Environmental and Social Impact Assessments
for Belmopan Sanitary Transfer Station

Draft Report on the Environmental and Social Impact Study

Ministry of Natural Resources
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Inter-American Development Bank

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Cover Design and Photographs: Juan R. Rancharan – Waste Picker on his way to recover a metal rim

Table of Contents

ABBREVIATIONS

ADI	Area of direct environmental and social influence
Bze	Belize
BET	Belize Environmental Technologies
BMP	Best Management Practice
BTS	Belmopan Transfer Station
CDB	Caribbean Development Bank
Cat.	Category
CAP	Chapter (Laws of Belize)
m3	cubic meter
m^3/s	cubic meters per second
dB A	decibels A weighted
DOE	Department of Environment
DBE	Design Build Engineer
ESIA	Environmental and Social Impact assessment
EA	Environmental Assessment
ECP	Environmental Compliance Plan
EIA	Environmental Impact assessment
EMP	Environmental Management Plan
EPA	Environmental Protection Act
GPH	George Price Highway
GOB	Government of Belize
GBRB	Greater Belize River Basin
HBH	Hummingbird Highway
H.	Hurricane
IADB	Inter American Development Bank
IDB	Inter American Development Bank
IPCC	*Intergovernmental Panel on Climate Change*
iRAP	International Road Assessment Programme
km	kilometer
km^2	square kilometer
LIC	Land Information Center
L/min.	Litres per minute
MDF	Material Drop-off Facility
m	meters
µg	micro gram
µs/cm	microsiemens per centimeter
m^3/s	Cubic meters per second
mls	miles
mph	miles per hour
mg/L	milligrams per litre
mm	millimeter
MNR	Ministry of Natural Resources

MEAs	Multilateral environmental agreements
NEMO	National Emergency Management Organization
NEAC	National Environmental Appraisal Committee
NICH	National Institute of Culture and History
NSWMP	National Solid Waste Management Plan
NTU	Nephelometric Turbidity Units
ppm	parts per million
ppt	parts per thousand
PSWGIA	Philip S W Goldson International Airport
PSF	pound per square feet
PIC	Prior Informed Consent
PAPs	Project Affected Persons
PPE	Personal Protection Equipment
PPP	Participatory Public Participation
RECONDEV	Reconstruction Development Corporation
SWAMA	Solid Waste Management Authority
SWMS	Solid Waste Management Systems
SIA	Social Impact Assessment
SIB	Statistical Institute of Belize
S.I.	Statutory Instrument
SPM	Suspended Particulate Matter
ToR	Terms of Reference
TDS	Total dissolved solids
TS	Transfer Station
TD	Tropical Depression
UNCCD	United Nations Convention to Combat Desertification and Drought
UNFCCC	United Nations Framework Convention on Climate Change
USD	United States Dollar
USG	US gallons
WHO	World Health Organization

EXECUTIVE SUMMARY

CHAPTER 1: PROJECT DESCRIPTION

Introduction

Solid waste management is one of the key areas requiring special attention in Belize. In the past, the waste collected in all cities and towns around the country was discharged in open or partially controlled dumps. These facilities lacked technical and environmental controls and operated without adequate equipment or sufficient cover material. Therefore, in 1991, the Belize Solid Waste Management Authority (SWAMA) was established through the enactment of the Solid Waste Management Authority Act.

SWAMA´s Mission is to establish a sustainable Solid Waste Management Systems (SWMS) to ensure that solid waste generated in the country is managed in an environmentally sound manner which meets the needs of all citizens including the poor.

To this end in 1997, an agreement for a Technical Assistance Project funded by the Japanese Government was signed between the Government of Belize (GOB) and the Inter-American Development Bank (IADB) for the preparation of a National Solid Waste Management Plan (NSWMP). The plan called for the Western Corridor Project to be implemented. Currently the Therefore, in order to accomplish this and others, the Government of Belize has requested the Inter-American Development Bank to prepare a loan proposal for the "Solid Waste Management Project II" (BL-L1021), for SWaMA to continue the implementation of improvements associated to solid waste management in Belize, improvements that were initiated as part of the Solid Waste Management Project (BL-L1006). It is currently discussed that the program BL-L1021 will be comprised of four components as outlined below:

- Component 1: Investments related to construction of transfer stations, recycling and composting and closure of open dumpsites. This component may include equipment for managing medical waste, and other waste specific streams.
- Component 2: Institutional strengthening support to ensure cost recovery mechanisms, medical waste and other specific streams characterization study, social communication strategy, and training and capacity building for recyclers
- Component 3: Project Execution Unit: office and administration expenses.
- Component 4: Monitoring and Evaluation, including financial audit and midterm and final evaluation
-

This Environmental Assessment (EA) focuses on the development of an Environmental Management Plan (EMP) for the closing of Belmopan Dumpsite and the Construction of a Transfer Station. The Belmopan transfer station has been designed to handle all the wastes from Capital City of Belmopan and environs, including Mahogany Heights. The latter is due to a contractual agreement with the Belmopan city Council.

Description of the Dump Site

The Belmopan Dump Site in the last 20 years has moved its location at least three times. Before the dump site was moved to its current location, it was located approximately one mile out of Belmopan on the right hand side (when traveling south on the Hummingbird Highway). This site was abandoned six years ago due to its inability to accommodate anymore waste. In addition, the

site presented challenges in its management due to the impacts of air emissions resulting from the burning of garbage and its close proximity to the city. Presently this area is being rehabilitated naturally.

The Belmopan Dump Site opened some 6 years ago is located some 4.5 miles south on the Hummingbird Highway from Belmopan. The 10.26 acres dumpsite forms part of a 50 acre parcel owned by RECONDEV. RECONDEV has subsequently transferred ownership of this 10.26 acres of land to SWAMA. The approach coming from Belmopan is just after a gentle curve and short climb while the approach coming from Dangriga the highway is somewhat level. Although, there is a security booth at the entrance of the dump site and two City Council security personnel stationed during normal working hours the area is not secured except for make shift entrance barrier to prevent easy access by vehicle after working hours

The Belmopan Dump Site is operated from Monday to Friday during the working hours of 8 am to 5 pm and has two city council employees serving as dump site security. A small cement block building situated at the entrance of the site serves as security hut. There is no security fence with gate or a permanent road barrier to prevent ingress and egress to the site. Make shift barriers are placed on the entrance of the road to prevent easy access to the site during closed periods. Burning of garbage is a tool employed in this dump to decrees the volume of waste.

CHAPTER 2: SOCIO-ECONOMIC BACKGROUND AND ROAD SAFETY

Introduction

The road network that will be used by the proposed Belmopan Transfer Station comprises of that section of highway from Miles 5 on the Hummingbird Highway to the junction with the George Price Highway and from the junction of the George Price Highway to Mile 24 where the Central Sanitary Land fill is situated. Invariably, road traffic will increase in these sections of both highways, especially by tractor trailers, as they haul waste from the proposed transfer station to the Central Sanitary Landfill

The Hummingbird Highway is the third major highway in Belize. It is 53.7 miles long and connects the George Price Highway outside of Belmopan, Cayo District to the Southern Highway outside of Dangriga, Stann Creek District. It partially follows, and sometimes uses the infrastructure of, the former Stann Creek Railway used from 1913 until 1937. In 1994 this highway was completely paved. All the citrus produced in Belize travels along this highway to the two major processing plants in Pomona, Stann Creek District. There are quite a few small villages along the highway.

The traffic along the Hummingbird Highway has been on the increase lately due to an increase in demand for eco-tourism and the passage of petroleum trucks to Big Creek, a deep water port for export. The Hummingbird Highway is the only Highway in Belize which cuts through the mountains of Belize and which rests in a valley that comprises citrus orchards in the lowland and untouched jungle habitat on the outskirts and beyond.

The George Price Highway (GPH) is critically important to the country's social and economic fabric, as it links three western towns (San Ignacio, Santa Elena and Benque Viejo del Carmen) and surrounding villages to the administrative capital in Belmopan and to the country's commercial center in Belize City. The areas serviced by this highway are critical to the country's

agricultural sector in the West where some of the country's most important agricultural lands, farms, businesses and industries are located. It also services the economically important tourism sector in the West, boasting many inland tourism resorts and some of the more prominent archaeological sites. Of equal importance is the fact that this highway is a part of the Pan American Highway.

Belize Road Safety

Belize roads and highways have continually experienced a high incidence of fatal traffic accidents. According to the World Health Organization's Global Status Report on Road Safety (2009), Belize recorded 68 road deaths in 2006, equivalent to approximately 31.1 traffic deaths per 100,000 inhabitants and the highest fatality rate of the Caribbean Development Bank's borrowing member countries for which data was available. In 2009, Belize experienced approximately 70 road deaths per year (WHO 2009). This equated to a rate of 23.6 deaths per 100,000 inhabitants. According to a 2012 Road Safety National Capacity Report conducted by the International Road Assessment Programme (iRAP), within the Latin American and Caribbean Countries, Belize has the highest death rate from traffic accidents per 100,000 inhabitants.

In 2012, there were a total of 718 traffic accidents in which 649 persons were injured and 69 were killed. Of those killed, 19 were pedestrians, 12 were passengers, 22 were cyclists and 16 were drivers. In 2013, 51 fatal traffic accidents were reported.

In 2011, there were 6 fatal traffic accidents reported within the George Price Highway (Belize to Belmopan Junction- between miles 2 to 44) and the Hummingbird Highway (Belmopan to Dangriga- between miles 28- 55). This indicates that 10% of all traffic fatalities in Belize occurred within the highways where the proposed Belmopan Dumpsite and the National Sanitary Landfill at Mile 23 lie. In 2012, traffic fatalities in that same area were 11 within the George Price Highway (Belize to Belmopan Junction- between miles 2 to 54) and the Hummingbird Highway (Belmopan to Dangriga- between miles 23- 43). These traffic fatalities represent 16% of the total throughout the country. However, none of the accidents occurred on or near the proposed Belmopan Dumpsite nor the Central Sanitary Landfill at mile 24, notwithstanding this, one fatal accident occurred in 2011 and 6 in 2012 occurred between these two sites.

The Belmopan Transfer Station has in its plan the design and construction of deceleration lanes, adjacent to the highway, fully surfaced with adequate road sign and markings. It is therefore recommended that GOB, through its road safety project consider for immediate upgrade similar to that of the "demonstration corridor" that section of the Hummingbird Highway- 5 miles to the proposed transfer station to compliment the Belmopan Transfer Station road upgrade. This will greatly enhance the safety of the increased traffic flow from the proposed transfer station.

Waste Generated and Disposal

In its 2011 Projected Annual Waste Generation Rates (tonnes), SENES Consultants Ltd projected for Belmopan City and nine surrounding communities, with a total population of 20,369 (Estimated 2010 Census), a total of 8,487 tonnes waste generated annually. The projected 2015 waste generated was reported as 9,355 tonnes almost a 1000 tonnes increase and a projected 2020 waste generated annually of 11,005 tonnes, a total increase of 2,500 tonnes from 2012 totals.

The proposed transfer site will service the City of Belmopan, and due to a previous contractual arrangement the community of Mahogany Heights, 21 miles from the proposed transfer station. It is estimated that the station will be receiving by 2020, 618 tonnes of waste on a monthly bases.

Population Affected

In addition to the estimated 14,000 population of the Belmopan City proper and surrounding communities that will be positively affected, the City of Belmopan Administration is expected to have cost savings as finances once air marked for an ad-hoc open-dump site management will now be streamlined for a well administered waste transfer station. In addition, this new operation will invariably have a positive impact on city waste collection services as the City administration will have more time to dedicate to this process.

Waste pickers, mentioned in Chapter 1, will be the most positively affected with the proposed transfer station. Their working condition will be dramatically improved. These pickers, about 17 in total, of which seven (7) are women, use the dump site to retrieve recyclable items. Interviews revealed that this group is constant and have been doing this type of activity for many years. They are all of Hispanic descent from El Salvador, now naturalized Belizeans, with Belizean born children living in Salvapan or San Martin communities of Belmopan. The group was not properly.

It is envisioned that with the operation of the transfer station occupational health and safety of the waste pickers will improve for they will now be working under a designated roofed area and be required to wear personal protective equipment.

Presently the dumpsite has no running potable water for either drinking or for washing. A couple of waste pickers were seen eating their lunch in a make shift shaded area. One can only assume that they used bottled water from home to wash off before engaging in this activity. It is foreseen that with the new transfer station they will have access to potable water for this purpose.

Ergonomic hazards such as heavy lifting and repetitive motion, and back and lower extremity pain can be arrested through an occupational health and safety (OHS) educational programme. Although the waste pickers acknowledged getting cuts and bruises, they admitted of "hardly falling sick". Therefore, through a properly managed transfer station, waste pickers can be monitored and encouraged to access the National Health Service for routine health checkups.

Finally, although waste pickers may suffer from social stigmatization they do play a role in the general economy of Belize as they provide recyclable materials to formal enterprises, private individuals and the general public and in so doing put in their ounce of contribution towards the protection of the environment.

CHAPTER 3: POLICY AND LEGAL FRAMEWORK

In ensuring that the closure of the Belmopan dumpsite and the construction of a Solid Waste Transfer Station is undertaken within the legal and regulatory framework in Belize, there are several national legislations and accompanying regulations which the SWAMA and its contractors must adhere to. There are national advisory policy documents which must be considered as well to ensure that the activities of the proposed project are aligned with GOB's national sustainable

development goals. Furthermore, there are several important operational policies of the IDB that must be taken into account as well as a few Multilateral Environmental Agreements.

CHAPTER 4: ENVIRONMENTAL SETTINGS

This chapter provides the baseline information of the Study Area and includes additional background environmental information collected by the ESA team and from several site assessments of the project area and its immediate surroundings. It also included the gathering of relevant baseline data on air quality, and noise.

The information is presented in this section is presented by providing a general background of the Study Area having a radius of five miles from the facility and then narrowing the information to the project site.

Geology

In general, the study area is predominantly underlain by consolidated marls and limestones. These marls and limestones form a gently undulating topography and tend to be typically massive with little to no variation in composition.

The hillocks near the study area, are primarily limestone outcrops that show bedded crystalline micritic limestones that are tan to white in color, relatively hard and consolidated material with some marl and clay inclusions. This is readily visible from the cutting made of the adjacent hill at the base of the entrance to the site as well as a nearby hill where marl material is currently being extracted. The clay deposits vary in thickness with this to be confirmed for specific project site.

Topography and Drainage Patterns

Furley and Newey (1979) described the study area as having well developed conical hills and depressions to more open topography exhibiting greater erosion and an overall reduction in relief. The actual project site forms part of a gently elevated sloped parcel of land bordered by a few hillocks on the north west border of the property. The land gently slopes to the north west of the property as can be readily seen by the storm water flow which drains toward the highway and eventually into a creek at the base of the hill on that section of the highway where the property lies. The south and east sides of the property are bordered by mainly undulating flat land which has been converted for agricultural crops. Within this undulating terrain are numerous gullies and ravines that provide a system of natural drainage to the area.

Land Use

The land use of the project site shows that a considerable portion of the nearby area is used for agriculture on both sides of the Humming Highway. The actual ten acre project site is bordered on the east and south by plots that have been cleared for rotational crop agriculture and a few small plots for plantains and bananas. The area to the north has some rounded hillocks with these areas having greater forest cover. The forests in the area appear to be in their early stages of succession.

The study area lies within the Roaring Creek sub-catchment area of the greater Belize River Basin. The land use in the in this sub-catchment is presented in summary form, highlighting five

main land use categories of the area. The urban areas in the vicinity of the project includes Belmopan and its environs and the village of Armenia.

Soils of Project Area

In 1979, Furley and Newey conducted studies of two transect that passed very near the project site to study the vegetation of the area and its relationship with the geology of the area. The information in this section has been gleaned from that report supported by BET's site surveys. The soils of the project area are shallow, rock outcrops are common and the sites are very freely drained. The areas are also much more exposed to wind, increasing evapotranspiration. The effects of the dry season are thus accentuated in these areas.

The soils are nearly all developed over limestones giving rise to rendzina and vertisol profiles of varying colour and drainage, They are referred to as fine textured, pellic vertisols in the FAO classification (FAO, 1975). There are also additions to the limestone parent materials from the alluvium derived from the granite, phyllite and sandstone rocks of the Maya Mountains to the south. There are further predominantly alluvial soils (Melinda suite) related to the present Belize river and its tributaries, such as Roaring Creek

Hydrology of the Project Area

The project area lies within the Roaring Creek sub-catchment of the Greater Belize River Basin area. The Belize River, the largest within the Belizean territory, originates in the western Maya Mountains and eastern Guatemala. Several major tributaries complement the combined Mopan and Macal contribution, thus maintaining high stages for long periods. Major complementary tributaries include the Iguana Creek**, Roaring Creek,** and Labouring Creek.

Total area of the GBRB covers about 10,500 km^2. Almost a third of the watershed (3,300 km^2) lies within Guatemala and a little over two-thirds (7,200 km^2) is in Belize. The Barton Creek and Roaring Creek drain the northern karst foothill of the Maya Mountain.

The drainage area of the Roaring Creek is 323.2 km^2. Flow discharge measurements at the Barton Creek Bridge in June 2014 was 0.93 m^3/s, which was relatively low for June, but reflected the below-normal rainfall in the area for the month of June 2014.

Groundwater

Groundwater is product of the rainfall regime and the geology of the landscape. Belize's geology is predominantly limestone, with the notable exception of the Maya Mountains that is composed of igneous, metamorphic, and sedimentary rocks. The project site lies within the Campur Ground Water Province.

