves, washout, dismantling joints                     | unit            | 4                                    | 3,200,000                | 12,800,000               |
| <b>A.1</b>        | <b>8</b>  | <b>New Market Street pipe from PS H (6) cr.ing to PS G (5) crossing</b>                                      |                 |                                      |                          |                          |
|                   |           | HDPE pipe PN 16, dia. 560 mm, including trench, sand bed, welding, road reinstatement                        | m               | 186                                  | 112,823                  | 20,985,078               |
|                   |           | pipe fittings, including gate valves, TEEs, air vent valves, washout, dismantling joints                     | unit            | 4                                    | 3,200,000                | 12,800,000               |
| <b>A.1</b>        | <b>9</b>  | <b>New Market - Second Street pipe from PS G (5) crossing to PS F (4) crossing</b>                           |                 |                                      |                          |                          |
|                   |           | HDPE pipe PN 10, dia. 560 mm, including trench, sand bed, welding, road reinstatement                        | m               | 645                                  | 112,823                  | 72,770,835               |
|                   |           | pipe fittings, including gate valves, TEEs, air vent valves, washout, dismantling joints                     | unit            | 6                                    | 3,200,000                | 19,200,000               |
| <b>A.1</b>        | <b>10</b> | <b>Light Street pipe from PS F (4) crossing to PS I (7) crossing</b>   |                 |                                      |                          |                          |
|                   |           | HDPE pipe PN 10, dia. 560 mm, including trench, sand bed, welding, road reinstatement                        | m               | 325                                  | 112,823                  | 36,667,475               |
|                   |           | pipe fittings, including gate valves, TEEs, air vent valves, washout, dismantling joints                     | unit            | 3                                    | 3,200,000                | 9,600,000                |

|                               |  |          |     |            |                    |                  |
|-------------------------------|--|----------|-----|------------|--------------------|------------------|
| <b>A.1 11</b>                 | <b>Light Street pipe from PS I (7) crossing to Regent St. crossing (incorporating trench crossing TC1)</b> |          |     |            |                    |                  |
|                               | HDPE pipe PN 10, dia. 560 mm, including trench, sand bed, welding, road reinstatement                      | m        | 391 | 112,823    | 44,113,793         | 220,569          |
|                               | steel pipe trench crossing PN 10, dia. 500 mm, including anchor blocks, air vent, elbows                   | m        | 16  | 600,000    | 9,600,000          | 48,000           |
|                               | pipe fittings, including gate valves, TEEs, air vent valves, washout, dismantling joints                   | unit     | 4   | 3,200,000  | 12,800,000         | 64,000           |
| <b>A.1 12</b>                 | <b>Light Street - Winter Place pipe from Regent St. c.sing to PS R (16) crossing</b>                       |          |     |            |                    |                  |
|                               | HDPE pipe PN 10, dia. 450 mm, including trench, sand bed, welding, road reinstatement                      | m        | 360 | 72,881     | 26,237,160         | 131,186          |
|                               | steel pipe trench crossing PN 10, dia. 400 mm, including anchor blocks, air vent, elbows                   | m        | 16  | 400,000    | 6,400,000          | 32,000           |
|                               | pipe fittings, including gate valves, TEEs, air vent valves, washout, dismantling joints                   | unit     | 4   | 2,600,000  | 10,400,000         | 52,000           |
| <b>A.1 13</b>                 | <b>Louisa Row pipe from PS R (16) c.sing to PS U (19) crossing</b>   |          |     |            |                    |                  |
|                               | HDPE pipe PN 10, dia. 355 mm, including trench, sand bed, welding, road reinstatement                      | m        | 489 | 45,533     | 22,265,637         | 111,328          |
|                               | pipe fittings, including gate valves, TEEs, air vent valves, washout, dismantling joints                   | unit     | 5   | 1,800,000  | 9,000,000          | 45,000           |
| <b>A.1 14</b>                 | <b>Louisa Row - Cemetery Rd. pipe from PS U (19) c.sing to PS X (22) crossing</b>                          |          |     |            |                    |                  |
|                               | HDPE pipe PN 10, dia. 280 mm, including trench, sand bed, welding, road reinstatement                      | m        | 508 | 28,240     | 14,345,920         | 71,730           |
|                               | pipe fittings, including gate valves, TEEs, air vent valves, washouts, dismantling joints                  | unit     | 5   | 1,800,000  | 9,000,000          | 45,000           |
| <b>A.1 15</b>                 | lump sum for relocation of existing utilities (pipes, cables, etc..)                                       | lump sum |     |            | 50,000,000         | 250,000          |
| <b>A.1 16</b>                 | contractor's mobilization costs (10% of works)   | unit     | 1   | 61,596,100 | 61,596,100         | 307,981          |
| <b>total works</b>            |  |          |     |            | <b>677,557,104</b> | <b>3,387,786</b> |
| contingencies 10%             |  |          |     |            | <b>67,755,710</b>  | <b>338,779</b>   |
| <b>TOTAL (without duties)</b> |  |          |     |            | <b>745,312,815</b> | <b>3,726,564</b> |

A.2 : Installation of second pump and upgrade of power supply in the pumping stations

| <i>investment</i>  | <i>unit</i> | <i>quantity</i> | <i>unit price or lump sum (GY\$)</i> | <i>total cost (GY\$)</i> | <i>total cost (US\$)</i> |                  |
|--|-------------|-----------------|--------------------------------------|--------------------------|--------------------------|------------------|
| <b>A.2 1</b> supply and install 15 KW submersible pumps, including control panel and level control | unit        | 8               | 7,800,000                            | 62,400,000               | 312,000                  |                  |
| supply and install 18,5 KW submersible pumps, including control panel and level control            | unit        | 16              | 8,600,000                            | 137,600,000              | 688,000                  |                  |
| supply and install 35 KW transformer, including circuit breaker, supports and all connections      | unit        | 8               | 6,500,000                            | 52,000,000               | 260,000                  |                  |
| supply and install 45 KVA transformer, including circuit breaker, supports and all connections     | unit        | 16              | 8,400,000                            | 134,400,000              | 672,000                  |                  |
| <b>A.2 2</b> lump sum for relocation of existing utilities (pipes, cables, etc..)                  | lump sum    |                 |                                      | 6,000,000                | 30,000                   |                  |
| <b>A.2 3</b> contractor's mobilization costs (10% of works)  | unit        | 1               | 39,240,000                           | 39,240,000               | 196,200                  |                  |
| <b>total works</b>   |             |                 |                                      |                          | <b>431,640,000</b>       | <b>2,158,200</b> |
| contingencies 10%  |             |                 |                                      |                          | <b>43,164,000</b>        | <b>215,820</b>   |
| <b>TOTAL (without duties)</b>  |             |                 |                                      |                          | <b>474,804,000</b>       | <b>2,374,020</b> |