The Campur Province coincides with the outcrop of the Campur limestone north of the Maya Mountains extending eastward toward Belmopan and the coast and northward to the boundary of the Coastal Plains and Shelf Province. Aquifers in this Province are recharged from direct infiltration and runoff from the Maya Mountains. Wells in the inland semi-confined aquifers penetrate to depths up to 150 metres with static levels rising to 26 metres below the surface. There were no groundwater wells located near and adjacent to the project area. All nearby communities inclusive of Belmopan obtained their source of domestic water from surface waters (Rivers and Streams). There is greater likelihood to tap a subterranean stream than tapping an

aquifer within the project area. Anecdotal information, however, indicates that there is a probability of tapping water at depths of 120 to 150 feet below ground.

Other information

Baseline information is also provided on climate giving special emphasis on rainfall and hurricanes in the area and the projected effects of climate change on these. In addition to this a brief description of the flora and fauna of the project area is provided.

CHAPTER 5: ASSESSMENT OF ALTERNATIVES

As part of the ESA requirement, there is the need to assess alternatives associated with the planning and implementation of the project and its associated activities.

The evaluation of alternatives may encompass a wide range of economic, social, and environmental considerations associated with the various available options. This section focuses on the evaluation of alternatives to the overall proposed development, inclusive of the 'No Action Alternative'. It focuses on the options that are most practical for the proposed Project Area.

Preliminary baseline information indicates that the major issues associated with the closure of the Belmopan dump site and its conversion to a transfer station are those primarily associated with the:

1. location of the facility;
2. closure and restoration of the dump site;
3. improvements to access road because of the danger it poses to motorists and the;
4. provision of utilities (water, electricity and telephone).

The assessment of alternatives focused on these key areas of concern and presented a discussion on at least three to four options. At the end of each discussion the preferred option is identified.

CHAPTER 6: ENVIRONMENTAL AND SOCIAL IMPACTS

Introduction

This Chapter of the ESA presents the assessment of the potential environmental and social impacts associated with the proposed closure of the Belmopan Waste Disposal Site and the construction of a Waste Transfer Station. As with most solid waste infrastructure project, the overarching goal is to improve the lives of the resident population, specifically those of the study area. Hence, despite one of the major objectives of the project is the improvement of solid waste management with its intended net positive environmental and social impacts it is important that special consideration be given to several potential environmental and social issues in the planning and implementation of the project. In addition, it is important that where negative impacts are identified that these be mitigated and that a proper monitoring plan be developed to monitor the effectiveness of these measures and the extent of both the negative and positive impacts of the project.

For each relevant environmental and social parameter, the potential impacts are discussed. The evaluation of potential environmental and social effects during the ESA aims to be as accurate and objective as possible, whilst providing as much detail as is available according to the proposed design. Many of the potential impacts have also been taken into account in the preparation of the preliminary designs described in Chapter One. The proposed mitigation

measures for addressing potentially adverse environmental and social impacts effects are also presented in this chapter as the impacts are discussed.

The evaluation of environmental and related socio-economic impacts related to the closure of the Belmopan Waste Disposal Site and the construction of transfer station has been prepared through the examination of individual environmental components that are potentially affected by the proposed activities.

Summary Potential Environmental Impacts

The environmental issues looked at included to be considered are as presented below:

- Air Quality/ Odour
- Water quality (Surface and Ground)
- Soils and Terrain
- Vegetation and Wildlife
- Current Land Uses
- Traffic
- Climate change and Disaster Preparedness
- Social Impacts

While the proposed closure of the dump and the construction of a transfer station is projected to have significant positive social and economic benefits it has the potential to affect the surrounding air and water quality; exacerbate soil erosion, and the hydrology and drainage of the area as well as nearby or adjacent ecosystems within the project area during the construction phase.

As can be seen from the matrices most of this negative impacts are predicted as either minimal to medium, are very localized and of short duration. In the instance of the positive impacts associated with the post closure of the dump and the operations of the transfer station, the opposite results are obtained. Here the impacts are major of long duration and significant. The activity with the highest negative potential negatively impact was that associated with the deceleration lanes. The impacts associated with the closure and rehabilitation of the dump and the construction of the Transfer Facility were rated to have similar levels of impacts, Despite this most of these impacts identified are readily mitigated though the implementation of best practices.

Social Impacts and Mitigation Measures

The social impact assessment is designed to ensure that the Project's potential impacts on individuals and groups of people are understood, so that positive impacts can be enhanced by project design while negative ones are mitigated, without compromising the economic efficiency of the project and its benefits.

For the Social Impact Assessment, an impact indicator is defined as any human/ social/environment indicator considered important or valuable and thus meriting consideration in the SIA process.

The methodology used to assess impact significance differs from that for environmental impacts in that the 'human environment' comprises social, health, cultural, demographic and economic aspects and it is not possible to categorize the 'sensitivity' of social valued receptors to different impacts simply as 'low', 'medium' or 'high'. This is because the 'sensitivity' of social

parameters relates to a complex mix of the vulnerability of different groups and individuals to Project impacts and to their perception of potential impacts. This is important because public perception of potential impacts is a key factor in relation to social risk, i.e. even if there is no clearly apparent scientific basis for a perceived impact, it still may contribute to social risk if people believe a project activity may have a negative or positive impact.

Social Impact Assessment

Social impacts may be caused by different Project activities and may be direct, indirect or cumulative in nature. As noted above, due to the fact that it is not possible to definitively measure and classify social impacts the way it is done for environmental impacts, the evaluation of the significance of social impacts has some differences to that used to classify environmental impacts.

In contrast, the social impact evaluation used the following three basic criteria for assessing the significance of an impact:

- Magnitude: The importance of the impact for people's quality of life, health, livelihoods and social relations;
- Spatial extent: Also known as the impact area of influence which is the population and/ or geographical area over which the impact is experienced;
- Duration: The length of time or level of permanence over which the impact will be experienced.

Health Impacts Resulting from Pollution

The key health problems identified from the literature review conducted in the baseline study relate primarily to those associated with vector diseases and to some degree respiratory health (dry cough, difficult breathing, chest wheezing/asthma) and thus the valued receptors most at risk from negative impacts are those already vulnerable to respiratory problems e.g. school children, asthmatic children/adults, smokers and the elderly. From the present operations of the dump it is clear that there is a high probability that present operations are contributing to air pollution and thus causing further health risks.

During the operational phase asthmatic children could be negatively impacted by increase in dust. Pollution (quality of life associated with environment conditions) is the major respiratory health risk factor raised by the local communities. The impacts of the Project on pollution related health problems are assessed as negative during construction, especially for those with existing respiratory problems, children and women who spend most of the day at home. The impacts during the operational phase are considered to be significantly positive because of the reduced burning, dust and chemical emissions.

During the construction phase, best management practices will be implemented to ensure excavation and construction activities minimize dust and noise-related pollution for the workforce and neighbouring communities.

Injury and Accidental Health Damage Impacts and Mitigation

Project activities, in particular construction activities, could expose workers to the risk of accidents. Transport vehicles and traffic in the area could expose both workers and residents to the risk of traffic accidents. There is a risk of small scale but potentially frequent traffic and

construction accidents and less frequent but potentially larger scale operations accidents both of which could impact on the health and safety of workers and local communities.
Risk of accidents from construction and operations is rated as moderately high, in particular risk of accidents from increased traffic.
While a major incident may be improbable, the project could benefit by the development and implementation of an Accident Preparedness Plan. To mitigate these issue traffic control measures to limit the risk of construction, operational and transport accidents which could endanger the health of community members will be put in place.

Worker Health and Safety and Mitigation Measures

Construction and operational activities could expose workers to health and safety risks. In particular, the following activities could have negative health impacts: noise and dust from demolitions and excavations (stress, ear and eye problems); working with heavy equipment (strains and accidents); heavy lifting, and working under noisy conditions (hearing and stress/psychological impacts). Excavations and transportation of materials may cause further health and safety negative impacts. Occupational health and emergency health services for the construction labour force will be at risk of negative health impacts which cannot be quantified, until clear plans emerge.

The need for an on-going, proactive workers health and safety plan applies for the full life cycle of the project. Contractors should be required to have an operational/fully functional Health and Safety plan and health training for workers since the risks of worker health and safety are high.

Social Risk Context

Despite the mitigation measures being put in place to reduce negative impacts and enhance positive impacts, the Project potentially faces social risks due to the national and local context in which it will be operating. To complete the impact risk assessment, the social risk context, over which the Project has little or no control, is presented below.

Past Relationship between Government and some community members reveals a level of mistrust that many local residents have for central governments and to a lesser extent the local governments in the Study Area. These are based on a perception that promises by governments in the past have not been honoured and that local people are generally not the beneficiaries of employment opportunities generated by these development projects. Responding to this mistrust requires on-going engagement, transparency and effective implementation of agreed social and environmental management measures; to this end, the risk could be reduced to medium/low.

CHAPTER 7: ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

Environmental Management Plan

This section of the ESA Report provides a summary of the assessment of the potential environmental impacts the project could have on the environmental and social setting of the study area. In most cases, it is possible to reduce potential adverse impacts to the point where the impacts are insignificant or negligible, either through effective design, the use of green technologies and best practices or through sound operational management of the proposed project and its accompanying activities.

The key in any successful mitigation measure is to adequately identify the potential negative impacts and their implications and to develop a supporting environmental management plan. As with all management functions, effective management tools and best practices based on a process of constant improvements is what is required. The implementation of environmental management standards, best practice, and the use of established protocols is important in helping to reduce environmental impacts as measured by some objective criteria. Thus the environmental management plan proposed for this project and supporting activities involves the close integration of the following:

1. ***Environmental Impact Mitigation Plan*** – Impact mitigation is the most critical component of the environmental study process. It aims to prevent adverse impacts from occurring and keeps those that do occur within an acceptable level.
2. ***Environmental Monitoring*** – Environmental monitoring provides information that can be used for documentation of the impacts that result from the construction and operational activities. This information enables more-accurate prediction of the associated impacts and the necessary feed- back mechanism essential in adjusting the EMP. Therefore, the monitoring system is a platform of measuring projected impacts and also in identifying unanticipated adverse impacts or sudden changes in impact trends essential in the implementation of an environmental management program based on the concept of constant improvement.

Monitoring Cost

The monitoring will incur a cost to the project and therefore a budget allocation will be required. Environmental monitoring of the road rehabilitation will be done by assigned qualified personnel and with the assistance from the Department of the Environment. The project intends to attach a technician from the Department of the Environment to the project so he/she can be a part of the monitoring team. This capacity building measure should benefit the Department's role in identify the impacts, institute mitigation measures and devise a monitoring plan to verify its effects and make corrective actions. The costs presented are all indicative and will be refined at the start of the construction contract.

General Reporting Requirements

In the general context of the monitoring plan, there must be established target goals and objectives in terms of monitoring the anticipated impacts. The results of these plans must be reported to the DOE as part of their requirement. Likewise, any adverse or potentially adverse impact must be reported immediately to the DOE and SWAMA as well as other regulatory agencies. A template is provided that could be used by the Contractor, SWAMA or DOE Officer assigned to the project to monitor compliance with the ECP and ESMP.

Social Management Plan

The Social Management Plan (SMP) describes the overall management and monitoring of these mitigation measures. It specifies the responsibilities, timings, institutional structures, human resources and estimated annual costs required to effectively implement the plan. Since many of the social issues of concern were primarily linked to health related issues associated with pollution and occupational and traffic safety issues these issues are not included as part of the recommended plan since they area essentially the same as those required to mitigate the environmental impacts.

The aim is to ensure that the social and economic environment, for workers, waste pickers and other stakeholders not to suffer adverse impacts during the development and life cycle of the Project.

Social Impact and Risk Management

Social risk will be managed through mitigation and a Participatory Public Participation Process, inclusive of a the maintenance of a complaints register, and the developing good relationship with stakeholders during project implementation;
It is recommended that the project maintain a complaints register on site and that this register be reviewed weekly by management of the project to ensure that complaints are promptly responded to.

Community and Worker Welfare, Safety and Health Requirements

- Work during daylight not exceeding 12 hrs.
- Ensure workers from local communities are hired with minimum of 30% quota for women;
- Inform communities of construction activities.
- Ensure that the contractor responds appropriately to complaints from communities.
- Improve road safety, especially at point of access to site.
- Maintain and regularly check tools fitted with mufflers where appropriate.
- Provide training to waste pickers on the occupational health and safety issue associated with their livelihood.
- Ensure workers and waste pickers wear Personnel Protective Equipment.
- Provide proper sanitation facilities at workers camps.
- Ensure fire and medical response for the campsites.

PPP Activities

The Participatory Public Participation Process (PPP) presents an opportunity for stakeholder engagement. The consultation process plays an essential role in reducing social risk by building relationships with stakeholders in particular the waste pickers that make their livelihood from the current dump. In consideration of this the consultants met at least on three occasions to inform of the proposed project and the potential benefits which the project will have on their working conditions through the improvements of the sanitary facilities and working under a roof. However, they were also informed of the fact that they would be required to work under rules and conditions that will not allow children below the age of 14 years to work within the facility, the need for them to wear PPE and to maintain order and respect for each other. They were shown pictures of the Belize City Transfer Station and explained how the waste sorting takes place and what could be expected of them. They all seemed very supportive. A consultation with them on the completion of this report was promised to them.

Management Mechanisms and Organizational Capacity

The implementation of the SMP is the direct responsibility of the SWAMA while he contractor will be required to apply international standard quality assurance procedures and management system and to comply with the environmental management plan.

It is recommended that SWAMA hire the support of sanitary engineer (to be contracted and housed in the SWAMA offices) who will report to the Director in the implementation of the project. It is recommended that DOE also identify a compliance enforcement officer to be partially assigned to the project during its implementation phase to monitor compliance of contractor with the Spend to provide basic training to waste pickers

CHAPTER 1: PROJECT DESCRIPTION

1.1 Introduction

Solid waste management is one of the key areas requiring special attention in Belize. In the past, the waste collected in all cities and towns around the country was discharged in open or partially controlled dumps. These facilities lacked technical and environmental controls and operated without adequate equipment or sufficient cover material. Therefore, in 1991, the Belize Solid Waste Management Authority (SWAMA) was established through the enactment of the Solid Waste Management Authority Act, 1991, Chapter 224 of the laws of Belize (now Revised Edition 2000).

SWAMA´s Mission is to establish a sustainable Solid Waste Management Systems (SWMS) to ensure that solid waste generated in the country is managed in an environmentally sound manner which meets the needs of all citizens including the poor. Furthermore, in 1996, the Department of Environment identified solid waste management as one of Belize's most pressing environmental/health concerns and prioritized it in its plan of action. To this end in 1997, an agreement for a Technical Assistance Project funded by the Japanese Government was signed between the Government of Belize (GOB) and the Inter-American Development Bank (IADB) for the preparation of a National Solid Waste Management Plan (NSWMP). The plan called for the Western Corridor Project to be implemented.

The project also had as its objective to support the GOB in its efforts to improve solid waste management practices, reduce environmental pollution and enhance the image of Belize in the eco-tourism market through better management of its municipal solid wastes. The project planned to address primarily the solid waste management needs along the western corridor (Belize City, Belmopan, San Ignacio and Santa Elena, and key islands such as San Pedro and Caye Caulker), and to also strengthen the central government's capacities to improve solid waste management.

The Western Corridor Project is composed of three phases namely:
Phase 1: Structuring of Implementation Conditions
Phase 2: Implementation of the Western Corridor Project

Phase 3: Management of the Solid Waste Management Program

Phase 1 was completed by 2012 and in that same year the execution of Phase 2 commenced and by 2013, the Belize City Transfer Station, San Ignacio/Santa Elena Transfer Station and Regional Sanitary Landfill were all completed, inaugurated and put to into operation. San Pedro, Ambergris Caye and Caye Caulker Transfer Stations just recently came into operation.

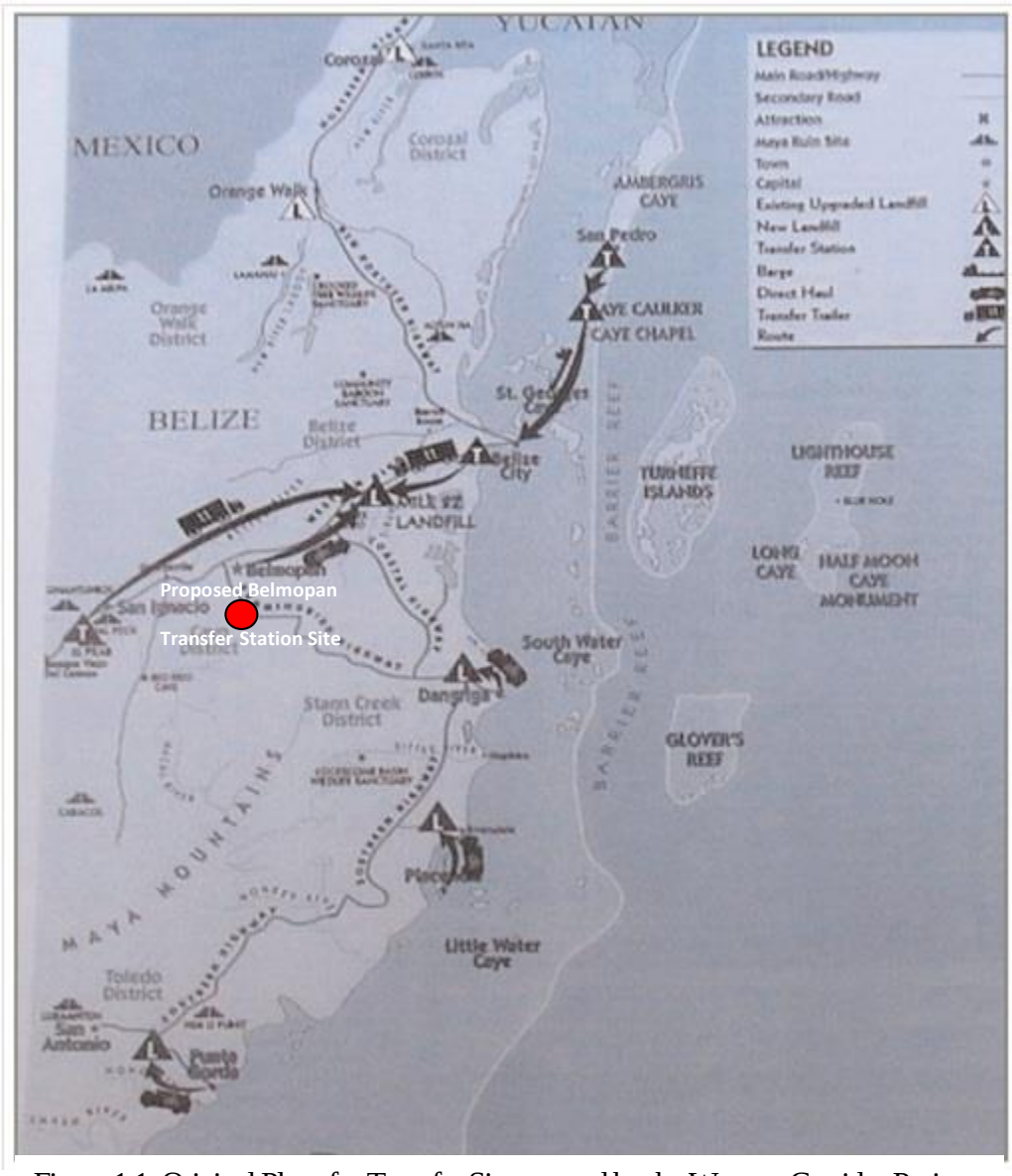

Figure 1.1: Original Plans for Transfer Site covered by the Western Corridor Project
Source: National Solid Waste Management Project, Stantec 1999

Although the project was to address primarily the solid waste management needs along the western corridor including the Capital City of Belmopan, the original plan (see Figure 1.1) did not call for a Transfer Station to be built for Belmopan as City Management perceived that such endeavour would not be financially feasible for such small city population at the time the study for the project was conducted. However, with the lessons learnt from the operations of the Belize City and San Ignacio/Santa Elena Transfer Stations, the there was an adjustment to the national plan and in an updated solid waste plan, Belmopan was included

Therefore, in order to accomplish this and others, the Government of Belize has requested the Inter-American Development Bank to prepare a loan proposal for the "Solid Waste Management Project II" (BL-L1021), for SWAMA to continue the implementation of improvements associated to solid waste management in Belize, improvements that were initiated as part of the Solid Waste Management Project (BL-L1006). It is currently discussed that the program BL-L1021 will be comprised of four components as outlined below.

- Component 1: Investments related to construction of transfer stations, recycling and composting and closure of open dumpsites. This component may include equipment for managing medical waste, and other waste specific streams.
- Component 2: Institutional strengthening support to ensure cost recovery mechanisms, medical waste and other specific streams characterization study, social communication strategy, and training and capacity building for recyclers
- Component 3: Project Execution Unit: office and administration expenses.
- Component 4: Monitoring and Evaluation, including financial audit and midterm and final evaluation

1.2 Consultancy

The IADB has engaged Ismael E. Fabro, Belize Environmental Technologies (BET) to prepare an Environmental Assessment (EA) / Environmental Management Plan (EMP) for the closing of Belmopan Dumpsite and the Construction of a Transfer Station. Appendix 1 provides copies of curriculum vitaes of the team. The Belmopan Transfer Station (BTS) has been designed to handle all the wastes from Capital City of Belmopan and environs, including Mahogany Heights. The latter is due to a contractual agreement with the Belmopan city Council.

1.2.1 Scope of Services

The scope of work for this consultancy is in general accordance with the Term of Reference (Appendix 2) provided by IADB. It includes the following:

(i) an analysis of the potential environmental risks and impacts of the Closing of the Belmopan Dumpsite and the Construction of a Transfer Station;

(ii) the development of the required environmental mitigation plan; and

(iii) The development of an environment monitoring plan.

The EA / EMP is intended address all phases of the project (construction, operation, closure).

1.3 Property Description And Access

1.3.1 General Location and Description

The 10.26 acre Belmopan Open Dump Site where the proposed Belmopan Transfer Station (BTS) will be built, is located within the 50 acres plot (owned by the RECONDEV) 5 miles south of Belmopan City on the Hummingbird Highway at UTM coordinates 312125.84 m E 1901247.65 m N (WGS84 -16Q) (see Figures 1.2 and 1.3). RECONDEV has subsequently transferred ownership of this 10.26 acres of land to SWAMA, (See Appendix I)

Figure 1.2: General Location of Project Area

Figure 1.3: Satellite Imagery showing the Project Area.

The area has an access via the Hummingbird Highway (Main Entrance) to the west and by foot path from San Martin (a residential area sea south of Belmopan) to the east through private agricultural land. The north perimeter is presently covered with vegetation and forms part of the rest of the 50 acres owned by RECONDEV. The south perimeter is delineated by a dirt road separating the dump site and a privately owned plot presently being used for agriculture.

1.3.2 Description of the Dump Site

The Belmopan Dump Site in the last 20 years has moved its location at least three times. Before the dump site was moved to its current location, it was located approximately one mile out of Belmopan on the right hand side (when traveling south on the Hummingbird Highway). This site

was abandoned six years ago due to its inability to accommodate anymore waste. In addition, the site presented challenges in its management due to the impacts of air emissions resulting from the burning of garbage and its close proximity to the city. Presently this area is being rehabilitated naturally (Figure 1.4).

The present Belmopan Dump Site opened some six years ago is located some 4.5 miles south on the Hummingbird Highway from Belmopan. The 10.26 acres dumpsite forms part of a 50 acre parcel owned by RECONDEV. The approach coming from Belmopan is just after a gentle curve and short climb while the approach coming from Dangriga the highway is somewhat level (Figure 1.5). Although, there is a security booth at the entrance of the dump site and two City Council security personnel stationed during normal working hours the area is not secured except for make shift entrance barrier to prevent easy access by vehicle after working hours.

Figure 1.4: Belmopan Old Dump Site

Figure 1.5 Belmopan Approach to Present Site

The site has four cells to the right of the road and a fifth larger cell at the end of the dump site. Immediately below the fifth cell to the left of the road is the sixth cell (See Figure 1.6).
The dump site is managed in such a way that when the area is dry the fifth larger cell is being used with the other smaller ones being used when the area is wet.

During the site visit cell number two was being used due to the wet condition of the dump site. Along the left hand side of the road, due to the wet areas, garbage was also being dump. Caribbean Tires was seen dumping a small trailer load of tires in this area, one of the two trailer loads of used non serviceable tires per week. However, dumping on this is not encouraged since the area is narrow and fills up to the road rapidly, therefore requiring frequent bulldozer push

back and/or burning. The dump site uses a bulldozer for 12 hours every five to six months to push back and compact the old garbage. Periodic burning of garbage is also used to manage the site.

Figure 1.6: Dump Site Entrance and Cells

As described in Chapter 4, the dumpsite has a gentle gradient from west to east from 138.3 meters at the entrance to 143.6 meters at the end at the fifth cell. As a result of this gradient it

was observed that the area drains from east to west to north following the natural contour of the area as illustrated in Figures 1.7.

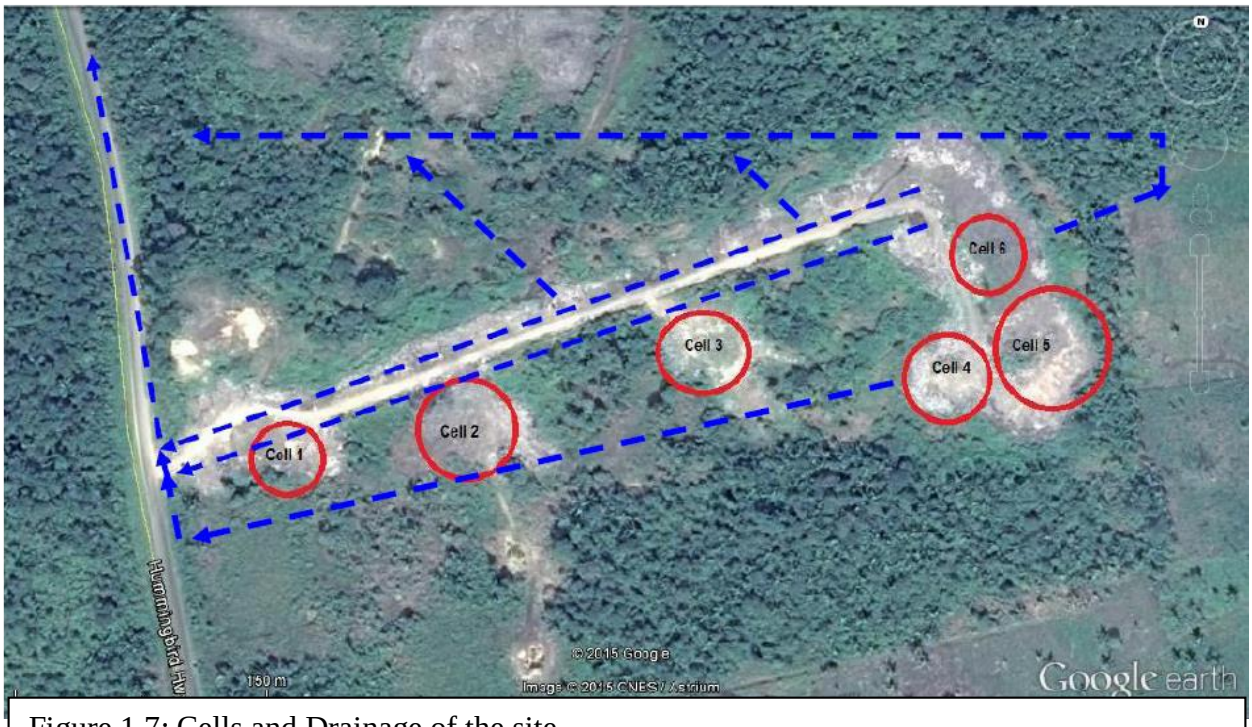

Figure 1.7: Cells and Drainage of the site

A creek to the north of the site serves as a catchment for the dump site drainage water. This creek then feeds into a bigger creek further north on the Hummingbird highway. During the site visits, the creek had a faster than normal flow but no garbage was observed floating in it. Garbage was seen on the road side drain (see Figure 1.8). Anecdotally, the Waste Pickers say that some floatable garbage is seen in the creek especially after a heavy torrential rain.

Figure 1.8: North Creek and Road Side Drain with Garbage

1.4 Operation of the Site

The Belmopan City Council operates the Belmopan Dumpsite as well as a small dumpsite located by the San Martin area used "exclusively for biodegradable material such as grass cuttings and tree trimmings".

The Belmopan Dump Site is operated from Monday to Friday during the working hours of 8 am to 5 pm and has two city council employees serving as dump site security. A small cement block building situated at the entrance of the site serves as security hut. There is no security fence with gate or a permanent road barrier to prevent ingress and egress to the site. Make shift barriers are placed at the entrance of the road to prevent easy access to the site during closed periods.

Garbage is collected as follows:

Days of Service	Collection Service Provided
Mondays	Residential
Tuesday	Commercial/Business Collection
Wednesday	Outer City -Salvapan, Maya Mopan, San Martin, La Flores and Rivera
Thursday	Residential
Friday	Commercial/Business Collection Also one trip from Mahogany Heights

In addition, from time to time, people from the village of Armenia which is about 3.5 miles from the site are allowed to dump their garbage at the site.

1.5 Waste Pickers

Waste picking has been practiced since antiquity, but modern traditions of waste picking took root during industrialization in the nineteenth century and in the developing world this was as a result of urbanization. According to the Solid Waste Management Glossary (Srinivas, 2015) a Waste Picker[1] is a person who picks out recyclables from mixed waste wherever it may be temporarily accessible or disposed of [to sell or for personal consumption]. In 2008, participants of The First World Conference of Waste Pickers chose to use the term "waste picker" for English usage to facilitate global communication. The term "scavenger" is also commonly used, but

[1] A waste picker is different from a waste collector because the waste collected by the latter may be destined for a landfill or dump site, not necessarily for a recycling facility.

many waste pickers find it demeaning due to the implied comparison with animals (Samson, 2008). In Belize, the common word used for waste pickers are “scavengers”.

The dump site receives city residential garbage every Monday and Thursday and this is the preferred days the waste pickers go to the dump site to conduct their honourable work. There are basically two families of waste pickers which comprise of about 17 persons in total, seven (7) of which are women. They use the dump site to retrieve recyclable items. A list with the personal contacts of waste pickers is with SWAMA. The items being recycled are pet bottles, copper, aluminum, iron and other items they deem useable. Persons interviewed said they have found gold chains and even an IPod in good working condition. Recently there has been a fall in price of these recycled items to the point that Bowen and Bowen who buys their products’ pet bottles stopped the purchase of its plastic bottles. However, the purchase of pet bottle by Bowen and Bowen has started once again.

Interviews revealed that some waste pickers have been doing this type of job all their lives and ages range from 44 years to 12 years. The elders are Salvadorans now naturalized Belizeans with Belizean born children. They either live in the Salvapan or San Martin communities of Belmopan. These waste pickers, although they realize the dangers of their activity, do not wear protective clothing for the exception of some who wear rubber boots.

Figure 1.9: Waste Pickers having a chat with Consultant

One of the elders commented that the monies gotten from the recycling of items is used to supplement their budget as they have a farm which is presently raising 40 pigs and monies are used to purchase feed, etc. Therefore, their main concern was that with the new transfer station being built, that they as the original waste pickers, do not lose this source of income and be granted permits to continue as waste pickers. In. addition, she was afraid that she may be preventing from obtaining the discarded old bread from the Bakery which she uses to feed her pigs. Presently they do not need a City council permit to operate in the dumpsite.

1.6 Proposed Transfer Station

Although the western corridor project did not envision the Capital City of Belmopan as a transfer zone, it was later incorporated into the plan to build a transfer station as the growing population of the City merited it. In addition, its inclusion increases the economic viability of the central sanitary landfill.

1.6.1 Basic Design Criteria

The preliminary drawings and specification done by Anthony Thurton and Associates (2014) shows and indicates the general design intent and outline certain minimum requirements for the project (Figures 1.9 –1.13). The selected Contractor shall be responsible to produce detailed Final Drawings and Supplementary Technical Specifications for all aspects of the works, complete with calculations for review and approval by the Design Build Engineer (DBE) and the Solid Waste Management Authority (SWAMA) prior to construction.

The Transfer Station and Administration buildings along with all components and claddings shall be designed to resist the effects of maximum winds from a Category three (3) Hurricane. All other facilities shall be designed to resist the effects of maximum winds from a Category one (1) Hurricane. The Transfer Station, Administration buildings and other structures shall be designed to meet all relevant aspects of the IBC (current version). The relevant codes shall include the National Electrical Code (NEC), the International Plumbing Code (IPC) and American Concrete Institute (ACI-318) with loadings based on ASCE-7. The Final Drawings and Supplementary Specifications shall include detailed testing requirements in full accordance with the relevant codes listed above, at a minimum. The Contractor shall perform all quality control tests as prescribed by the relevant codes and industry norms at a minimum. Tests shall be in full accordance with the testing frequency and other requirements of the relevant codes. All tests shall be performed by an established independent testing firm and copies of the results shall be sent from the firm directly to the DBE and SWAMA within two (2) days of the execution, unless otherwise shown. All tests shall be sequentially numbered and referenced with respect to date, location, design targets and components being tested. The Contractor shall provide written notice to the DBE and SWAMA of intent to cover up works no less than 36 hours before cover up. The Contractor shall obtain written no-objection to cover up from the DBE or SWAMA before doing so for all relevant aspects of the works.