A.3 : Force main from ring to WWTP

|                               |  |          |       |            |                    |                  |
|-------------------------------|--|----------|-------|------------|--------------------|------------------|
| <b>A.3 1</b>                  | HDPE pipe PN 10, dia. 800 mm, including trench, sand bed, welding, road reinstatement    | m        | 2,290 | 230,260    | 527,295,400        | 2,636,477        |
|                               | pipe fittings, including gate valves, TEEs, air vent valves, washout, dismantling joints | unit     | 20    | 3,200,000  | 64,000,000         | 320,000          |
| <b>A.3 2</b>                  | lump sum for relocation of existing utilities (pipes, cables, etc..)                     | lump sum |       |            | 50,000,000         | 250,000          |
| <b>A.4 3</b>                  | contractor's mobilization costs (10% of works)   | unit     | 1     | 64,129,540 | 64,129,540         | 320,648          |
| <b>total works</b>            |  |          |       |            | <b>705,424,940</b> | <b>3,527,125</b> |
| contingencies 10%             |  |          |       |            | <b>70,542,494</b>  | <b>352,712</b>   |
| <b>TOTAL (without duties)</b> |  |          |       |            | <b>775,967,434</b> | <b>3,879,837</b> |

A.4 : Primary treatment plant

| <i>investment</i>             |   | <i>unit</i>   | <i>quantity</i> | <i>unit price or lump sum (GY\$)</i> | <i>total cost (GY\$)</i> | <i>total cost (US\$)</i> |
|-------------------------------|---|---|-----------------|--------------------------------------|--------------------------|--------------------------|
| A.4                           | 1 | treatment plant composed of 2-channel screening and 2 circular sedimentators<br>(see separate bill of quantities) | lump sum        |                                      | 133,199,505              | 665,998                  |
| A.4                           | 2 | lump sum for relocation of existing utilities (pipes, cables, etc..)  | lump sum        |                                      | 6,000,000                | 30,000                   |
| A.4                           | 3 | contractor's mobilization costs (10% of works)  | unit            | 1                                    | 13,919,951               | 69,600                   |
| <b>total works</b>            |   |   |                 |                                      | <b>153,119,456</b>       | <b>765,597</b>           |
| contingencies 10%             |   |   |                 |                                      | <b>15,311,946</b>        | <b>76,560</b>            |
| <b>TOTAL (without duties)</b> |   |   |                 |                                      | <b>168,431,401</b>       | <b>842,157</b>           |

A.5 : Low-head pumping station at WWTP outlet

|                               |   |   |          |   |                    |                |
|-------------------------------|---|---|----------|---|--------------------|----------------|
| A.5                           | 1 | Pumping station with three 50 Kw pumps ( 2 + 1 stand-by) including 180 KVA generator transformer and connection to power line (see separate bill of quantities) | lump sum |   | 113,147,441        | 565,737        |
| A.5                           | 2 | lump sum for relocation of existing utilities (pipes, cables, etc..)  | lump sum |   | 6,000,000          | 30,000         |
| A.5                           | 3 | contractor's mobilization costs (10% of works)  | unit     | 1 | 11,914,744         | 59,574         |
| <b>total works</b>            |   |   |          |   | <b>131,062,185</b> | <b>655,311</b> |
| contingencies 10%             |   |   |          |   | <b>13,106,218</b>  | <b>65,531</b>  |
| <b>TOTAL (without duties)</b> |   |   |          |   | <b>144,168,403</b> | <b>720,842</b> |

A.6 : Delivery main to the new outfall

|                               |   |  |          |       |                    |                  |           |
|-------------------------------|---|--|----------|-------|--------------------|------------------|-----------|
| A.6                           | 1 | HDPE pipe PN 10, dia. 800 mm, including trench, sand bed, welding, road reinstatement    | m        | 1,880 | 230,260            | 432,888,800      | 2,164,444 |
|                               |   | pipe fittings, including gate valves, TEEs, air vent valves, washout, dismantling joints | unit     | 6     | 3,200,000          | 19,200,000       | 96,000    |
| A.6                           | 2 | lump sum for relocation of existing utilities (pipes, cables, etc..)                     | lump sum |       |                    | 50,000,000       | 250,000   |
| A.6                           | 3 | contractor's mobilization costs (10% of works)   | unit     | 1     | 50,208,880         | 50,208,880       | 251,044   |
| <b>total works</b>            |   |  |          |       | <b>552,297,680</b> | <b>2,761,488</b> |           |
| contingencies 10%             |   |  |          |       | <b>55,229,768</b>  | <b>276,149</b>   |           |
| <b>TOTAL (without duties)</b> |   |  |          |       | <b>607,527,448</b> | <b>3,037,637</b> |           |

A.7 : Replacement of some sections of delivery mains from pumping stations

| <i>investment</i>             |   |   |          | <i>unit</i> | <i>quantity</i> | <i>unit price or lump sum (GY\$)</i> | <i>total cost (GY\$)</i> | <i>total cost (US\$)</i> |
|-------------------------------|---|---|----------|-------------|-----------------|--------------------------------------|--------------------------|--------------------------|
| A.7                           | 1 | HDPE pipe PN 10, dia. 160 mm, including trench, sand bed, welding, road reinstatement     | m        | 200         | 9,287           | 1,857,400                            | 9,287                    |                          |
|                               |   | pipe fittings, including gate valves, TEEs, air vent valves, washouts, dismantling joints | unit     | 2           | 1,800,000       | 3,600,000                            | 18,000                   |                          |
| A.7                           | 2 | lump sum for relocation of existing utilities (pipes, cables, etc..)                      | lump sum |             |                 | 2,000,000                            | 10,000                   |                          |
| A.7                           | 3 | contractor's mobilization costs (10% of works)  | unit     | 1           | 745,740         | 745,740                              | 3,729                    |                          |
| <b>total works</b>            |   |   |          |             |                 | <b>8,203,140</b>                     | <b>41,016</b>            |                          |
| contingencies 10%             |   |   |          |             |                 | <b>820,314</b>                       | <b>4,102</b>             |                          |
| <b>TOTAL (without duties)</b> |   |   |          |             |                 | <b>9,023,454</b>                     | <b>45,117</b>            |                          |