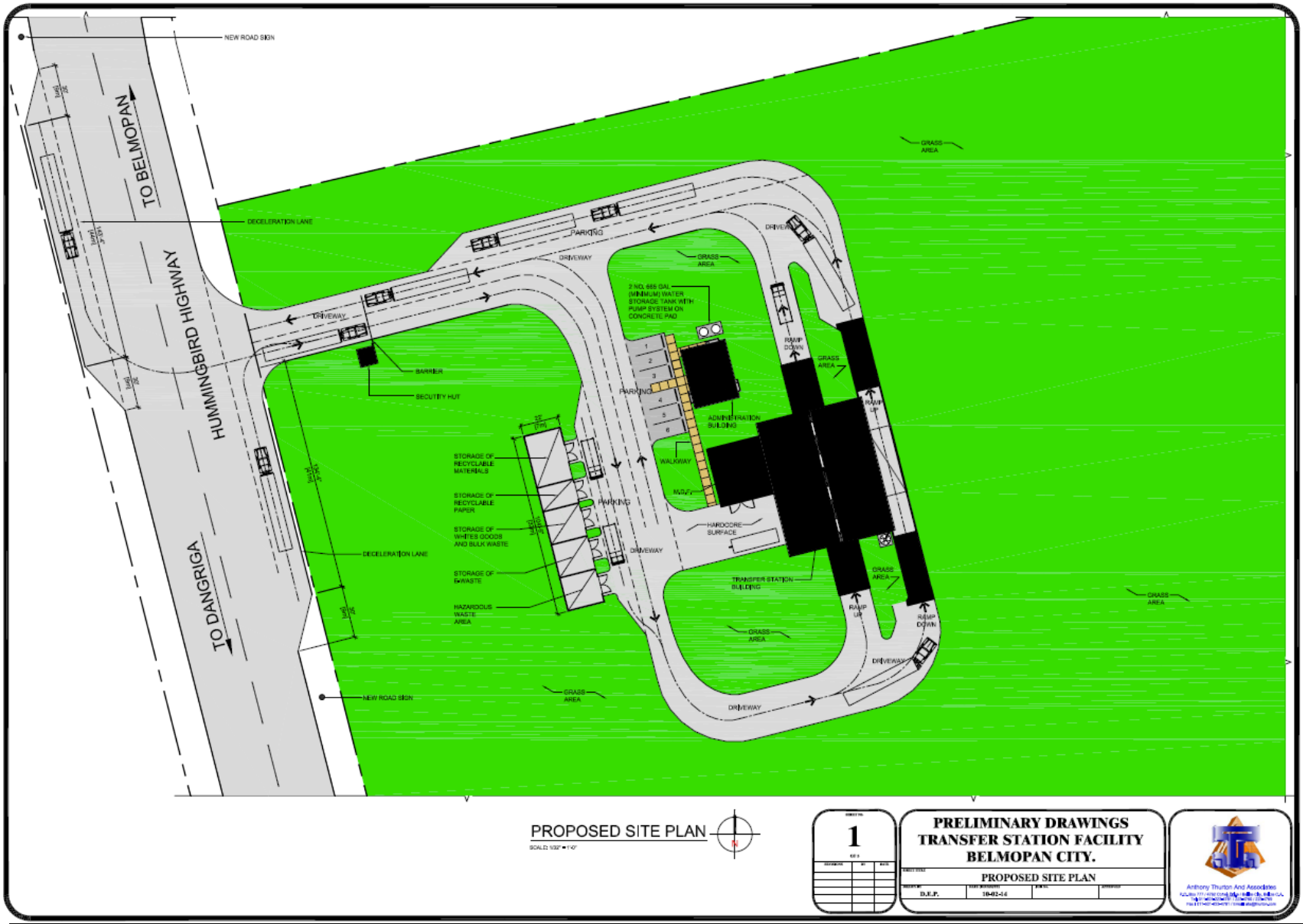

Figure 1.9: Proposed Belmopan Transfer Station Site Plan

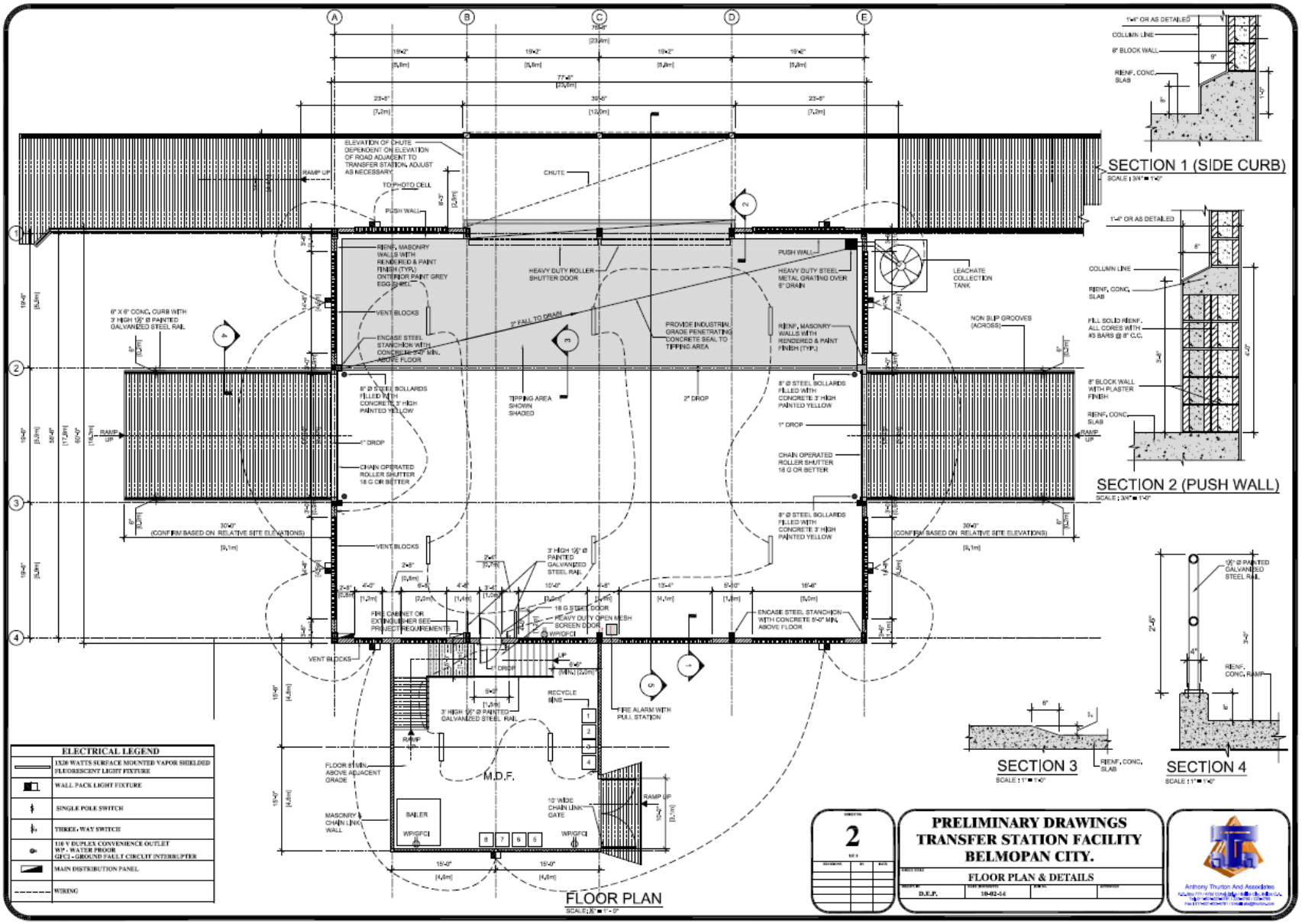

Figure 1.10: Proposed Belmopan Transfer Station Floor Plan

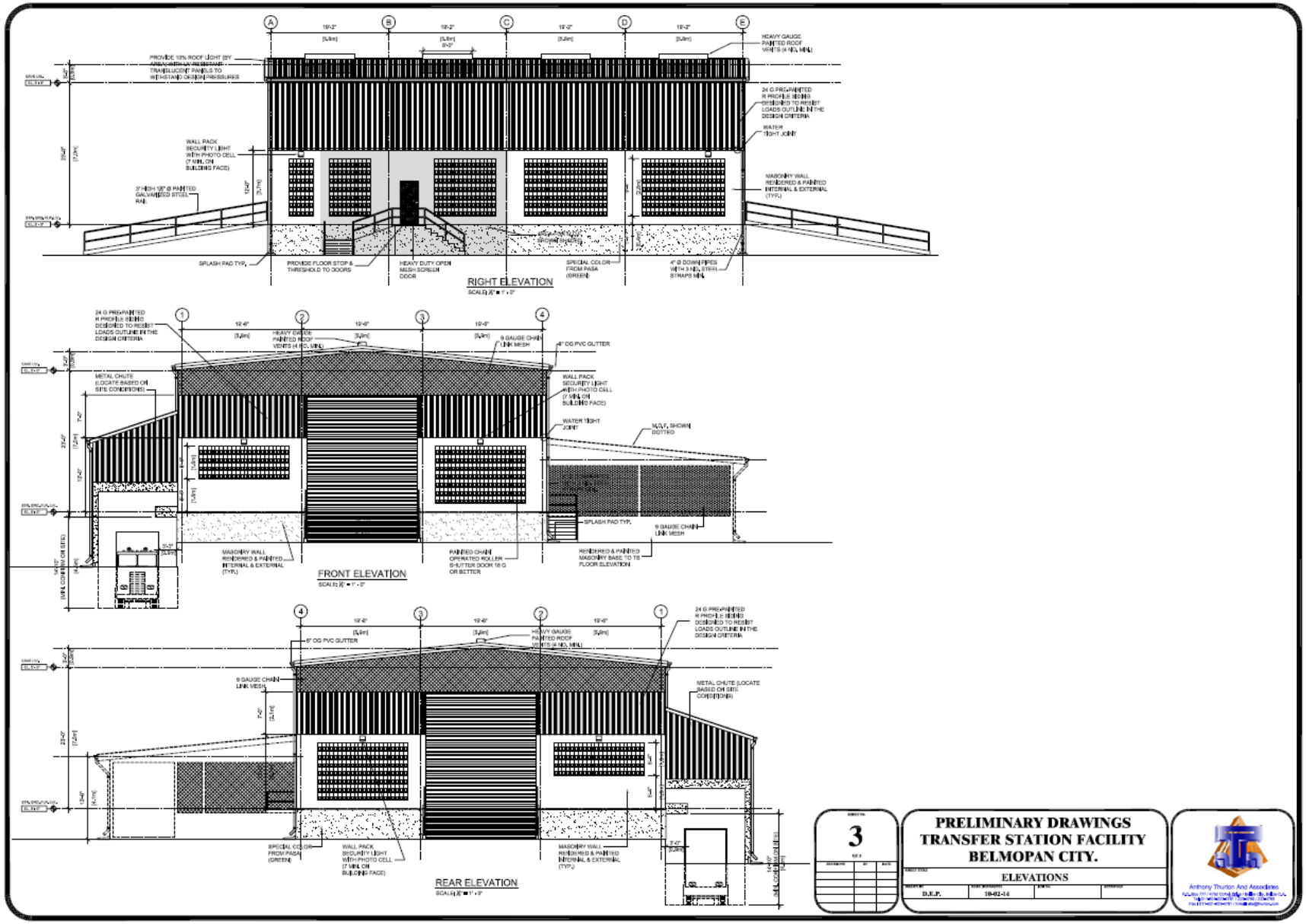

Figure 1.11: Proposed Belmopan Transfer Station Elevations

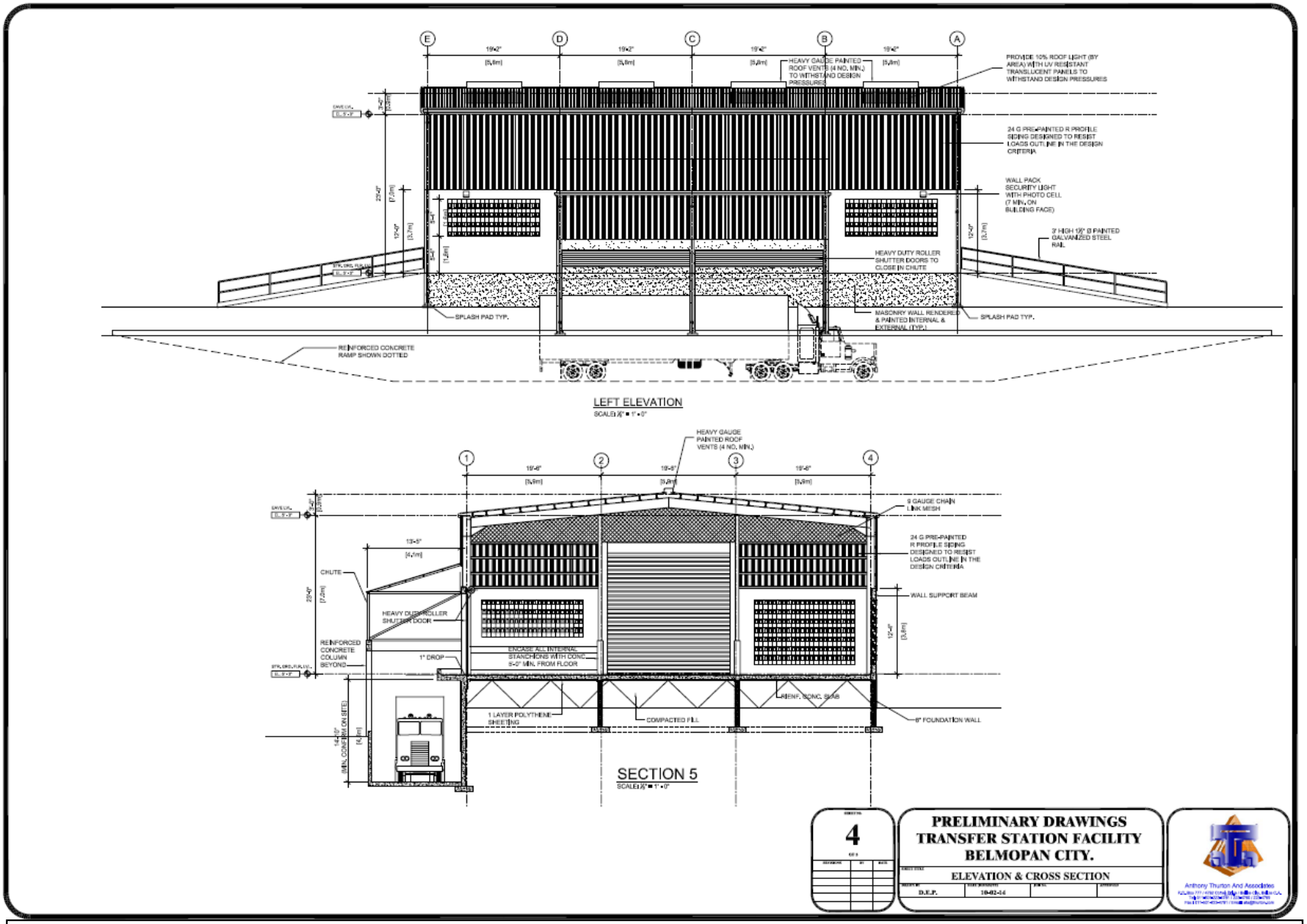

Figure 1.12: Proposed Belmopan Transfer Station Elevations and Cross Section

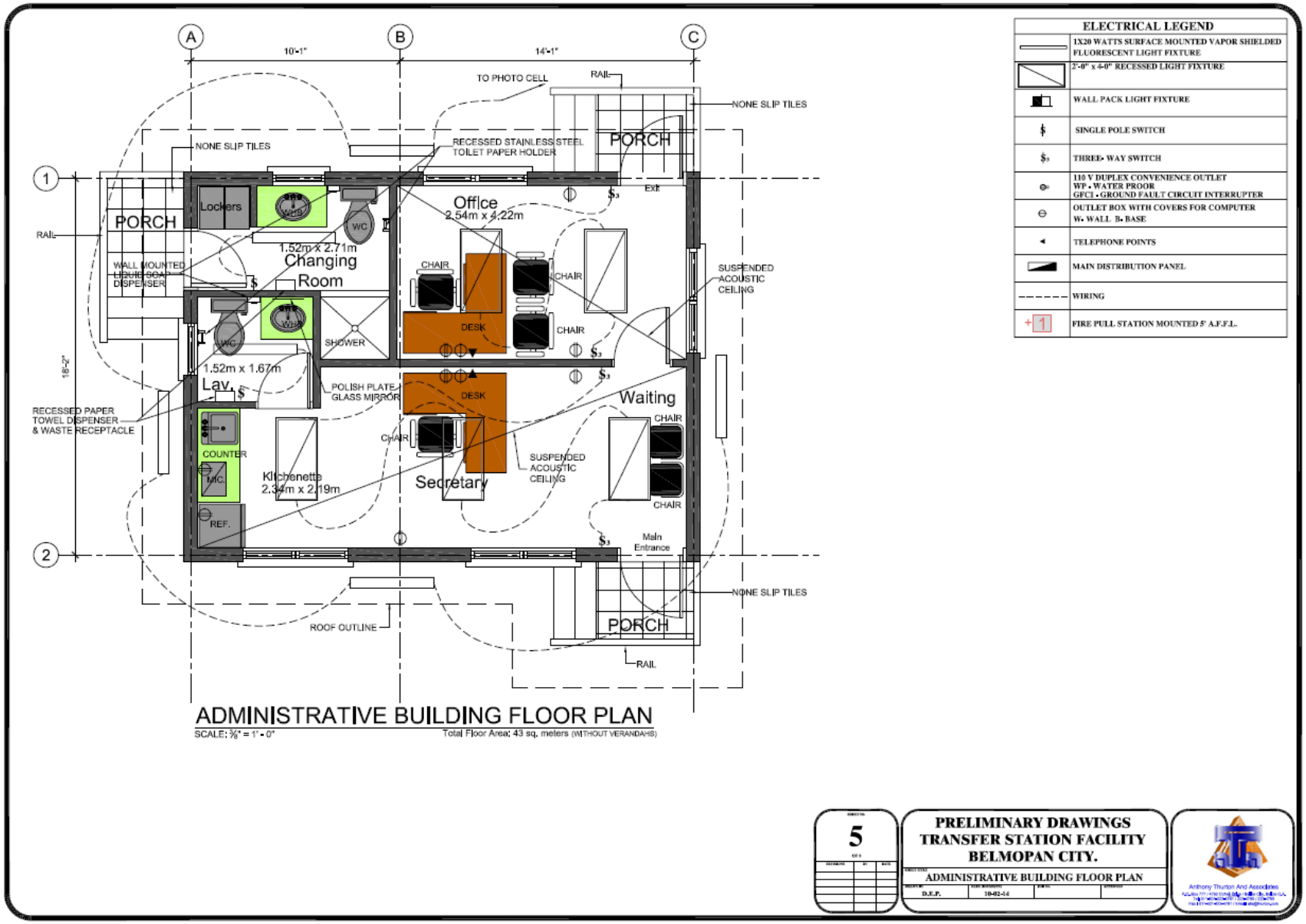

Figure 1.13: Proposed Belmopan Transfer Station Administrative Building Floor Plan

1.6.2 Transfer Station Specifications

1. All designs shall be prepared by qualified professionals and shall be done in full accordance with the latest version of the following codes unless otherwise agreed with the DBE:

   1. ACI -318 Reinforced Concrete (Design, construction and testing)
   2. AISI -Structural Steel (Hot Rolled)
   3. AISI - Cold Formed Steel Members
   4. NEC -Electrical and Associated Systems
   5. IPC - International Plumbing Code
   6. AASHTO or TRL Road Notes - Civil Works (Including roads and similar works).