B. *capacity building and works supervision*

| <i>investment</i>  |  |   |          | <i>unit</i> | <i>quantity</i> | <i>unit price or lump sum (GY\$)</i> | <i>total (GY\$)</i> | <i>total (US\$)</i> |
|--|--|---|----------|-------------|-----------------|--------------------------------------|---------------------|---------------------|
|  |  | <i>works supervision</i>                    | month    | 24          | 9,000,000       | 216,000,000                          | 1,080,000           |                     |
|  |  | <i>capacity building</i>                    | month    | 6           | 9,000,000       | 54,000,000                           | 270,000             |                     |
|  |  | <i>information, communication, seminars</i> | lump sum | 1           | 8,000,000       | 8,000,000                            | 40,000              |                     |
| <b>TOTAL INSTITUTIONAL SUPPORT AND SERVICES (without duties)</b> |  |   |          |             |                 | <b>278,000,000</b>                   | <b>1,390,000</b>    |                     |

|               |                      |                   |
|---------------|----------------------|-------------------|
| overall total | <b>3,195,031,816</b> | <b>15,975,159</b> |
|---------------|----------------------|-------------------|

## ANNEX 2 : Estimated O&M costs for Option 1.a and Option 1.b



Table 7.1 - estimation of annual O&M costs with implementation of option 1.a

nota: unit rates have been updated to the year 2011

a) human resources

| activity   | working days              |                            | working time required                    |                                       |                                  |  |  |   |  |                  |
|--|---------------------------|----------------------------|--|---------------------------------------|----------------------------------|--|--|---|--|------------------|
|  | daily operation           | extra-ordinary maintenance | team responsible<br>10,000<br>GY\$ / day | pump operators<br>4,500<br>GY\$ / day | labourers<br>3,000<br>GY\$ / day | electrical technician<br>4,500<br>GY\$ / day | mechanical technician<br>4,500<br>GY\$ / day | excavator operator<br>6,000<br>GY\$ / day | car / truck drivers<br>3,000<br>GY\$ / day |                  |
| pumping station operation and inspection                       | 312                       |                            |  | 624                                   |                                  | 20   | 10   |   | 312  |                  |
| extra-ordinary maintenance (pipe burst repair, trench digging) |                           | 15                         | 15                                       |                                       | 30                               |  |  | 15  | 15   |                  |
| extra-ordinary maintenance (pump spare parts replacement)      |                           | 2                          | 2  |                                       | 4                                | 2  | 2  |   | 2  |                  |
|  | <b>total working days</b> |                            | 17                                       | 624                                   | 34                               | 22   | 12   | 15  | 329  |                  |
|  |                           |                            | <b>annual costs</b>                      | <b>170,000</b>                        | <b>2,808,000</b>                 | <b>102,000</b>                               | <b>99,000</b>                                | <b>54,000</b>                             | <b>90,000</b>                              | <b>987,000</b>   |
|  |                           |                            |  |                                       |                                  |  |  |   | <b>TOTAL ANNUAL COSTS (GY\$)</b>           | <b>4,310,000</b> |
|  |                           |                            |  |                                       |                                  |  |  |   | <b>TOTAL ANNUAL COSTS (US\$)</b>           | <b>21,550</b>    |

b) equipment

| activity   | working days                      |                            | equipment needs (days)                 |  |                               |                                       | main materials and spare parts   |                                      |   |                  |
|--|-----------------------------------|----------------------------|--|--|-------------------------------|---------------------------------------|----------------------------------|--------------------------------------|---|------------------|
|  | daily operation                   | extra-ordinary maintenance | pick-up vehicle<br>6,500<br>GY\$ / day | excavator small size<br>80,000<br>GY\$ / day | truck<br>20,000<br>GY\$ / day | lifting crane<br>60,000<br>GY\$ / day | pipe 160 mm<br>6,300<br>GY\$ / m | pump motor<br>600,000<br>GY\$ / unit | pump impeller<br>900,000<br>GY\$ / unit |                  |
| pumping station operation and inspection                       | 312                               |                            | 312                                    |  |                               |                                       |                                  |                                      |   |                  |
| extra-ordinary maintenance (pipe burst repair, trench digging) |                                   | 15                         | 15                                     | 15   | 15                            |                                       | 30                               |                                      |   |                  |
| extra-ordinary maintenance (pump spare parts replacement)      |                                   | 2                          | 2                                      |  | 2                             | 2                                     |                                  | 1                                    | 1                                       |                  |
|  | <b>total working days / units</b> |                            | 329                                    | 15   | 17                            | 2                                     | 30                               | 1                                    | 1                                       |                  |
|  |                                   |                            | <b>annual costs</b>                    | <b>2,138,500</b>                             | <b>1,200,000</b>              | <b>340,000</b>                        | <b>120,000</b>                   | <b>189,000</b>                       | <b>600,000</b>                          | <b>900,000</b>   |
|  |                                   |                            |  |  |                               |                                       |                                  |                                      | <b>TOTAL ANNUAL COSTS (GY\$)</b>        | <b>5,487,500</b> |
|  |                                   |                            |  |  |                               |                                       |                                  |                                      | <b>TOTAL ANNUAL COSTS (US\$)</b>        | <b>27,438</b>    |

c) energy costs

| activity   | working time       |                       | annual energy cost               |                         | Option 1.a<br>Total annual costs for O&M |                   |
|--|--------------------|-----------------------|----------------------------------|-------------------------|--|-------------------|
|  | total pumping days | working hours per day | annual energy consumption<br>KWh | unit cost<br>GY\$ / KWh |  |                   |
| functioning of 24 pumping stations under automatic control | 365                | 4.2                   | 591,125                          | 63.04                   |  |                   |
|  |                    |                       |                                  |                         | <b>in GY\$</b>                           | <b>47,062,007</b> |
|  |                    |                       |                                  |                         | <b>in US\$</b>                           | <b>235,310</b>    |