2. The designs and subsequent construction and quality control systems shall also adhere to these standards and the Final Drawings, which shall be prepared by the Contractor's Engineers shall include comprehensive details in the form of drawings, supplementary specifications.
3. Basic Over view of Works: The Contractor shall be responsible for the full designs, construction, commissioning, testing and connections of the relevant systems to provide the Owner with a complete facility ready for occupancy. The works shall include but shall not be limited to the following:

   A. Site Works

   1. The design and construction of a suitable storm water drainage system, including culverts with end structures, drains, swales, and the like, for a return period of 100 years.
   2. The designs and construction of deceleration lanes adjacent to highway fully surfaced and with adequate road signs and markings.
   3. The design and construction of a 2 m high perimeter fence with gates and security barrier.
   4. The design and construction of a suitable security hut (fully furnished) with ventilation by a ceiling fan and louver windows only.
   5. The design and construction of internal road network, parking and other hard areas as shown on the Preliminary Drawings, designed for the trailer trucks complete with necessary road signs and other works.
   6. The design and construction of other site works such as a network for the plumbing system, the electrical system, backup generator system, security yard lighting, walk ways, grassing, storage areas, planters, and other associated works.

7. The mounding of garbage in the existing dumpsite and the compaction and covering of same with clay and the application of topsoil and grassing.

B. Transfer Station Building

1. The design and construction of a transfer station building is being shall be required to have a minimum floor load of 200 PSF (un-factored) and all other loading conditions
2. Design and install the electrical and plumbing systems to the TS complete with grounding, internal and external lights, fire extinguishers, proper signage, leachate collection system including tank with a minimum capacity of 100 USG, hose bib taps internally and externally.
3. Plastering, painting and sealing of the concrete floor.
4. Other items of works as shown in the Preliminary Drawings and as required and necessary for the proper operation of the facility.

C. Other Building Structures and Systems

1. Other buildings and structures required include concrete storage areas with storage for paper and hazardous materials provided with concrete floors, roofs and internal lights, complete with rendered and painted walls and other concrete components.
2. Material Drop-off Facility (MDF) building.
3. Back-up power system connected to the TS, baler, pumping system and the administration building.
4. Deep water well along with storage tanks, well pump, pressure tank and pump, and distribution system to feed the various buildings with hose bib taps externally.

D. Additionally the following shall be included:

Furniture and appliances to all buildings including suitable and durable office chairs and desks, lockers, bathroom and kitchen accessories, baler, trash bins, internal and external signs, and the like.

CHAPTER 2: SOCIO-ECONOMIC AND ROAD SAFETY BACKGROUND

2.1 Introduction

The road network that will be used by the proposed Belmopan Transfer Station comprises of that section of highway from Miles 5 on the Hummingbird Highway to the junction with the George Price Highway and from the junction of the George Price Highway to Mile 24 where the Central Sanitary Land fill is situated. Invariably, road traffic will increase in these sections of both highways, especially by tractor trailers, as they haul waste from the proposed transfer station to the Central Sanitary Landfill

The Hummingbird Highway is the third major highway in Belize. It is 53.7 miles long and connects the George Price Highway outside of Belmopan, Cayo District to the Southern Highway outside of Dangriga, Stann Creek District. It partially follows, and sometimes uses the infrastructure of, the former Stann Creek Railway used from 1913 until 1937. In 1994 this highway was completely paved. All the citrus produced in Belize travels along this highway to the two major processing plants in Pomona, Stann Creek District. There are quite a few small villages along the highway. A new bridge was completed over the Sibun River in 2004, and a new bridge inaugurated in 2006 across Silver Creek; however, there are still quite a few one-lane dilapidated bridges over numerous creeks and streams.

The traffic along the Hummingbird Highway has been on the increase lately due to an increase in demand for eco-tourism and the passage of petroleum trucks to Big Creek, a deep water port for export. The Hummingbird Highway is the only Highway in Belize which cuts through the mountains of Belize and which rests in a valley that comprises citrus orchards in the lowland and untouched jungle habitat on the outskirts and beyond.

The George Price Highway (GPH) is critically important to the country's social and economic fabric, as it links three western towns (San Ignacio, Santa Elena and Benque Viejo del Carmen) and surrounding villages to the administrative capital in Belmopan and to the country's commercial center in Belize City. The areas serviced by this highway are critical to the country's

agricultural sector in the West where some of the country's most important agricultural lands, farms, businesses and industries are located. It also services the economically important tourism sector in the West, boasting many inland tourism resorts and some of the more prominent archaeological sites. Of equal importance is the fact that this highway is a part of the Pan American Highway. The section of interest of the GPH includes approximately 50 miles of two lane surfaced (chip seal) road which was originally built in the 1930's.

2.2 Belize Road Safety

Belize roads and highways have continually experienced a high incidence of fatal traffic accidents. According to the World Health Organization's Global Status Report on Road Safety (2009), Belize recorded 68 road deaths in 2006, equivalent to approximately 31.1 traffic deaths per 100,000 inhabitants and the highest fatality rate of the Caribbean Development Bank's borrowing member countries for which data was available. In 2009, Belize experienced approximately 70 road deaths per year (WHO 2009). This equated to a rate of 23.6 deaths per 100,000 inhabitants. According to a 2012 Road Safety National Capacity Report conducted by the International Road Assessment Programme (iRAP), within the Latin American and Caribbean Countries, Belize has the highest death rate from traffic accidents per 100,000 inhabitants.

In 2012, there were a total of 718 traffic accidents in which 649 persons were injured and 69 were killed. Of those killed, 19 were pedestrians, 12 were passengers, 22 were cyclists and 16 were drivers. In 2013, 51 fatal traffic accidents were reported.

In 2011, there were 6 fatal traffic accidents reported within the George Price Highway (Belize to Belmopan Junction- between miles 2 to 44) and the Hummingbird Highway (Belmopan to Dangriga- between miles 28- 55). This indicates that 10% of all traffic fatalities in Belize occurred within the highways where the proposed Belmopan Dumpsite and the National Sanitary Landfill at Mile 23 lie. In 2012, traffic fatalities in that same area were 11 within the George Price Highway (Belize to Belmopan Junction- between miles 2 to 54) and the Hummingbird Highway (Belmopan to Dangriga- between miles 23- 43). These traffic fatalities represent 16% of the total throughout the country. However, none of the accidents occurred on or near the

proposed Belmopan Dumpsite nor the Central Sanitary Landfill at mile 24, notwithstanding this, one fatal accident occurred in 2011 and 6 in 2012 occurred between these two sites.

Under the 2013 Road Safety Project funded by a loan from the Caribbean Development Bank (CDB), the Government of Belize has converted part of the George Price Highway from the Belmopan Junction to Belize City as the "demonstration corridor" by putting international standard safety features on the highway with the vision of zero deaths on Belize's roads and highways by the year 2030. This section of the highway saw shoulder widening, roadside safety barriers, delineation, pedestrian crossings, traffic calming, road surface upgrades, pedestrian footpath, signalized intersection, delineated intersection, road side safety hazard removal, bicycle facilities, lane widening and two speeding radar detectors (one on each side of the highway) to remind drivers of their speed. In addition, this highway section is patrolled by a crew of highway patrol vehicles. The project also has a road communities' component which gives the opportunity both to contribute to road design and public awareness/education programs. Additionally significant benefits will be realized through coordinated targeting of risk factors for road users (such as speeding, seat belt wearing, and alcohol consumption) and vehicles.

Presently the junction between the George Price Highway and the Hummingbird Highway is being upgraded and a roundabout is being constructed. It is envisioned that this new feature will greatly assist with traffic flow to and from the George Price Highway and the Hummingbird Highway.

In addition, the Belmopan Transfer Station has in its plan the design and construction of deceleration lanes, adjacent to the highway, fully surfaced with adequate road sign and markings. It is therefore recommended that GOB, through its road safety project consider for immediate upgrade similar to that of the "demonstration corridor" that section of the Hummingbird Highway- 5 miles to the proposed transfer station to compliment the Belmopan Transfer Station road upgrade. This will greatly enhance the safety of the increased traffic flow from the proposed transfer station.

2.3 Waste Generated and Disposal

In its 2011 Projected Annual Waste Generation Rates (tonnes), SENES Consultants Ltd projected for Belmopan City and nine surrounding communities, with a total population of 20,369 (Estimated 2010 Census), a total of 8,487 tonnes waste generated annually. The projected 2015 waste generated was reported as 9,355 tonnes almost a 1000 tonnes increase and a projected 2020 waste generated annually of 11,005 tonnes, a total increase of 2,500 tonnes from 2012 totals.

Table 2.1: Projected Annual Waste Generation Rates

Region[a,b]	Estimated Population	Projected Annual Waste Generation Rates (Tonnes)								
	2010	2012	2013	2014	2015	2016[c]	2017[c]	2018[c]	2019[c]	2020
Belmopan		-	-	-	-					-
Belmopan	13654	5,690	5,878	6,072	6,272	6,479	6,693	6,914	7,142	7,378
Cotton Tree Village	813	339	350	361	373	386	398	412	425	439
St. Mattews Village	669	278	288	297	307	317	328	338	350	361
Frank's Eddy Village	199	83	86	88	91	94	98	101	104	107
Armenia Village	641	267	276	285	294	304	314	324	335	346
More Tomorrow Village	120	50	52	53	55	57	59	61	63	65
Roaring Creek	1645	685	708	732	755	780	806	833	860	889
Roaring River	53	22	23	23	24	25	26	27	28	29
Camalotte Village	1294	539	557	575	594	614	634	655	677	699
Teakettle Village	1281	533	551	569	588	608	628	648	670	692
Subtotal Belmopan Region (Tonnes)	20369	8,487	8,767	9,056	9,355	9,664	9,983	10,312	10,653	11,005

[b] Waste Projection for all other cities based on 1.07 Kg per capita per day as outlined in Table 4.1.5-1 (Hydroplans, May 2011) and population growth rates of 2.4%/yr for Belize City Region, 3.3%/yr for Belmopan Region and 4.3%/yr for San Ignacio/Santa Elena Region.

[c] Waste Projection for years 2016-2019 interpolated from values for the years 2015 to 2020.

[d] Hazardous waste estimated to be 2% of total waste production

(DH) Wastes from these villages may be directly hauled to the Mile 24 landfill. The waste quantities are included in the Belize City Region subtotal.

SENES Consultants Limited August 2010 (Undated July 2011)

However, of those communities reported, the proposed Belmopan Transfer Station encompasses within its 5 miles (8 kilometers) radius, only the City of Belmopan and five communities (see list below and Figure 2.1).

1. City of Belmopan and its surrounding communities of Salvapan, San Martin, Maya Mopan and Las Flores.
2. Part of Roaring Creek (George Price Highway)
3. Part of Camalote (George Price Highway)
4. Spring Field (Mennonite Community –Hummingbird Highway)
5. Armenia Village (Hummingbird Highway)

Aqua Viva (Private Subdivision) (Hummingbird Highway)

Furthermore, the proposed transfer site will service the City of Belmopan, and due to a previous contractual arrangement the community of Mahogany Heights, 21 miles from the proposed transfer station. It is estimated that the station will be receiving by 2020, 618 tonnes of waste on a monthly bases.

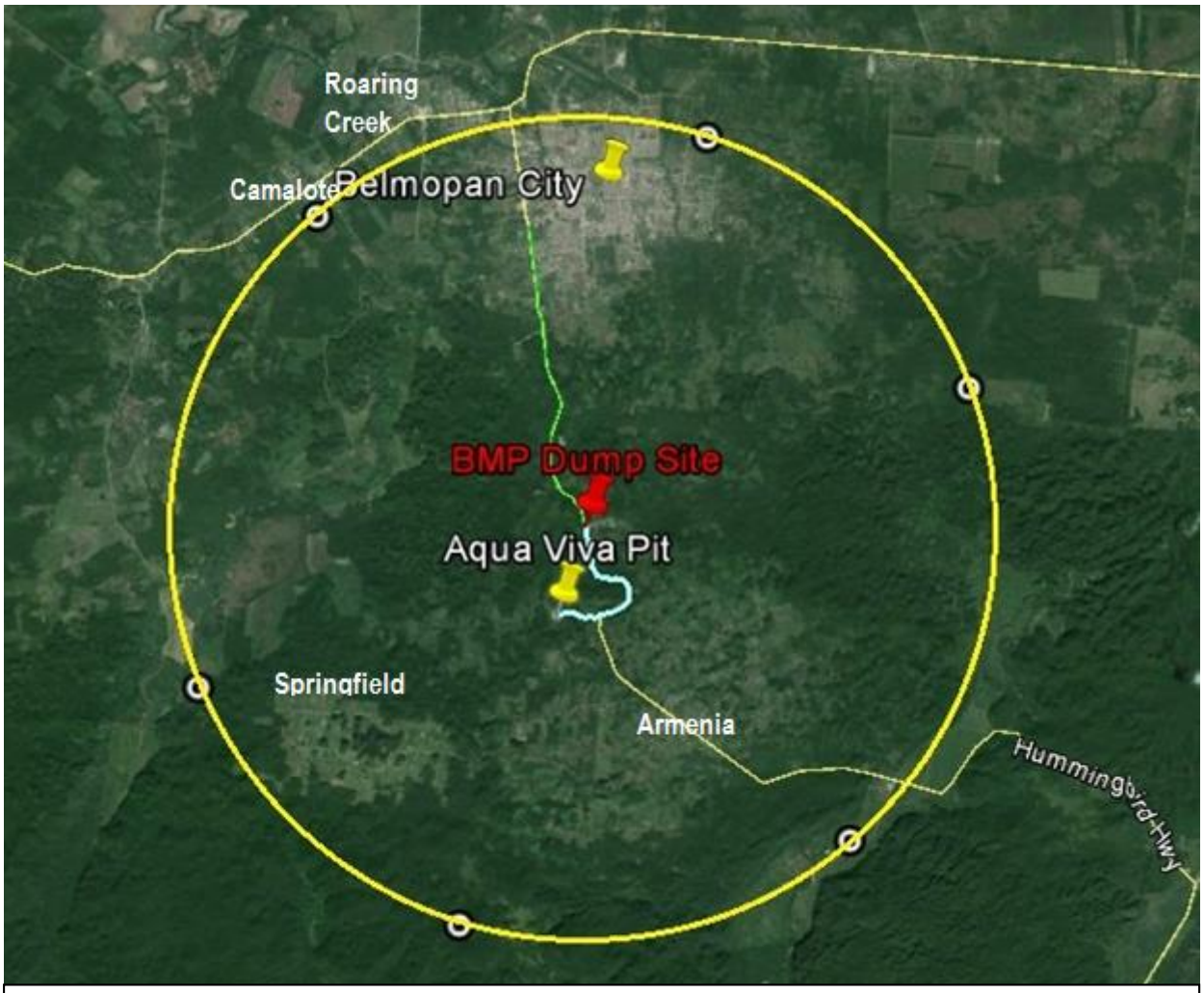

Figure 2.1: Project Area with its 5 miles Radios.

It is expected that the transfer station will alleviate the major issue of improper garbage disposal by allocating a proper venue for collecting and sorting garbage before being transported by road to the Central Sanitary Landfill at Mile 24. Several problems beside just improper disposal will be eliminated. Aesthetically, the area will be improved. The burning of garbage will no longer be allowed, thus eliminating a primary source of air pollution from the burning of garbage. Water

and land pollution from the seeping of hazardous materials in to the nearby creek network will also be eliminated. Vermin such as rats, roaches and flies attracted to open dumpsite would be controlled.

2.4 Population Affected

In addition to the estimated 14,000 population of the Belmopan City proper and surrounding communities that will be positively affected, the City of Belmopan Administration is expected to have cost savings as finances once air marked for an ad-hoc open-dump site management will now be streamlined for a well administered waste transfer station. In addition, this new operation will invariably have a positive impact on city waste collection services as the City administration will have more time to dedicate to this process.

Waste pickers, mentioned in Chapter 1, will be the most positively affected with the proposed transfer station. Their working condition will be dramatically improved. These pickers, about 17 in total, use the dump site to retrieve recyclable items (Figure 2.2).

Figure 2.2: Waste Picker

Interviews revealed that this group is constant and have been doing this type of activity for many years. They are all of Hispanic descent from El Salvador, now naturalized Belizeans, with Belizean born children living in Salvapan or San Martin communities of Belmopan. The group was not properly informed and there was a worry that with the new transfer station their livelihood would be eliminated and voiced that they would like to register their names with the pertinent authorities for them to be granted "first come first serve" status for when the transfer station becomes operational for their continued access to the area. The elder said that the monies gotten from the recycled of items is used to supplement their budget as they have a farm which is presently raising 40 hogs and monies are used to purchase feed in addition to food scavenged form the site.

It is envisioned that with the operation of the transfer station, the occupational health and safety of the waste pickers will improve for they will now be working under a designated roofed area and be required to wear personal protective equipment.

Presently the dumpsite has no running potable water for either drinking or for washing. A couple of waste pickers were seen eating their lunch in a make-shift shaded area. One can only assume that they used bottled water from home to wash off before engaging in this activity. It is foreseen that with the new transfer station they will have access to potable water for this purpose.

Ergonomic hazards such as heavy lifting and repetitive motion, and back and lower extremity pain can be arrested through an occupational health and safety (OHS) educational programme. Although the waste pickers acknowledged getting cuts and bruises, they admitted of "hardly falling sick". Therefore, through a properly managed transfer station, waste pickers can be monitored and encouraged to access the National Health Service for routine health checkups.

Finally, although waste pickers may suffer from social stigmatization they do play a role in the general economy of Belize as they provide recyclable materials to formal enterprises, private individuals and the general public and in so doing put in their ounce of contribution towards the protection of the environment.

CHAPTER 3: POLICY AND LEGAL FRAMEWORK

3.1 Introduction

In ensuring that the closure of the Belmopan dumpsite and the construction of a Solid Waste Transfer Station is undertaken within the legal and regulatory framework in Belize, there are several national legislations and accompanying regulations which the SWAMA and its contractors must adhere to. There are national advisory policy documents which must be considered as well to ensure that the activities of the proposed project are aligned with GOB's national sustainable development goals. Furthermore, there are several important operational policies of the IDB that must be taken into account as well as a few Multilateral Environmental Agreements.

3.2 National Environmental Institutional Framework

In Belize, like in several other countries in the region, despite there being a ministry with the direct responsibility for Environmental Protection, the legal and administrative responsibility is shared by a number of ministries, departments, statutory bodies and to some extent non-governmental institutions which are actively involved as members of intersectoral coordination mechanism such as the National Environmental Appraisal Committee , and where through co-management agreements are responsible for the day to day management of several public protected areas.

Although the environmental portfolio has shifted from one ministry to another, the national environmental agenda has been able to make significant progress primarily due to the stability of the departments and statutory institutions that are for the most part established by law with defined duties and responsibilities. This situation can also be said for the Ministry with the direct responsibility for solid waste management in Belize (see Table 3.1).

Table 3.1 Summary of Environmental Institutional Framework

Ministry	Portfolio Responsibility	Departments & Statutory Bodies	Legislative Authority
Ministry of Agriculture, Fisheries , Forestry, the Environment and Sustainable Development,	Agriculture, Agro industry, Aquaculture, Animal and Plant Health, quarantine, Bio-safety, Environmental Protection (Pollution	Department Of the Environment	Environmental Protection Act Cap 328
		Fisheries Department	Fisheries Act Cap 210, High Seas Fishing Act Cap 210.01
		Forest Department	Forest Act Cap 213, Forest Fire Protection Cap 212 Act, Private Forest (Conservation) Act Cap 217, Wildlife Protection Act Cap. 220,

	prevention and control, EIA) Fisheries Management, Forests Management, Protected Areas Management, Biodiversity, Climate Change, Biodiversity, and Coastal Zone Management).		National Parks System Act Cap 215
		Coastal Zone *Management Authority and Institute	Coastal Zone Management Act Cap 329
		Protected Areas Conservation Trust*	Protected Areas Conservation Trust Act Cap 218
Ministry of Natural Resources and Immigration	Land Administration & land Management, land Use Planning, Mining, Integrated Water Resource Management, Solid Waste Management, Agriculture,	Land and Surveys Department	National Lands Act Cap 191, Land Tax Act Cap 58, Aliens Landholding Act Cap 179, Land Acquisition (Promoters) Act Cap 183, Land Acquisition (Public Purposes) Act Cap 184, *Land Adjudication Act Cap 185*, Land Reform (Security of Tenure) Act Cap 186, Land Surveyors Act Cap 187, Land Utilization Act Cap 188, Registered Land Act Cap 194, Strata Titles Act Cap 196,
		Agriculture Department	Veterinary Surgeons Act 326 Agriculture Fires Act Cap 204
		Geology Department	Mines and Minerals Act Cap 226
		BAHA (Belize Agricultural Health Authority)*	Belize Agricultural Health Authority Act Cap 211
		Pesticides Control Board*	Pesticides Control Act Cap 216
		Solid Waste Management Authority*	Solid Waste Management Authority Act Cap 224
		National Integrated Water Resources Authority*	National Integrated water resources Act No. 19, 2010
Ministry Of Health	Potable water quality monitoring, sanitation and environmental health, registration of pharmaceuticals, public clinics and medical facilities	Health Department	Public Health Act Cap 40, Chemists and Druggists Act Cap 311, Food and Drugs Act Cap 291, Medical Services and Institutions Acts Cap 39. Medical Practitioners' Registration Act Cap 318 Slaughter of Animals Act Cap 154

Ministry of Local Government, Labor and Rural Development	Occupational health and safety,	Labor Department	Labour Act Cap 297
		Local Government Department	Town Councils Act Cap 87, Intoxicating Liquor Licensing Act Cap 150
		RECONDEV*	Reconstruction and Development Corporation Act
Minister of Works, Transport and NEMO (National Emergency Management Organization)	Works, transport, disaster prevention, emergency management[oil and chemical spill], rural water supply	NEMO	National Emergency Management Authority Act
		National Meteorological Services	----------
		National Fire Service	Fire Brigades Act Cap 137 Fire (Negligent Use Of) Act Cap 117
Ministry of Education, Science and Technology education, Culture, Youth and Sports	Education, Culture, Archaeology, Cultural Development, Museums, Youth and Sports	National Institute of Culture and History (NICH)*	National Institute Of Culture and History Act Cap 331
Ministry Of Tourism	Tourism, Hotels Tax, Tourism Development, Abandoned Wrecks, Archives, Arts and Culture,	Belize Tourism Board	Belize Tourism Board Act Cap 275 ;Hotels and Tourist Accommodation Act Cap 285
		Border Management Agency*	Border Management Agency Act Cap 144
		Abandoned Wreck Authority	Abandon Wrecks Act Cap 235
		Belize Archives and Records Service	Belize Archives Act Cap 333
		Belize National Tourism Council	Belize National Tourism Council Act Cap 276

Presently the Ministry of Agriculture, Fisheries, Forests, Environment and Sustainable Development together with the Ministry of Natural Resources and Immigration are the two primary ministries with direct responsibility for solid waste management. The Ministry of Health primary focus also has some legal responsible to control issues on waste management (medical waste) and the prevention and control pollution their primary focus has been on those issues directly impacting health and the control and prevention of diseases. The Pesticide Control Board Act also has a big focus on regulating the use of pesticides and the management of used pesticide containers and packages.

3.3 National Environmental Legislative Framework

Belize has in place a very expansive and detailed legal and regulatory framework for sustainable development underpinned by an integrated environmental management approach. This legal and regulatory framework includes national legislations and regulations that address issues of environmental management including pollution control and prevention, natural resource management, biodiversity conservation, protected areas management, preservation of historic and cultural resources, chemicals management and integrated water resources management. In addition, Belize has also signed on to various multilateral environmental agreements (MEAs).

This section of this report provides information on Belize's National Environmental Institutional and Legal Framework, focusing on the primary institutions with a legislative and/ or administrative mandate for environmental protection and natural resources management in Belize. A specific focus is given to those institutions that either directly or indirectly are involved in one way or the other with solid waste management issues.

The important primary legislations that govern the control and prevention of pollution are the Environmental Protection Act, the Solid Waste Management Authority Act and the Public Health Act. The Environmental Tax Act which was enacted to allow for the collection of an environmental levy on the importation of all products to offset the cost associated with solid waste management. This revenue however, forms part of Government's consolidated revenue and has yet to be specifically dedicated for its legislated purposes.

Another new legislation the "Returnable Containers Act" also could serve to assist in the recovery of plastic, glass and aluminum containers for carbonated and alcoholic beverages and removing a considerable amount of these from the waste stream. There are other supporting legislations in the legislative framework that form part of the wider national environmental and natural resources management framework such as those that have to do with the management of chemicals that can be considered as supporting legislation by the nature of their intended purposes.

Table 3.2 provides a summary of these legislations.

Table 3.2 Summary of Pollution Control Legislation

AGENCY	LEGAL INSTRUMENT	OBJECTIVE OF THE LEGISLATION
Department of the Environment	1. Environmental Protection Act. Cap. 328. Rev. Ed. 2000 and 2009 Amendment	General environmental protection and prevention and control for all types of pollutants; Regulates all projects, programs or activities that could have significant impacts to the environment, prohibits dumping, and regulates environmental issues associated with industrial pollution including the petroleum industry. It mandates the DOE to "maintain a register of all wastes, discharges, emissions, deposits or other sources of emission or substances which are of danger or potential danger to the environment".
	SI No. 94 of 1995 The Effluent Limitation Regulations and 2009 Amendment	To control the discharge of effluents into any inland water or the marine environment. Establishes standard for the discharge of effluent pollutants including sewage was amended in 2009 to make it consistent with the Aruba Protocol on land base sources of marine pollution
	SI No. 107 of 1995 Environmental Impact Assessment Regulations and 2007 Amendment	Provides details of procedures involved in the preparation of EIAs or Limited Level Studies (LLES) for projects programs or activities that could have significant impacts on the environment
	SI No. 56 of 1996 Pollution Regulations as at 31 October 2003 and amended by SI No. 60 of 2009	Provide for the prevention and abatement of various kinds of pollution (air, water and land); Regulates imports and use of ODSs and the discharge of all pollutants and contaminants. Has been amended to make it consistent with the Montreal Protocol and its amendments.
	S.I. No. 100 of 2009 Hazardous Waste Regulations.	Regulates the management of hazardous waste (storage, transportation, treatment and disposal). Any material or substances that is toxic, corrosive, flammable, reactive, explosive, infectious or pathogenic. Regulations were drafted to allow for consistency with the Basel Convention.
Ministry Resp. for the Environment /Dept. of the Environment	Returnable Container Act 2009	Provides for the control of sale of beverages in beverages containers and for the payment of a deposit on beverage containers and for a refund for the return of those containers. The Act has one great shortcoming in that it does not cover plastic containers and deals only with glass and metal containers
Ministry Resp. for the Environment	Summary Jurisdiction (Littering Offences) (Violation Tickets) Regulations	Person who commits a littering offence may be issued with a violation ticket by an authorized officer, includes Environmental Officers, Public health officer, Police, Justice of the Peace employees of local governments etc.,
Solid Waste Management Authority	Solid Waste Management Authority Act. Cap. 224. Rev. Ed. 2000.	Establishes the Solid Waste Management Authority (SWAMA). Defines its functions for an integrated approach to solid waste management.
Pesticides Control Board (PCB)	Pesticides Control Act, Cap. 216 Rev. Ed. 2000	1. Established the PCB 2. Provides for the control of the manufacture, importation, sale, storage, use and disposal of pesticides.
	Pesticides Control Act, Cap. 216 S Rev. Ed. 2003. (Subsidiary Laws)	Regulations on Registered and Restricted Pesticides: 1. Uses, Restrictions and Precautions 2. Manufacture, Import and Sale. 3. Registration. 4. Certification of User.

	SI No. 77 of 1995 Registered and Restricted Pesticides (Registration Regs.)	Deals with the Registration of pesticides and labeling
	SI No.18 of 2003 Registered and Restricted Pesticides (Registration Amend. Regulations, 2003.) Amends SI N0. 77 of 1995	Defines Domestic Pesticide and their Registration Schedule. Provide for a trade applicator, pest exterminator, or other pesticide user who wishes to register a pesticide for his own use to apply for minor-use authorization by submitting.
	SI No. 8 of 1989 Registered and Restricted Pesticides (Manufacture, Import and Sale-Amend Regulations, 1988) Amends Previous Regulations	Requirements for licenses and fees for the manufacture, import, sale and registration of registered and restricted pesticides
	SI No. 30 of 1996 – Registered and Restricted Pesticides (Mfg., Import and Sale-Amend. Regs. 1996) Amends Previous Regs.	Repeals End-User and Multiple Licenses and replaces with Import Licenses for pesticides.
	SI No. 112 of 1996 – Restricted Pesticides (Certified User) Regulations	Provides for the certification of restricted pesticides users. Require formal training of users.
	SI No. 71 of 1998 – Pesticides Control (Sale and Confiscation) Regulations	Establishments are required to maintain a register of restricted pesticides, required to provide personal protective equipment (PPE) and separate storage of same.
Belize Agriculture and Health Authority	Belize Agriculture and Health Authority Act, Cap. 211. Rev. Ed. 2003	Provides for monitoring, regulation, control and use of animal drugs, feed and litter, and use and sale of fertilizers otherwise restricted and regulated. Responsible for monitoring of chemical residues in food.
Ministry of Health	Public Health Act Cap. 40 Rev. Ed. 2000	Have regulations for the use of pesticides associated with control of vectors, and regulations governing the spraying of premises. Responsible for the monitoring and regulating potable and bottled water. Use of pesticides for vector control-and pesticides used in the spraying of premises, monitors the presence of chemicals in potable water as they relate to public heath
		Part VIII of the act deals with the prevention, control and reduction of emissions or pollutants into the air, soil and water (solid and liquid wastes). However, this section has now been superseded by the EPA.
	Chemist and Druggist Act Cap. 311. Rev. Ed. 2000	Regulates registration of a druggist as well as the storage, sale and disposal of drugs (pharmaceuticals)
	Misuse of Drugs Act Cap. 103 Rev. Ed. 2000	Restriction on importation, exportation, production and supply of controlled drugs.
	Antibiotic Act Cap. 33 Rev. Ed. 2000	Restriction on importation, exportation, production and supply of antibiotics. Lists of approved pharmaceutical firms. Variation of lists of approved pharmaceutical firms.

Belize Port Authority	Belize Port Authority Act, Cap. 233, Rev. 2000	The regulation, restriction and control (without prejudice to the conduct of navigation) of the depositing of any substance, solid matter, article or things that cause pollution of Belize's ports – Responsible for the management of all ports. All groups of chemicals imported/ temporary storage of imports/ Solid, liquid and gaseous discharged from sea navigation vessels.
Dept. of Geology	Mines and Minerals Act. Cap. 226. Rev. Ed. 2000.	The prevention, limitation or treatment of pollution related to mining.
	Mines and Minerals Act. Cap. 226 S. Subsidiary Laws Rev. Ed. 2003	Regulates use of explosives used in mining activities, sets standards for the emissions and effluents produced from mining activities sets standards for the discharge of heavy metals and other pollutants normally associated with mining and establishes requirements for personnel safety, emergency preparedness and industrial hygiene related to mining.
Department of Petroleum	Petroleum Act Cap. 225	Section 24. of the act requires that petroleum contractors ensure that all petroleum operations: generally adopt the necessary measure for the protection of flora, fauna and other natural resources; avoid the pollution or contamination of water, atmospheric or terrestrial; take all steps necessary to secure the safety, health and welfare of persons engaged in petroleum operations; upon the termination of the contract, carry out all clean-up operations and render the contract area safe.
	Petroleum Regulation Cap. 225s	Section 15 allows for the Minister to appoint an environmental pollution control board to ensure that all petroleum operations comply with the requirements of environmental standards and the relevant laws of Belize at an appropriate time as he deems fit. The Minister require the establishment of a common fund to which the contractor(s) would contribute, to be held in trust and managed for the sole purpose of indemnification against any or all environmental damage(s) caused during petroleum operations.
Ministry of Finance - Customs Department	S.I. No. 77 of 2006 Customs Regulation (Prohibited and Restricted Goods) (Consolidation) (Amendment) Order 2006.	Regulates the importation or exportation of any goods which for the time being is subject to any number of conditions or restrictions. Imports of all chemicals and export of chemicals and related substances (Scrap Metal, Lead-acid Batteries, and Used Oil.)
Ministry of National Security	Dangerous Goods Act. Cap. 134. Rev. Ed. 2003.	Explosives and petroleum products including Blasting Powders, boosters, primers and detonators of any description, Primacord Safety fuses; Regulates the manufacture, storage, import, transport and sale of explosives and the sale and delivery of liquefied petroleum gases. It regulates the sale and delivery of liquefied petroleum gases for residential use.
National Emergency Management Organization	Disaster Preparedness And Response Act Cap. 145 Rev. Ed. 2000	The Act establishes the National Emergency Management Organization and assigns its responsibilities relating to the mitigation of, preparedness for, response to and recovery from emergencies and disasters in Belize. Mitigation and emergency preparedness related to spills, fires and accidents associated with transport , production and use of all classes of chemicals

3.4 Summary of Most Pertinent Legislations

The important primary legislations that govern the control and prevention of pollution are the Environmental Protection Act, the Solid Waste Management Authority Act and the Public Health Act. The Environmental Tax Act was enacted to allow for the collection of an environmental levy on the importation of all products to offset the cost associated with solid waste management. This revenue however, forms part of Government's consolidated revenue and has yet to be specifically dedicated for its legislated purposes. Another new legislation the "Returnable Containers Act" also could serve to assist in the recovery of plastic, glass and aluminum containers for carbonated and alcoholic beverages and removing a considerable amount of these from the waste stream. Other legislations such as those related to the management of chemicals can be considered as supporting legislation by the nature of their intended purposes**.**

3.4.1 The Environmental Protection Act

The Environmental Protection Act and its subsidiary regulations are the predominant legislation on all matters related to the control and prevention of pollution. These include the Effluent Limitation Regulations, the Pollution Regulations, the Hazardous Waste Regulations and the EIA Regulations.

The Environmental Protection Act legally established the Department of the Environment. Under section 3 subsection (3) the Department has the responsibility to monitor the implementation of the Act and Regulations, and to take necessary actions to enforce the provisions of the Act and its Regulations.

The Environmental Protection Act Revised Edition 2003, also charges the Department Of the Environment with the responsibility for formulating environmental codes of practices, specifying procedures, practices or releases limits for pollution control relating to works, undertakings and activities during any phase of their development and operation, including the location, design, construction, start-up, closure, dismantling and clean-up phases and any subsequent monitoring activities. Under the Act, no person, installation, factory or plant shall, unless specifically permitted by the Department, emit, deposit or discharge or cause emission of any pollutant or

contaminant into the atmosphere or environment in contravention of the permitted levels. Every person, installation, factory or plant emitting air pollutants is required to maintain and submit to the Department, records of the type, composition and quantity of pollutants emitted.

Furthermore the EPA requires "that any person or undertaking exploiting the land, water resources, seas or other natural resources shall ensure the protection of the environment against unnecessary damage or from pollution by harmful substances; and no person shall emit, import, discharge, deposit, dispose of or dump any waste that might directly or indirectly pollute water resources or damage or destroy marine life."

The 2009 Amendments of the Environmental Protection Act provide for greater environmental control and management of the petroleum industry, to make improved provisions for the protection of the Belize Barrier Reef System, to establish an environmental management fund, to provide for out-of-court settlement in appropriate cases, and to provide for the issue of violation tickets for pollution offences. It is expected that the "Environmental Management Fund" would provide for the necessary resources required by the Department to ensure Compliance Monitoring and to offset cost with Oil and Chemical Spill preparedness. In accordance with the EPA and its regulations the cost of any spill response or remediation response required is borne by the polluter in accordance with the "polluter pays principle."