Table 7.2 - estimation of annual O&M costs with implementation of option 1.b

nota: unit rates have been updated to the year 2011

a) human resources

| activity   | working days              |                            | working time required                    |                                       |                                  |  |  |   |  |  |
|--|---------------------------|----------------------------|--|---------------------------------------|----------------------------------|--|--|---|--|--|
|  | daily operation           | extra-ordinary maintenance | team responsible<br>10,000<br>GY\$ / day | pump operators<br>4,500<br>GY\$ / day | labourers<br>3,000<br>GY\$ / day | electrical technician<br>4,500<br>GY\$ / day | mechanical technician<br>4,500<br>GY\$ / day | excavator operator<br>6,000<br>GY\$ / day | car / truck drivers<br>3,000<br>GY\$ / day |  |
| pumping station operation and inspection                       | 312                       |                            |  | 936                                   |                                  | 20   | 10   |   | 312  |  |
| extra-ordinary maintenance (pipe burst repair, trench digging) |                           | 15                         | 15                                       |                                       | 30                               |  |  | 15  | 15   |  |
| extra-ordinary maintenance (pump spare parts replacement)      |                           | 4                          | 4  |                                       | 4                                | 4  | 4  |   | 4  |  |
|  | <b>total working days</b> |                            | 19                                       | 936                                   | 34                               | 24   | 14   | 15  | 331  |  |
|  | <b>annual costs</b>       |                            | 190,000                                  | 4,212,000                             | 102,000                          | 108,000                                      | 63,000                                       | 90,000                                    | 993,000                                    |  |
|  |                           |                            | <b>TOTAL ANNUAL COSTS (GY\$)</b>         |                                       |                                  |  |  |   | 5,758,000                                  |  |
|  |                           |                            | <b>TOTAL ANNUAL COSTS (US\$)</b>         |                                       |                                  |  |  |   | 28,790                                     |  |

b) equipment

| activity   | working days                      |                            | equipment needs (days)                 |  |                               |                                       | main materials and spare parts   |                                     |  |  |
|--|-----------------------------------|----------------------------|--|--|-------------------------------|---------------------------------------|----------------------------------|-------------------------------------|--|--|
|  | daily operation                   | extra-ordinary maintenance | pick-up vehicle<br>6,500<br>GY\$ / day | excavator small size<br>80,000<br>GY\$ / day | truck<br>20,000<br>GY\$ / day | lifting crane<br>60,000<br>GY\$ / day | pipe 160 mm<br>6,300<br>GY\$ / m | pump motor<br>600,000<br>GY\$ /unit | pump impeller<br>900,000<br>GY\$ /unit |  |
| pumping station operation and inspection                       | 312                               |                            | 312                                    |  |                               |                                       |                                  |                                     |  |  |
| extra-ordinary maintenance (pipe burst repair, trench digging) |                                   | 15                         | 15                                     | 15   | 15                            |                                       | 30                               |                                     |  |  |
| extra-ordinary maintenance (pump spare parts replacement)      |                                   | 4                          | 4                                      |  | 4                             | 4                                     |                                  | 2                                   | 2                                      |  |
|  | <b>total working days / units</b> |                            | 331                                    | 15   | 19                            | 4                                     | 30                               | 2                                   | 2                                      |  |
|  | <b>annual costs</b>               |                            | 2,151,500                              | 1,200,000                                    | 380,000                       | 240,000                               | 189,000                          | 1,200,000                           | 1,800,000                              |  |
|  |                                   |                            | <b>TOTAL ANNUAL COSTS (GY\$)</b>       |  |                               |                                       |                                  |                                     | 7,160,500                              |  |
|  |                                   |                            | <b>TOTAL ANNUAL COSTS (US\$)</b>       |  |                               |                                       |                                  |                                     | 35,803                                 |  |

c) energy costs

| activity   | working time                     |                       | annual energy cost               |                         |
|--|----------------------------------|-----------------------|----------------------------------|-------------------------|
|  | total pumping days               | working hours per day | annual energy consumption<br>KWh | unit cost<br>GY\$ / KWh |
| functioning of 24 pumping stations under automatic control | 365                              | 4.2                   | 591,125                          | 63.04                   |
| electrical equipment in treatment plant                    | 365                              | 24                    | 350,400                          | 63.04                   |
| pumping station at treatment outlet, automatic control     | 365                              | 4.0                   | 219,000                          | 63.04                   |
|  | <b>TOTAL ANNUAL COSTS (GY\$)</b> |                       | 73,159,483                       |                         |
|  | <b>TOTAL ANNUAL COSTS (US\$)</b> |                       | 365,797                          |                         |

|                            |                |  |            |
|----------------------------|----------------|--|------------|
| Option 1.b                 |                |  |            |
| Total annual costs for O&M |                |  |            |
|                            | <b>in GY\$</b> |  | 86,077,983 |
|                            | <b>in US\$</b> |  | 430,390    |

## ANNEX 3 : Environmental Screening Checklist- Option 1.a

## Environmental Screening Checklist

### 1. Summary of Project:

Option 1a : Rehabilitation of existing ring and pumping stations power increase

### 2. Project Environmental Summary

The main potential negative impacts of the project that require careful management concern principally the work construction phases and can be summarized as follows:

- Traffic congestion and temporary road closing,
- Air quality problems and noise pollution during construction
- Construction material storage and transportation;
- Temporary disposal of wastewater in the drainage channels during phase of connection to the new ring.

The negative impact during the operation phase derives from the fact that the collected sewerage will be discharged into the Demerara river estuary without any preliminary treatment. This situation corresponds to the current situation, however we expect that after the rehabilitation of the sewer system, the quantity of effluent to be discharged will increase considerably. Analysis on the dilution factor and water quality monitoring will be required during the operation phase.

The key positive environmental impacts are:

- Reduction of leakage into the ground and superficial groundwater
- Reduction of risk of contamination of potable water consequent to infiltration of wastewater
- Elimination of leakage into canals

### 3. Description of Site and Checklist

|                              |  |
|------------------------------|--|
| <b>Address:</b>              | Central Georgetown   |
| <b>Site Configuration:</b>   | the project site consists of the area served by the existing Georgetown central sewer system. The catchment area extends over about 460 hectares. The main ring to be rehabilitated has a total length of 5.515 Km   |
| <b>Improvement:</b>          | N/A  |
| <b>Current Use:</b>          | resident population along public road  |
| <b>Adjoining properties:</b> | the service area is bounded by the Demerara River in the West, Vlissengen Road in the East, the Atlantic Ocean in the North and Sussex Street in the South   |
| <b>Area Description:</b>     | The project concerns the Georgetown central sewerage system area. The area covered by Georgetown has basically a flat morphology and is located between 0.60 and 1.40 m above the mean sea level. The top soils concerned by the project can be classified as Demerara clay. The economy of the area is mainly |

based on small trades or linked to the sugarcane, lumber and mining sectors. The population is mostly comprised of low and middle income families.