3.4.1.1 Effluent Limitation Regulations and Standards

Following a study on Effluent Standards for Belize, guidelines and recommendations were made and S. I. No. 94 of 1995 The **Environmental Protection (Effluent Limitations) Regulations** was promulgated. In 2009, the Regulations were amended to allow for better regulation of "domestic waste water discharges" and to make the regulation consistent with the Aruba Protocol of the Cartagena Convention.

The ***Effluent Limitation Regulations (S.I No. 94 of 1995 and amendments of 2009)*** were established to control and monitor discharges of effluent into any inland waters or the marine environment of Belize. The regulations establishes and implements the requirements for the

treatment of effluent, prohibit the discharges of effluent from new and altered point sources without a license and implements a licensing system for the discharge of effluents.

Part II of the regulation prohibits new and altered sources of effluent to be discharged into the environment without first obtaining prior approval of the DOE. The regulation at Section 8 prohibits a person from carrying out any work without permission on any premises that may result in a new source of effluent discharge or cause a material change in the quantity or quality of the discharge from an existing source. This section also requires that the plans for treatment facilities be submitted for approval by the DOE.

Part III prohibits the discharge of effluent and containing certain substances and approves the "Standard methods" of analysis of effluents while Part IV restricts the discharge of effluents on land and provides restrictions on disposal of sludge on land. Section 3 of the regulation applies to discharges of effluent into any inland waters or the marine environment, other than the effluents discharged from premises specified in the Third Schedule of the regulation.

In the 2009 amendments receiving water bodies were classified either as Class I or Class II water bodies with differential standard established for these (Table 3.3).

Table 3.3 Water Bodies Classification

"Class I waters" means waters that, due to inherent or unique environment characteristics or fragile biological or ecological characteristics or human use, are particularly sensitive to the impact of domestic effluent, Class I waters include, but are not limited to: *(a)* Waters containing coral reefs, seagrass beds, or mangrove; *(b)* Critical breeding, nursery or forage areas for aquatic and terrestrial life; *(c)* Areas that provide habitat for species protected under the Protocol Concerning Specially Protected Areas and Wildlife to the Convention (the SPAW Protocol); *(d)* Protected areas listed in the SPAW Protocol; and *(e)* Waters used for recreation.	"Class II Waters" means waters other than Class I waters, that due to oceanographic, hydrologic, climatic or other factors are less sensitive to the impact of domestic effluent and where humans or living resources that are likely to be adversely affected by the discharge are not exposed to such discharges.

Following are the present effluent standards for the discharge of effluents into either Class I or Class II waters shown in Tables 3.4 and 3.7.

Table 3.4: First Schedule – Effluent Standard

FIRST SCHEDULE			
EFFLUENT	**EFFLUENT STD**	**EFFLUENT**	**EFFLUENT STD**
Plastic and Synthetics:		**Battery Manufacturing:**	
Biochemical Oxygen Demand (BOD_5)	10 mg/L	BOD_5	30mg/L
Total Suspended Solids (TSS)	30 mg/L	TSS	30mg/L
Chemical Oxygen Demand (COD)	40 mg/L	Temp	35°C
Phenolics Less Than	0.50 mg/L	pH	6-9 units
Zinc Less Than	1.0 mg/L	NO_3	10mg/L
Chromium Less Than	0.10 mg/L	PO_4	5mg/L
Oil and Grease	10.0 mg/L	SO_4	200mg/L
Fluoride (F^-) Less Than	1.0 mg/L	Pb	0.1mg/L
Copper (CU^{2+}) Less Than	0.05 mg/L	Fe	20mg/L
		Cu	0.1mg/L
		Pb Reduction	10:1
		COD	100mg/L
Food Processing:		**Fish Processing:**	
BOD_5	15mg/L	BOD_5	100mg/L
Oil and Grease	15 mg/L	TSS	100mg/L
Suspended Solids	15mg/L	Temp	35°C
pH	6-9 units	pH	6-9 units
NO_3	10mg/L	NO_3	10mg/L
PO_4	5mg/L	PO_4	30mg/L
SO_4	200mg/L	SO_4	200mg/L
		COD	100mg/L
Service Industry:		**Poultry Industry:**	
BOD_5	15mg/L	BOD_5	50mg/L
Oil and Grease	10 mg/L	BOD Reduction	2000:1
COD	40mg/L	TSS	50mg/L
pH	6-9 units	TSS Reduction	1500:1
NO_3	10mg/L	Temp	35°C
PO_4	5mg/L	pH	6-9 units
		NO_3	10mg/L
		PO_4	5mg/L
		SO_4	200mg/L
		COD	100mg/L
Garment Industry:		**Dairy Industry:**	
BOD_5	50mg/L	W.W. Concn	50mg/L
BOD Reduction	303:1	BOD Reduction	500:1
TSS	50mg/L	TSS Concn	50mg/L
Temp	35°C	Temp	35°C
pH	6-9 units	pH	6-9 units
NO_3	10mg/L	NO_3	30mg/L
PO_4	5mg/L	PO_4	5mg/L
SO_4	200mg/L	SO_4	200mg/L
COD	100mg/L	COD	100mg/L

FIRST SCHEDULE (Cont.)			
EFFLUENT	**EFFLUENT STD**	**EFFLUENT**	**EFFLUENT STD**
Citrus Industry:		**Rum Refinery Industry:**	
BOD_5	50mg/L	BOD_5	50mg/L
BOD Reduction	2500:1	TSS	60mg/L
TSS	50mg/L	Temp	35°C
TSS Reduction	1176:1	pH	6-9 units
Temp	35°C	NO_3	10mg/L
pH	6-9 units	PO_4	1mg/L
NO_3	10mg/L	SO_4	500mg/L
PO_4	5mg/L	COD	200mg/L
SO_4	200mg/L		
COD	100mg/L		
Brewery Industry:		**Sugar Industry:**	
BOD_5	35mg/L	BOD_5	50mg/L
BOD Reduction	175:1mg/L	BOD Reduction	1000:1
TSS	50mg/L	TSS	50mg/L
Temp	35°C	TSS Reduction	1500:1
pH	6-9 units	Temp	35°C
NO_3	10mg/L	pH	6-9 units
PO_4	5mg/L	NO_3	10mg/L
SO_4	200mg/L	PO_4	5mg/L
COD	200mg/L	SO_4	200mg/L
		COD	200mg/L
Shrimp Processing:		**Soft Drinks Bottling Standards:**	
BOD_5	30mg/L	BOD_5	35mg/L
TSS	30mg/L	TSS	35mg/L
Temp	35°C	Temp	35°C
pH	6-9 units	pH	6-9 units
NO_3	10mg/L	Oil and Grease	10mg/L
PO_4	1mg/L	NO_3	10mg/L
SO_4	200mg/L	PO_4	30mg/L
COD	200mg/L	SO_4	200mg/L
		COD	100mg/L

Table 3.5: Second Schedule – Effluent Limitations for other Industries or Commercial Activities

SECOND SCHEDULE EFFLUENT LIMITATIONS FOR OTHER INDUSTRIES OR COMMERCIAL ACTIVITIES	
PARAMETER	**LIMITATION / STANDARD**
Biochemical Oxygen Demand (BOD) at 20°c	50mg/L
Chemical Oxygen Demand (COD)	100mg/L
Coliform -Faecal	0 MPN/100ml
Coliform -Total	0-10 MPN/100ml
Colour (LU)	7
Dissolved Oxygen (DO)	5mg/L
pH	6-9 units
Total Dissolved Solids (TDS)	2000mg/L
Temperature	33°c
Total Suspended Solids (TSS)	50mg/L
Ammonia (NH4)	1mg/L
Arsenic	1mg/L
Barium	5mg/L
Beryllium	0.5mg/L
Boron	5mg/L
Calcium	200mg/L
Carbon -Total Organic	200mg/L
Chloride (as Cl)	600/mg/L
Chlorine	1mg/L
Cyanide (as CN)	0.1mg/L
Detergent (LAS as Methyl Blue active subs.)	15mg/L
Fluoride	5mg/L
Iron	20mg/L
Magnesium	200mg/L
Manganese	5mg/L
Nitrate (as NO)	3mg/L
Oil and Grease	10mg/L
Phenolic Compounds (as Phenols)	0.2mg/L
Phosphates (as PO)	5mg/L
Sulphate (as SO_4)	500mg/L
Sulphide (as S)	0.2mg/L
Tin	10mg/L
Cadmium**	0.1mg/L
Chromium** (Trivalent & Hexavalent)	1mg/L
Copper **	1mg/L
Lead**	0.1mg/L
Mercury**	0.05mg/L
Nickel**	1mg/L
Selenium**	0.5mg/L
Silver**	0.1mg/L
Zinc**	1mg/L
Total Metals**	2.0mg/L
** The concentration of toxic metal should not exceed these limits, individually or in total.	

Table 3.6: Third Schedule- Discharge into Class I Waters

THIRD SCHEDULE DISCHARGES FROM DOMESTIC WASTEWATER TREATMENT SYSTEMS (SEWAGE WATER AND GREY WATER) INTO CLASS I WATERS	
PARAMETER	**EFFLUENT LIMIT**
Total Suspended Solids (TSS)	30 mg/L*
Biochemical Oxygen Demand (BOD_5)	30 mg/L
pH	5-10 pH units
Fats, Oil and Grease	15 mg/L
Coliform –Faecal (*E. coli* (freshwater) and *Enterococci* (saline water))	200/mpn/100 ml Or (a) *E. coli*: 126 organisms/100 ml; (b) Enterococci 35 organisms/100 ml
Floatables	Not visible
*Does not include algae from treatment ponds.	

Table 3.7: Fourth Schedule- Discharge into Class II Waters

FOURTH SCHEDULE DISCHARGES FROM DOMESTIC WASTEWATER TREATMENT SYSTEMS (SEWAGE WATER AND GREY WATER) INTO CLASS II WATERS	
PARAMETER	**EFFLUENT LIMIT**
Total Suspended Solids (TSS)	150 mg/L*
Biochemical Oxygen Demand (BOD_5)	150 mg/L
pH	5-10 pH units
Fats, Oil and Grease	50 mg/L
Coliform –Faecal	Not applicable
*Does not include algae from treatment ponds.	

3.4.1.2 The Pollution Regulations (S. I. No. 56 of 1996 and amendments of 2009)

The Pollutions Regulations address all issues of air, water (not addressed in the effluent regulations) and soil pollution, including noise pollution.

Part II of the of the regulations states that " No person shall emit, deposit, issue or cause the emission, deposit, issuance or discharge into the environment of-(a) a contaminant from a domestic, commercial, agricultural, recreational, industrial, or any other source; or (b) a contaminant, the presence of which in the environment is prohibited by these Regulations or is likely to affect the life, health, safety, welfare or comfort of human beings or cause damage to or otherwise impair the quality of the environment, unless a prior permit to do so has been granted by the Department upon such terms and conditions as it may determine."

The regulation goes on to state that "where the discharge of any pollutant in excess of the prescribed standards occurs or is apprehended to occur due to any accident or other unforeseen act or event, the person responsible for such discharge and the person in charge of the premises, vessel, vehicle or container shall be bound to prevent or mitigate the pollution caused as a result of such discharge and shall also forthwith inform the Department of the fact of such occurrence or apprehension of such occurrence and provide the Department with – (a) a brief description of the emission; (b) an assessment of any damage or potential damage to the public health or the environment associated with the emission; (c) a description of the emergency response plan and resources to address the discharge; (d)evidence that he has taken or is taking steps to mitigate damage or contamination resulting from the emission." These sections alone set the stage for all the other regulations and standards contained in it.

Part III – 6 (1) deals generally with the emission of contaminants into the air where no person shall cause, allow or permit contaminants to be emitted or discharged either directly or indirectly into the air from any source.

Regulation 31 of the Pollution Regulations (1996) provides that a person shall not pollute the land so that the condition of the land is so changed as to be capable of making the land noxious or harmful to animals.

Regulation 32 provides that no person shall cause any seepage or leaching contamination of the adjacent soil, groundwater or surface water. Regulation 33 empowers DOE to issue directions to persons operating a site for the elimination of waste or a solid waste treatment plant and disposal system. Regulation 35 prohibits the deposition of waste in a place other than a site approved by DOE for the storage or elimination of waste or operation of a waste treatment plant or waste management system.

Amendments were made in 2007 to provide for the establishment of a licensing regime for the importation of certain substances which were identified in the Montreal Protocol as "substances of concern." In 2009 the regulation was once more amended to establish standards for the new blossoming petroleum industry. Standards were set associated with storage equipment, flaring, and refining or processing of refined products. Other supporting regulations addressing the safety and other environmental related issues associated with the management, and production of petroleum products. In addition, it prohibited the manufacturing of all CFC's and provided for the inclusion of other refrigerants to be listed as "scheduled substances."

Under this regulation the Department of the Environment has established several licensing requirements for the prevention of pollution which include permits for the imports of ODS, Lead Acid Batteries, and Used tires. In addition the DOE has also established permitting requirements for the export of scrap metals, used oil and used batteries. As a result of the illegal cannibalization of electrical power lines and other overhead wires the exportation of copper as scrap metal is constituted as an illegal activity.

The Pollution Regulations and its Amendments established several other standards. Table 3.8 provides a main summary of the regulation and pollutant or issue being regulated.

Table 3.8: Pollution Regulation	
Section	**Pollutant or Issue**
Part II	Sets Standard for Ambient Air Quality for (SPM, SO_2, CO, and NO_x) See Table
Part IV	Deals with particulate emissions (SPM) from stationary sources
Part V	Deals with emission of organic compounds from stationary sources
Part VI	Deals with emissions of carbon monoxide from stationary sources
Part VII	Deals with emissions of nitrogen oxides
Part VIII	Deals emission from combustion engines (Vehicular Emissions) Set standards for vehicular emissions

The regulation also allows the Department to direct any "contractor, owner or operator who carries on quarry or mining, manufacturing, power generating or related activities shall, prior to closing down operations on any site" to "remove all equipment and installations, structures, plants, appliances from the relinquished area or site in a manner agreed with the Department pursuant to an abandonment plan; and perform all necessary site restoration."

In accordance with Part VIII of the regulation, no person shall cause a vehicle to discharge into the atmosphere exhaust emission contaminants in excess of the quantity specified by the Department. This section set standards according to the type of vehicle engine and the model year of the vehicle and requires that motor vehicles be tested for emissions compliance. Although Belize has these regulations in place, DOE is unable to enforce due to lack of testing equipment.

Table 3.9 indicates the ambient air standards that must be maintained by industries. These standards are measured immediately outside the perimeters of the compound of the industry.

Table 3.9: Ambient Air Standards

FIRST SCHEDULE [Regulation 6] CONCENTRATION OF AIR CONTAMINANTS				
Location	Concentration in micrograms per M^3			
	SPM	**SO_2**	**CO**	NO_X
A. Industrial and mixed use	500	120	5000	**120**
B. Residential and Rural	200	80	2000	**80**
C. Sensitive	**100**	**30**	**1000**	**30**

The Pollutions Regulations also specify standards for noise levels (see Table 3.6).

Table 3.10: Noise Levels Required by the Belize Laws. Source: Environmental Protection Act Chapter 328

	Noise Level According to the dB (A) Scale (as defined by the International Electronics Commission).										
		Structure A		Structure B		Structure C		Structure D		Structure E	
	Duration of Noise	D	N	D	N	D	N	D	N	D	N
1	More than 9 hrs	60		60		70		70		85	
2	More than 3 hrs, less than 9 hrs	70		70		75		75		90	

3	More than 30 min	75		75		80		80		100	
4	More than 30 min		45		45		45		45		90
5	More than 15 min and less than 1 hr	70		70		90		90		105	
6	More than 10 min and less than 30 min		45		50		50		50		90
7	More than 5 min and less than 15 min	70		85		100		90		90	
8	More than 2 min and less than 5 min	90		95		100		100		95	
9	Less than 10 min		50		70		70		70		80
10	Less than 2 min	100		100		105		100		110	
	Noise from infrequent (less than 4 times per week) explosions	109		109		114		114		114	

Revised Edition 2003 of the Substantive Laws of Belize, "Chapter 238 Pollution Regulations.

Structure A: any building used as a hospital, convalescent home, old age home, or school.
Structure B: any residential building.
Structure C: any building in an area that is used for residential and one or more of the following purposes: commerce, small scale production, entertainment.
Structure D: any residential apartment in an area that is used for the purposes of industry, commerce or small scale production.
Structure E: any building used for the purposes of industry, commerce, or small scale production in an area used for the purposes of industry, commerce, or small scale production.

3.4.1.3 The Hazardous Waste Management Regulations (S. I. No. 100 of 2009)

The Hazardous Waste Management Regulations (S. I. No. 100 of 2009) establishes regulations for the transportation, storage disposal of hazardous waste. The Hazardous waste Regulation of 2009 defines hazardous wastes as "any material or substance characterized as being toxic, corrosive, flammable, reactive, explosive, infectious, or pathogenic that may pose a threat to the environment and human health.

The regulation also defines a hazardous waste management facility as a "facility for the collection, storage, treatment, or disposal of hazardous wastes which is authorized or permitted to operate for this purpose by the Department", making it a legal requirement for all such facilities to obtain a licence from the DOE to operate such a facility.

In accordance with the regulation, the treatment of hazardous wastes includes any thermal, physical, chemical or biological processes that change the characteristics of the waste in order to reduce its volume or hazardous nature or facilitates its handling, disposal or recovery.

The regulations do not address hazardous waste contained in domestic waste or waste generated from the use of agrochemicals since these were being already addressed in other specific legislation governing this group of chemicals. Table 3.11 provides a brief summary of the Hazardous Waste Regulations.

Table 3.11: Hazardous Waste Regulations

Section	Issue Regulated
Part II	Regulates Hazardous Waste Facility requiring specific records to be kept
Part III	Regulate the storage of hazardous waste and set standards for the facility inclusive of labeling requirements
Part VI	Establishes standards for disposal of hazardous waste on land
Part IV	Regulates the transportation of hazardous waste
Part V	Regulates the treatment of hazardous waste
Part VI	Establishes minimum requirements for disposal of hazardous waste on land
Part VII	Establishes restrictions and prohibitions on landfill disposal; and bans the importation of all hazardous waste; and prohibits its mixing, dilution and subdivision.