**Property History:**

Property owned by Government of Guyana

**Proposed Project Description:**

- It is proposed the complete reconstruction of the existing main pressure sewer ring collecting the wastewater from the project area and transmitting it to the existing outfalls at the Demerara river estuary
- Installation of second pump and upgrade of power supply in the existing Pumping Stations
- Replacement of some sections of delivery mains from pumping stations
- The existing new outfall at Fort Groyne is integrated in the project (this is deemed to be one of the best locations for discharge)

**Potential Benefits of Project:**

- Reduction of leakage into the ground and superficial groundwater
- Reduction of risk of contamination of potable water consequent to infiltration of wastewater
- Elimination of leakage into canals
- Increase of pumping capacity and system flexibility

**Checklist**

| Potential Impacts of Proposed Project   | Y/N/NA/Unknown <sup>1</sup> | Negative Impacts <sup>2</sup> |           |                 | Positive Impacts, Comments   |
|---|-----------------------------|-------------------------------|-----------|-----------------|--|
|   |                             | Construction                  | Operation | Decommissioning |  |
| <b>Future Use</b>   |                             |                               |           |                 |  |
| Will hazardous chemicals or petroleum fuels be stored on site (i.e., for generators)? <i>if so, potential impact may be addressed by secondary containment and regular inspection</i>   | Y                           | Minor                         | Minor     | Minor           | <i>Construction phase: Lubricants may be stored on site</i>  |
| <b>Geology/physical setting</b>   |                             |                               |           |                 |  |
| Are soils highly erodible due to steep grade or soil content (organic material, muck peat, etc.) within 1 foot (0.3m) of surface?   | N                           | Minor                         | Minor     | Minor           | <i>Clay formation allows for cohesion during trenching, heavy rains may compromise stability. Safety conditions in the trenches during construction phase shall be ensured through the use of appropriate shoring systems and dewatering</i> |
| Is bedrock located within 6ft. (1.8m) of the soil surface (i.e. to limit potential migration of a potential on-site spill)?<br>Alternatively, is fractured bedrock located within 10ft. (3m) of the soil surface (i.e., that might provide a preferential conduit for a potential on-site spill)? | N                           | Minor                         | Minor     | Minor           | <i>Potential for contaminant migration is minimal by virtue of limited quantity in use and cohesiveness of clay formations at project site</i>   |
| <b>Hydrology</b>  |                             |                               |           |                 |  |
| Will storm water be discharged off-site or managed via on-site infiltration? <i>If discharged off-site, minor impact may be addressed via on-site collection and inspection for sheen prior to discharge during both construction and operation.</i>  | Y                           | Minor                         | Minor     | Minor           | <i>During the construction phase, storm water will be pumped to the ditches and canals existing beside the roads</i>   |

| Potential Impacts of Proposed Project  | Y/N/NA/Unknown <sup>1</sup> | Negative Impacts <sup>2</sup> |           |                 | Positive Impacts, Comments  |
|--|-----------------------------|-------------------------------|-----------|-----------------|---|
|  |                             | Construction                  | Operation | Decommissioning |   |
| Does project include fill within the 100-year floodplain? If data is not available, has site flooded in memorable history?   | N                           | Minor                         | Minor     | Minor           | <i>No impact</i>  |
| Will surface topography be significantly altered?  | N                           | Minor                         | Minor     | Minor           | <i>No foreseeable impacts: Asphalted roads and adjacent grounds will be reinstated with the same levels as before</i>   |
| Will site be more than 50% covered with impermeable surfaces or result in a significant increase in capacity requirements of a waterway or facility within 1 mile (i.e, such as associated with a grade increase)?   | N                           | Minor                         | Minor     | Minor           | <i>No foreseeable impacts: There will be no increase of asphalted / impermeable surfaces</i>  |
| Is the groundwater table located within 10 ft. (3m) of the soil surface? <i>If so, minor impacts during construction may be addressed by dewatering and providing secondary containment for fuels to avoid spill contamination and inspection during operation</i> | Y                           | Minor                         | Minor     | Minor           | <i>The works will be carried out through dewatering of the trenches. Secondary containment for fuels to avoid spill contamination and inspection during operation</i>                               |
| Are suspected wetlands, marsh or mangroves located on site?  | N                           | Minor                         | Minor     | Minor           | <i>No impact</i>  |
| Will any stream, ditch, navigable stream or dry run (storm water conveyance) be traversed or transected by the project?  | Y                           | Minor                         | Minor     | Minor           | <i>Project will follow the existing ring layout overcrossing some canals and minor ditches . The new crossing pipes will be constructed in a way to avoid leakage of foul water into the canals</i> |
| Will project be located with ¼ mile (0.4km) of a major water body?   | Y                           | Minor                         | Minor     | Minor           | <i>The sewerage will be discharged at the existing outfall at the estuary of Demerara river as it is the current situation</i>  |

| Potential Impacts of Proposed Project  | Y/N/NA/Unknown <sup>1</sup> | Negative Impacts <sup>2</sup> |           |                 | Positive Impacts, Comments   |
|--|-----------------------------|-------------------------------|-----------|-----------------|--|
|  |                             | Construction                  | Operation | Decommissioning |  |
| <b>Water/wastewater</b>  |                             |                               |           |                 |  |
| Will project require water?  | Y                           | Minor                         | Minor     | Minor           | <i>Clear water will be required for washouts and construction works, such as concrete mixing and curing, pipe cleaning, etc.. Potable water is available at a short distance from construction site</i>  |
| If groundwater will be used, will pumping or drainage potentially lower the water table? | N                           | Minor                         | Minor     | Minor           | <i>The water table shall be lowered locally through pumping during construction. For the laying of each short stretch of pipe the trench shall be isolated with sheet piles . No permanent effect is expected on shallow or deep aquifers</i>  |
| Will project have a wastewater discharge?  | Y                           | Major                         | Major     | Minor           | <i>The existing ring will be kept in operation during the construction of the new mains. During the phase of connection between the old and new ring, wastewater will be temporarily discharged into canals. Measures shall be taken to minimize the connection time and negative impacts</i>                    |
| Will septic tank-soil absorption fields for on-site waste disposal be used on-site?      | N                           | Minor                         | Minor     | Minor           | <i>No impact</i>   |
| Could any waste materials enter ground or surface waters associated with the site?       | Y                           | Major                         | Minor     | Minor           | <i>The project will reduce the risk of wastewater infiltration and consequent soil and water contamination. During the phase of connection between the old and new ring, wastewater will be temporarily discharged into canals. Measures shall be taken to minimize the connection time and negative impacts</i> |
| <b>Air</b>   |                             |                               |           |                 |  |
| Will project result in air emissions?  | Y                           | Minor                         | Minor     | Minor           | <i>Minor emissions from the use of machines during construction phase- they will be re-distributed by coastal air</i>  |
| Will project generate dust?  | Y                           | Minor                         | Minor     | Minor           | <i>Small amount during construction phase- the contractor shall use mitigation measures for reducing the impact</i>  |



| Potential Impacts of Proposed Project   | Y/N/NA/Unknown <sup>1</sup> | Negative Impacts <sup>2</sup> |           |                 | Positive Impacts, Comments   |
|---|-----------------------------|-------------------------------|-----------|-----------------|--|
|   |                             | Construction                  | Operation | Decommissioning |  |
| <b>Solid waste</b>  |                             |                               |           |                 |  |
| Are there any environmental health hazards, including exposure to toxic chemicals, risk of fire and explosion, spill or hazardous waste that could occur as a result of this project? | N                           | Minor                         | Minor     | Minor           | <i>No impact</i>   |
| Will project generate, transport or store solid or hazardous waste?   | Y                           | Minor                         | Minor     | Minor           | <i>Trenches excavation will lead to store and transport of non reusable excavation materials- excavation materials are not harmful</i> |
| Will dredging be required?  | N                           | Minor                         | Minor     | Minor           | <i>No impact</i>   |
| Does (will) this site have storage tanks, underground or above ground? If so, what will be stored in the tanks?   | N                           | Minor                         | Minor     | Minor           | <i>No impact</i>   |
| Is the site located near a landfill?  | N                           | Minor                         | Minor     | Minor           | <i>No impact</i>   |
| <b>Natural resources</b>  |                             |                               |           |                 |  |
| Does the site contain critical habitat for endangered, threatened or rare plants and animals? <i>If none listed by EPA, no impact</i>   | N                           | Minor                         | Minor     | Minor           | <i>No impact</i>   |
| Are endangered, threatened, unusual or rare species (animal, bird or plant) present in the area? <i>If none listed by EPA, no impact</i>  | N                           | Minor                         | Minor     | Minor           | <i>No impact</i>   |
| Will project result in removal of a significant percentage of trees?  | N                           | Minor                         | Minor     | Minor           | <i>No impact</i>   |
| Does the project involve conversion of existing agricultural land?  | N                           | Minor                         | Minor     | Minor           | <i>No impact</i>   |

| Potential Impacts of Proposed Project   | Y/N/NA/Unknown <sup>1</sup> | Negative Impacts <sup>2</sup> |           |                 | Positive Impacts, Comments   |
|---|-----------------------------|-------------------------------|-----------|-----------------|--|
|   |                             | Construction                  | Operation | Decommissioning |  |
| <b>Cultural/archeological</b>   |                             |                               |           |                 |  |
| Has the site been previously disturbed?   | Y                           | Minor                         | Minor     | Minor           | <i>The site has been previously disturbed during construction of the existing sewer ring</i>   |
| Are there any places or objects listed on, or proposed for national or local preservation registers known to be on or next to the site? | N                           | Minor                         | Minor     | Minor           | <i>No impact</i>   |
| <b>Disruption</b>   |                             |                               |           |                 |  |
| Will project disturb more than 1 acre of land? <i>If so, construction impact may be addressed by erosion control methods</i>            | Y                           | Minor                         | Minor     | Minor           | <i>Construction will follow existing sewer route. Total length 5.515 Km</i>  |
| Will project disrupt traffic (road closures, etc.)?   | Y                           | Major                         | Minor     | Minor           | <i>Temporary disruption of traffic during construction due to excavation across and along roads. The works will be effectuated on lots of limited length, in a way to minimize closure of main streets stretches</i> |
| Will project disrupt businesses?  | Y                           | Minor                         | Minor     | Minor           | <i>Short term potential impact during works</i>  |
| Will project require resettlement?  | N                           | Minor                         | Minor     | Minor           | <i>No impact</i>   |
| <b>Aesthetics</b>   |                             |                               |           |                 |  |
| Will project emit noise?  | Y                           | Minor                         | Minor     | Minor           | <i>Noise pollution during construction phase due to the use of excavation equipment</i>  |
| Will ambient light be altered via spotlights, etc.?   | N                           | Minor                         | Minor     | Minor           | <i>A temporary impact can be foreseen in the case of overnight works</i>   |

| Potential Impacts of Proposed Project   | Y/N/NA/Unknown <sup>1</sup> | Negative Impacts <sup>2</sup> |           |                 | Positive Impacts, Comments |
|---|-----------------------------|-------------------------------|-----------|-----------------|----------------------------|
|   |                             | Construction                  | Operation | Decommissioning |                            |
| <b>Regulatory review</b>  |                             |                               |           |                 |                            |
| Have regulations applicable to project been identified and strategy for compliance developed? Provide detail in separate attachment | N                           | Minor                         | Minor     | Minor           | <i>No impact</i>           |

**Key:**

<sup>1</sup> “Y”= yes, “N” = No, “NA”= not applicable

<sup>2</sup> Negative impacts are characterized either “minor” or “major”. In general, minor impacts are temporary visible or otherwise notable changes while major impacts generally are permanent and require significant mitigation such as resettlement. All minor impacts may be addressed sufficiently in the contractor’s EMP. All major impacts will review by EPA to determine is a full-scale EIS is needed.

Italic = Guidance for determination of impact or impact mitigation procedure that may be included in contractor’s ESMP

ANNEX 4 : Environmental Screening Checklist- Option 1.b

## Environmental Screening Checklist

### 4. Summary of Project:

Option 1.b : Rehabilitation of existing ring, pumping stations power increase and preliminary treatment

### 5. Project Environmental Summary

Option 1.b is practically the complementation of Option 1.a with a WWTP and the needed connections, thus it entails the same potential negative and positive impacts of the first option for the reconstruction of the ring main component, and allows reducing the negative impact of discharging the raw sewerage directly into the sea.

The main potential negative impacts of the project that require careful management concern mainly the work construction phases and can be summarized as follows:

- Traffic congestion and temporary road closing;
- Air quality problems and noise pollution during construction;
- Construction material storage and transportation;
- Temporary disposal of wastewater in the drainage channels during the phase of connection between the old and new ring.

The negative impact during the operation phase can be air quality problems deriving from odour emissions that might be generated from the preliminary plant and transmitted to the neighbourhood by the coastal air and in windy periods.

The key positive environmental impacts are:

- Reduction of leakage into the ground and superficial groundwater;
- Reduction of risk of contamination of potable water consequent to infiltration of wastewater;
- Elimination of leakage into canals.
- The treatment plant will ensure a reduction of polluting charge of the effluent
- Consequent improvement of the public health and sanitary conditions of central Georgetown.

### Construction of Wastewater preliminary treatment Plant

### 6. Description of Site and Checklist

|                              |  |
|------------------------------|--|
| <b>Address:</b>              | Central Georgetown   |
| <b>Site Configuration:</b>   | Site area approximately 3000 m2  |
| <b>Improvement:</b>          | N/A  |
| <b>Current Use:</b>          | Empty field belonging to the Government  |
| <b>Adjoining properties:</b> | The WWTP chosen location is at the angle between Carifesta Avenue and the sea protection wall. It borders an Army Camp and it is not far from the GT&T Telecommunication headquarters and the National Park. |

**Area Description:**

The proposed ring location is as described in Option 1.a. The possible WWTP site is close to the ocean with no noticeable elevation variations. The soils concerned by the project can be classified as Demerara clay. Economy of the area is mostly based on small trade related to the sugarcane, lumber and mining industries. The population is mostly comprised of low and middle income families

**Property History:**

Property owned by Government of Guyana

**Proposed Project Description:**

- All the works included in Option 1.a
- Construction of a force main from ring to WWTP
- Construction at the crossing of Carifesta Avenue and Vlissengen Rd. of a small wastewater treatment plant for preliminary treatment of effluent
- Installation of Low-head pumping station at WWTP outlet
- Construction of a delivery main from the WWTP outlet to the new outfall

**Potential Benefits of Project:**

- In addition to the benefits of Option 1.a, the treatment plant will ensure a reduction of polluting charge of the effluent

**Checklist**

| Potential Impacts of Proposed Project   | Y/N/NA/Unknown <sup>1</sup> | Negative Impacts <sup>2</sup> |           |                 | Positive Impacts, Comments   |
|---|-----------------------------|-------------------------------|-----------|-----------------|--|
|   |                             | Construction                  | Operation | Decommissioning |  |
| <b>Future Use</b>   |                             |                               |           |                 |  |
| Will hazardous chemicals or petroleum fuels be stored on site (i.e., for generators)? <i>if so, potential impact may be addressed by secondary containment and regular inspection</i>   | Y                           | Minor                         | Minor     | Minor           | <i>Construction phase: Lubricants may be stored on site</i>  |
| <b>Geology/physical setting</b>   |                             |                               |           |                 |  |
| Are soils highly erodible due to steep grade or soil content (organic material, muck peat, etc.) within 1 foot (0.3m) of surface?   | N                           | Minor                         | Minor     | Minor           | <i>Clay formation allows for cohesion during excavation, heavy rains may compromise stability. Safety conditions in the excavations during construction phase shall be ensured through the use of appropriate shoring systems and dewatering</i> |
| Is bedrock located within 6ft. (1.8m) of the soil surface (i.e. to limit potential migration of a potential on-site spill)?<br>Alternatively, is fractured bedrock located within 10ft. (3m) of the soil surface (i.e., that might provide a preferential conduit for a potential on-site spill)? | N                           | Minor                         | Minor     | Minor           | <i>Potential for contaminant migration is minimal by virtue of limited quantity in use and cohesiveness of clay formations at project site</i>   |

| Potential Impacts of Proposed Project  | Y/N/NA/Unknown <sup>1</sup> | Negative Impacts <sup>2</sup> |           |                 | Positive Impacts, Comments   |
|--|-----------------------------|-------------------------------|-----------|-----------------|--|
|  |                             | Construction                  | Operation | Decommissioning |  |
| <b>Hydrology</b>   |                             |                               |           |                 |  |
| Will storm water be discharged off-site or managed via on-site infiltration? <i>If discharged off-site, minor impact may be addressed via on-site collection and inspection for sheen prior to discharge during both construction and operation.</i>               | Y                           | Minor                         | Minor     | Minor           | <i>During the construction phase, storm water will be pumped to the ditches and canals existing beside the roads</i>   |
| Does project include fill within the 100-year floodplain? If data is not available, has site flooded in memorable history?   | N                           | Minor                         | Minor     | Minor           | <i>No impact</i>   |
| Will surface topography be significantly altered?  | N                           | Minor                         | Minor     | Minor           | <i>No foreseeable impacts: Asphalted roads and adjacent grounds will be reinstated with the same levels as before</i>  |
| Will site be more than 50% covered with impermeable surfaces or result in a significant increase in capacity requirements of a waterway or facility within 1 mile (i.e, such as associated with a grade increase)?   | Y                           | Minor                         | Minor     | Minor           | <i>Existing drainage canals in the WWTP area will be rehabilitated</i>   |
| Is the groundwater table located within 10 ft. (3m) of the soil surface? <i>If so, minor impacts during construction may be addressed by dewatering and providing secondary containment for fuels to avoid spill contamination and inspection during operation</i> | Y                           | Minor                         | Minor     | Minor           | <i>The works will be effectuated through dewatering of the excavations. Secondary containment for fuels to avoid spill contamination and inspection during operation</i> |
| Are suspected wetlands, marsh or mangroves located on site?  | N                           | Minor                         | Minor     | Minor           | <i>No impact</i>   |



| Potential Impacts of Proposed Project   | Y/N/NA/Unknown <sup>1</sup> | Negative Impacts <sup>2</sup> |           |                 | Positive Impacts, Comments  |
|---|-----------------------------|-------------------------------|-----------|-----------------|---|
|   |                             | Construction                  | Operation | Decommissioning |   |
| Will any stream, ditch, navigable stream or dry run (storm water conveyance) be traversed or transected by the project? | N                           | Minor                         | Minor     | Minor           | <i>No impact</i>  |
| Will project be located with ¼ mile (0.4km) of a major water body?  | Y                           | Minor                         | Minor     | Minor           | <i>Project is close to the ocean but no impact is envisaged because the discharge of effluent will be done through the existing outfall</i>   |
| <b>Water/wastewater</b>   |                             |                               |           |                 |   |
| Will project require water?   | Y                           | Minor                         | Minor     | Minor           | <i>Clear water will be required for washouts and construction works, such as concrete mixing and curing, pipe cleaning, etc.. Potable water is available at a short distance from construction site</i> |
| If groundwater will be used, will pumping or drainage potentially lower the water table?                                | N                           | Minor                         | Minor     | Minor           | <i>The water table shall be lowered locally through pumping during construction. No permanent effect is expected on shallow or deep aquifers</i>  |
| Will project have a wastewater discharge?   | Y                           | Minor                         | Minor     | Minor           | <i>Construction water and washouts shall be discharged into the drainage canals, no impact anticipated</i>  |
| Will septic tank-soil absorption fields for on-site waste disposal be used on-site?                                     | N                           | Minor                         | Minor     | Minor           | <i>No impact</i>  |
| Could any waste materials enter ground or surface waters associated with the site?                                      | N                           | Minor                         | Minor     | Minor           | <i>No impact</i>  |
| <b>Air</b>  |                             |                               |           |                 |   |
| Will project result in air emissions?   | Y                           | Minor                         | Major     | Minor           | <i>Minor emissions from the use of machines during construction phase- they will be re-distributed by coastal air<br/>Bad smells can result from the treatment process</i>                              |
| Will project generate dust?   | Y                           | Minor                         | Minor     | Minor           | <i>Small amount during construction phase- the contractor shall use mitigation measures for reducing the impact</i>   |

| Potential Impacts of Proposed Project   | Y/N/NA/Unknown <sup>1</sup> | Negative Impacts <sup>2</sup> |           |                 | Positive Impacts, Comments  |
|---|-----------------------------|-------------------------------|-----------|-----------------|---|
|   |                             | Construction                  | Operation | Decommissioning |   |
| <b>Solid waste</b>  |                             |                               |           |                 |   |
| Are there any environmental health hazards, including exposure to toxic chemicals, risk of fire and explosion, spill or hazardous waste that could occur as a result of this project? | N                           | Minor                         | Minor     | Minor           | <i>No impact</i>  |
| Will project generate, transport or store solid or hazardous waste?   | Y                           | Minor                         | Minor     | Minor           | <i>excavation will lead to store and transport of non reusable excavation materials- excavation materials are not harmful</i> |
| Will dredging be required?  | N                           | Minor                         | Minor     | Minor           | <i>No impact</i>  |
| Does (will) this site have storage tanks, underground or above ground? If so, what will be stored in the tanks?   | N                           | Minor                         | Minor     | Minor           | <i>No impact</i>  |
| Is the site located near a landfill?  | N                           | Minor                         | Minor     | Minor           | <i>No impact</i>  |
| <b>Natural resources</b>  |                             |                               |           |                 |   |
| Does the site contain critical habitat for endangered, threatened or rare plants and animals? <i>If none listed by EPA, no impact</i>   | N                           | Minor                         | Minor     | Minor           | <i>No impact</i>  |
| Are endangered, threatened, unusual or rare species (animal, bird or plant) present in the area? <i>If none listed by EPA, no impact</i>  | N                           | Minor                         | Minor     | Minor           | <i>No impact</i>  |
| Will project result in removal of a significant percentage of trees?  | N                           | Minor                         | Minor     | Minor           | <i>There are no trees in the zone selected for the WWTP</i>   |
| Does the project involve conversion of existing agricultural land?  | N                           | Minor                         | Minor     | Minor           | <i>No impact</i>  |

| Potential Impacts of Proposed Project   | Y/N/NA/Unknown <sup>1</sup> | Negative Impacts <sup>2</sup> |           |                 | Positive Impacts, Comments  |
|---|-----------------------------|-------------------------------|-----------|-----------------|---|
|   |                             | Construction                  | Operation | Decommissioning |   |
| <b>Cultural/archeological</b>   |                             |                               |           |                 |   |
| Has the site been previously disturbed?   | Y                           | Minor                         | Minor     | Minor           | <i>The site for pipe laying has been previously disturbed during construction of the existing sewerage ring.</i>        |
| Are there any places or objects listed on, or proposed for national or local preservation registers known to be on or next to the site? | N                           | Minor                         | Minor     | Minor           | <i>No impact</i>  |
| <b>Disruption</b>   |                             |                               |           |                 |   |
| Will project disturb more than 1 acre of land? <i>If so, construction impact may be addressed by erosion control methods</i>            | Y                           | Minor                         | Minor     | Minor           | <i>No erosion is expected on the area, which is completely flat. Sheet piles and shoring will be used for trenching</i> |
| Will project disrupt traffic (road closures, etc.)?   | Y                           | Minor                         | Minor     | Minor           | <i>Temporary disruption of traffic during construction</i>  |
| Will project disrupt businesses?  | Y                           | Minor                         | Minor     | Minor           | <i>Short term potential impact during works</i>   |
| Will project require resettlement?  | N                           | Minor                         | Minor     | Minor           | <i>No impact</i>  |
| <b>Aesthetics</b>   |                             |                               |           |                 |   |
| Will project emit noise?  | Y                           | Minor                         | Minor     | Minor           | <i>Noise pollution during construction phase due to the use of excavation equipment</i>                                 |
| Will ambient light be altered via spotlights, etc.?   | N                           | Minor                         | Minor     | Minor           | <i>A temporary impact can be foreseen in the case of overnight works</i>  |
| <b>Regulatory review</b>  |                             |                               |           |                 |   |
| Have regulations applicable to project been identified and strategy for compliance developed? Provide detail in separate attachment     | N                           | Minor                         | Minor     | Minor           | <i>No impact</i>  |

**Key:**

<sup>1</sup> “Y” = yes, “N” = No, “NA” = not applicable

<sup>2</sup> Negative impacts are characterized either “minor” or “major”. In general, minor impacts are temporary visible or otherwise notable changes while major impacts generally are permanent and require significant mitigation such as resettlement. All minor impacts may be addressed sufficiently in the contractor’s EMP. All major impacts will review by EPA to determine if a full-scale EIS is needed.

*Italic* = Guidance for determination of impact or impact mitigation procedure that may be included in contractor’s ESMP