Regulation 20 prohibits persons from importing any hazardous waste into Belize without first obtaining written authorization from the Department, provided no such authorization shall be given unless the person establishes to the satisfaction of the Department that:

(a) the hazardous waste will be used as a raw material for an industry in Belize; and

(b) there will be no harm to the human health and the environment from the use of such hazardous waste.

Subsection 2 of this same regulation prohibits the importation of hazardous waste into Belize for the purpose of disposal.

Records Required of Hazardous Waste Facility

Part II of the regulation requires that the operator of a hazardous waste management facility keep an operating record.

Hazardous Waste Facility Operating Record

a) a description of each waste received, generated or stored including:
    (i) the name of the waste;
    (ii) a description of the wastes including the physical, chemical and biological characteristics of the waste;
    (iii) the physical state of the waste;
    (iv) the quantity in kilograms or in liters of the waste;

b) records of all waste obtained from a generator;
c) all results of plant inspections, tank inspections and the comments and data resulting from the inspections;
d) all personnel training program documentation;
e) a record of all events which resulted in contingency plan implementation;
f) all monitoring data collected as required by any approvals, including original strip chart recordings and recordings from continuous monitoring equipment, where applicable;
g) calibration and maintenance records of monitoring equipment;
h) copies of all approvals issued by the Department;
i) copies of all applications for approvals filed with the Department;
j) copies of all reports and records required by the Department;
k) the results of all physical inventories of waste at the facility.

Standards for Hazardous Waste Storage Facilities

The following are standards established for hazardous waste storage facilities:

Hazardous Waste Storage Standard

1. any leakage is contained and prevented from entering into the remainder of the storage site and places beyond, including sewers and the ground underneath the site;
2. a secondary containment system is provided as a minimum for liquid hazardous waste;
3. the hazardous waste is adequately labeled, stating the identity of the contained hazardous waste;
4. incompatible hazardous wastes are stored in such a manner that there will be no contact even in the event of a release;
5. routine inspections of the facility are performed;
6. the place where the hazardous waste is stored:
7. is secured from public entry,
8. is prominently identified as a hazardous waste storage site,
9. is equipped with suitable equipment to handle emergency situations,
10. is provided with operators trained to respond to emergency situations specific to the waste and other substances stored;
11. has no opening in the secondary containment system that provides a direct connection to any place beyond the containment system,
12. provides no access for surface water to enter the secondary containment system.

Prohibitions on Hazardous Waste Prohibited of Entering a Landfill

The following Table 3.12 provides a listing of substances prohibited from entering a landfill.

Table 3.12: Hazardous Waste Regulations, 2008- Landfill Disposal Prohibitions

Landfill disposal of the following hazardous wastes is prohibited:

(a) solid hazardous wastes containing 1 or more halogenated organic compounds in a total combined concentration greater than 1000 milligrams per kilogram;

(b) solid hazardous wastes containing 1 or more halogenated organic compounds in a total combined concentration greater than 1000 milligrams per kilogram;

1. acetone	**8.** ethyl benzene	**14.** isobutyl ketone
2. benzene	**9.** ethyl ether	**15.** nitrobenzene
3. butyl alcohol	**10.** isobutanol	**16.** 2-nitropropanone
4. carbon disulfide	**11.** methanol	**17.** pyridine
5. cresols and cresylic acid	**12.** methyl ethyl ketone	**18.** toluene
6. cyclohexanone	**13.** methyl	**19.** xylene
7. ethyl acetate		

(c) flammable gasses that exert a measurable pressure on the cylinder, tube, tank or container in which they are held;

(d) hydrocarbon contaminated solids exhibiting a flash point less than or equal to 61 degrees Centigrade as determined by the closed cup test method;

(e) flammable substances that are liable to spontaneous combustion under the conditions of disposal or are liable to emit flammable gasses under the conditions of disposal;

(f) wastes which produce a waste extract that contains one or more substances listed in Column I of Table 2 of the Schedule in concentrations equal or greater than the concentration specified for each contaminant in Column II of the said Table, if those wastes are to be disposed with municipal garbage;

(g) earthen materials including gravel, sand clay and soil, that contain more than 100 parts per million by weight of polychlorinated biphenyls;

(h) hazardous wastes with a pH less than 2.0 or more than 12.5;

(i) solid hazardous wastes producing a waste extract which contains any substance in a concentration greater than the value for that substance shown in sub-regulations (f) to (h).

3.4.1.4 The EIA Regulations

The **Environmental Protection Act** requires a developer to carry out an EIA whenever a project significantly affects the environment. In order to specify what projects have a significant effect on the environment the EIA Regulations classifies projects into two categories (Schedule I and Schedule II). A third schedule provides the guidelines for schedule II projects which should be used by permitting agencies for the determination as to when a project should be deferred to the DOE.

The two categories are as follows:

1. Schedule I:	**Full EIA required**
2. Schedule II:	**A full EIA or some Environmental analysis in the form of an LLES may be required depending on the location and size of the project and other considerations**
3. Schedule III:	**Guidelines for Schedule II projects requiring deferral to DOE**

Under section 20 of the **Environmental Protection Act**, any project that may ***significantly affect the environment*** requires an EIA. **Schedule I** projects are those that are likely to have adverse impacts that may be sensitive, irreversible and diverse. Many **Schedule II** projects differ from **Schedule I** projects only in scale. In a **Schedule II** project the impact may not be as serious as a **Schedule I** project depending on size, location and other considerations.

3.4.2 Solid Waste Management Authority Act

The Solid Waste Management Authority Act (1991) provides for the formation of an independent Solid Waste Management Authority (SWAMA) with broad powers to provide for the collection and disposal of waste in accordance with regulations issued under the Act. The Solid Waste Management Authority Act was enacted in June 1991 but did not come into effect until 2000 (see S.I.42 of 2000). Section 3(1) of the Act established the Solid Waste Management Authority and a Board of Directors was constituted under section 3(2). By Gazette Notice 242 the membership of the Board was gazetted. The Board comprises of 5 private sector Directors and 2 public sector Directors.

The SWMA has the authority to declare "service areas" (with the approval of local authorities), arrange for collection and disposal services (including the use of contractors) for those areas, and explore available recycling alternatives. The SWAMA also has the authority to enact and implement policy and guidelines conducive to adequate solid waste management throughout the Country. The Act also authorizes and directs the SWAMA to devise methods for the efficient disposal of solid waste, employing modern methods and techniques.

The Solid Waste Management Authority is currently in the ;process of institutional building and strengthening itself while embarking at the same time with the implementation of a National Solid Waste Management Plan to address current solid waste problems that had reached alarming levels. The Authority has prepared new regulations and standards for the following:

- construction and management of landfills;
- construction and operation of incinerations;
- construction and operation of composting plants;
- collection and transportation of industrial waste;
- tipping fees at landfill sites

While the Authority is seen as an implementer of solid waste programs the Department of the Environment remains as the regulator of most aspects pertaining to solid waste related standards. The Ministry responsible for the Environment and the Ministry responsible for Public Health are the only two ex-officio members of the board of directors. This is so because of the prominent

responsibility these two institutions have in addressing pollution related issues associated with the improper management of solid waste and its potential negative impacts on human health and the environment.

Although the SWAMA is in its early nascent stage, it is playing a major role in the control and prevention of pollution associated with the improper management of solid waste. Although its focus is presently on abating the current problems associated with municipal or domestic solid waste, it will also play a pivotal role with the disposal of hazardous waste generated in Belize.

3.4.3 The Public Health Act, Cap. 40 Rev. 2000

The Public Health Act establishes the position of the Director of Health Services, medical officers and public health inspectors and a Central Board of Health. Some of the issues addressed by the Act which have incidence on the control and prevention of pollution include those sections of the act pertaining to the "Drains and Water Supply, Infectious diseases, Mosquito destruction, Offensive trades and Sanitation and Prevention of Nuisances from Factories and Miscellaneous Trades." As a result, the Ministry of Health participates as a member for most of the inter-sectoral institutions that have an environment and human health protection focus established under the various primary legislations mentioned above. The Public Health Bureau in the Ministry of Health also participates in the control of pollution through inspection on monitoring programs for the supply of potable water and through their vector control programs. In their Malaria and Dengue public education programmes are topics related to proper sanitation and the proper disposal of solid waste.

The Public Health Act covers liquid and solid waste disposal and issues relating to general public health. However, their focus has been towards human health and the regulation of pollution and the establishment of all these standards is being done under the Environmental Protection Act. The Ministry of Health is given a mandate for addressing public health issues and related complaints, monitoring of sewage and solid waste, and prosecution of public health offenders. .

3.4.4 Town Council Act Chapter 87 Revised Edition 2000

The Town Council Act Chapter 87 Revised Edition 2000 establishes Town Councils as body corporate with perpetual succession and a common seal. The Council shall have capacity to

acquire, hold and dispose of real and personal property and to sue and be sued in all courts of law. The Council shall consist of a Mayor and six other members duly elected in accordance with this Act and regulations made thereunder. Town Councils have wide powers to manage the affairs of the towns, and operate within declared town limits. They can make subsidiary laws or by laws for the good governance of the towns.

Towns Property Tax Act Chapter 65 Revised Edition 2000. This act empowers City and Town Councils to charge for property tax of properties within town limits.

3.4.5 Village Councils Act Chapter 88 Revised Edition 2000

The Village Councils Act Chapter 88 Revised Edition 2000, empowers The Minister responsible for the Ministry under which Village Councils fall to fix and declare any area of Belize not comprised within any city or town to be a village for the purpose of the Act, provided that at least two hundred persons who would be qualified to vote for village councils under this Act live in such an area.

Section 5 (2) of the Act states that every council shall:

(a) be a corporate body bearing the name of "The Village Council of" followed by the name of the village in respect of which it is constituted;

(b) have perpetual succession and a common seal;

(c) be vested with power to sue and be sued in such name;

(d) have capacity to hold lands for the purposes of this Act; and

(e) subject to section 10 of this Act, hold office for three years.

Part IV Section 23 states that "A council may from time to time make by-laws for the rule and good government of its village generally, and in particular in respect of all or any of the following matters:

(i) for the cleanliness of streets and other public places;

(j) for the cleaning of unkempt and overgrown yards within the limits of a village and for recovering the costs of doing same from the owners;

(k) (i) for the sanitation of the village in general;

(ii) for drainage and sewage;

(iii) for scavenging and the removal and disposal of excreta;

3.4.6 Summary Jurisdiction Offences Act (Chapter 98) Revised Edition 2003.

This Act is a Consolidation of Chapter 98 Summary Jurisdiction (Littering Offences Violation Tickets) Regulations. This law Authorizes officials such as policemen, Justices of the Peace, Town and City Administrators, or those authorized by city or town councils to issue violation tickets for littering offences. Section (4) - Authorizes officials to issue violation tickets for littering. An authorised officer may, if he sees a person committing a littering offence, issue him with a violation ticket either at the same time the offence is committed or within forty-eight hours thereafter. There have been several Regulations passed for different service areas administered by either the local government or Border Management Authority at the various points of entry into the country. These rates also vary with respect to where the littering offence is committed.

3.5 Socio-Economic Legislation

These legislation although not directly related to pollution control and prevention are also important to be considered by the contractors during project planning and implementation

3.5.1 The Labour Act

Labour relations between contactors and their workers will be governed by the Labour Act which makes provisions for recruiting employees, terms and conditions of employment, payment of wages, dispute resolution etc.

3.5.2 Workmen Compensation Act

The Workmen Compensation Act applies to workers who are involved with cases of accidents on the job or while being transported to the job. The Act makes provisions for the contactors' liability for compensation, amount of compensation, conditions of compensation, insurance, insolvency or bankruptcy of the contractor, etc.

3.5.3 International Labour Organization Conventions Act

The ILO Conventions Act lists the ILO Conventions ratified by Belize and which have the force of law in Belize. As such, these Conventions will govern the relation between contractors and their workers as to the particular subject matter of the Convention. These Conventions include,

inter alia, Minimum Age, Right of Association, Minimum Wage, Freedom of Association and Protection of the Right to Organize, Abolition of Forced Labour, Radiation Protection, Paid Leave, etc.

3.5.4 Social Security Act

Workers involved with the execution of the project are assured some monetary insurance by the provisions of the Social Security Act, which requires that contractors pay social security contributions for their employees to assist them in times of sickness or injury.

3.5.5 National Occupational Safety and Health Bill

Comprehensive legislation governing workers safety and health have been introduced in the House of Representative in the form of a National Occupational Safety and Health Bill. While this is not yet law, the provisions of this Bill serves as an excellent best practice guide for ensuring the safety and good health of workers involved with the execution of the project.

3.5.6 Dangerous Goods Act

In situations where contractors may import, produce, transport, store and/or distribute dangerous goods such as explosives, petroleum products, gunpowder, dynamite, nitroglycerine, gun cotton, blasting powders, fulminate of mercury or of other metals, coloured fires, other similar substances, the Dangerous Goods Act will govern these activities.

3.5.7 Public Health Act

The health conditions of the workers camps and that of the communities in which they are located during the execution of the project, is governed by the Public Health Act. In the worker's camps and communities, the Public Health Act regulates water supply, drainage, garbage collection and storage, infectious diseases, mosquito destruction, sanitation and prevention of nuisances etc. Also, the Public Health Act makes provisions for ensuring that establishments providing food services are staffed by persons in receipt of Food Handlers Certificates from the Public Health Department and that these food establishments have sanitary toilet and washing facilities.

3.5.8 National Institute of Culture and History (NICH) Act

The NICH Act protects our cultural assets during the rehabilitation of the GPH in the Project Area in particular in section 62 (1) which prohibits the willful damage, destruction or disturbance of any ancient monument, or their marking or defacing, or removal; or the removal or destruction

of any antiquity. Another important provision of the NICH Act is section 63 which authorizes the Director of Archaeology to direct any … contractor … who is about to engage in any operation which in the opinion of the Director is liable to destroy, damage, interfere with or otherwise be to the detriment of any ancient monument or antiquity; not to proceed with any operation until the Director shall have had an archaeological exploration and survey carried out; and to take or to refrain or desist from taking any such action as part of the operation as the Director may decide to be fair and reasonable for the proper protection of the ancient monument or antiquity.

3.5.9 Public Roads Act

The Public Roads Act in section 3 entrusts the Chief Engineer with the responsibility, under the authority, control and direction of the Minister of Works, with the construction, alteration, maintenance and supervision of all public roads of Belize, which includes all existing highways. It is therefore with the consent and approval of the Chief Engineer, that the access road into the current site will be adjusted as part of implementation of the project.

The Chief Engineer is empowered by the Public Roads Act in relation to any work on any public road, to close, divert, prohibit or manage traffic in the public interest; appropriate uncultivated lands; make arrangements for compensation, on behalf of the Government of Belize, with the owners of appropriated cultivated land; lawfully enter upon any land; take material from any cultivated or uncultivated land; erect buildings or place construction debris on any adjacent land; make temporary roads; remove any obstruction or encroachment; or construct tunnels, culverts or bridges on any adjacent land.

The Public Roads Act authorizes the Chief Engineer to acquire land on behalf of the Government of Belize if necessary, and in section 10 (2), where the Chief Engineer and the owner cannot agree on the compensation to be made for the acquired land, proceedings are taken to take possession of the land and pay compensation in accordance with the Land Acquisition (Public Purposes) Act.

3.5.10 Land Acquisition (Public Purposes) Act

The Land Acquisition (Public Purposes) Act makes provisions for compulsorily acquiring land for public purposes, assessment and compensation, etc. Section 11 (1) of the Land Acquisition (Public Purposes) Act stipulates that all claims related to the payment of compensation under the

Act shall be submitted to a Board of Assessment. The Board shall comprise the Chief Justice, or other Judge of the Supreme Court nominated by the Chief Justice, who shall be the Chairman of the Board; a member appointed by the Minister; and a member nominated by the owner of the land to be acquired. An award of the Board may be enforced in the same manner as a judgment or order of the Supreme Court.

3.6 National Advisory Policies and Strategic Plans

There have been recent initiatives within the past few three to five years to main-stream several of the environmental management issues into Belize's National policies, strategies and action plans. In addition, efforts have been taken to update many of the old policies and supporting legislations to ensure consistency with Belize's international commitments and the objectives of the multilateral international conventions. However, some of the new policies and legislation have yet to be put into effect or are in the process of early implementation. Such is the case of the new Sustainable Land Use Policy, the National Integrated Water Resources Policy and Legislation and the National Protected Areas Policy and Plan.

The fundamental concept underpinning these policies is the concept of sustainable development. Belize has received support from the UN system and much grant funding for the implementation of initiatives such as SAICM programme and those targeting the implementation of the Montreal Protocol, CBD, UNCCD and UNFCC. Funds have been received for programs or projects that have targeted the opportunities for synergies among these international initiatives that are also intended to assist Belize meet its national, regional, and sectoral and locally defined developmental goals. Nevertheless, there remain policies, strategies, plans and frameworks formulated, adopted and being implemented, either with or without conscious reference to the concept of sustainable development.

3.6.1 National Environmental Policy

Belize National Environmental Policy and Strategy 2014 to 2024 commits to making Belize Green, Clean *Resilient and Strong* by committing to policies for Waste Management and Pollution Control, Integrated Natural Resources Management and Disaster Risk Reduction and Climate Change Adaptation. This project is being designed and implemented to be supportive of these goals.

3.6.2 National Solid Waste Management Policy

The National Solid Waste Management Policy was developed in 2015 as a shared vision by the GOB of how solid waste will be managed. This was developed though the consultation and involvement of all sectors and focuses primarily on domestic waste. It has as its vision, "A healthy, prosperous and resource –sufficient society in which wastes are prevented, re-used, recycled or recovered wherever feasible and beneficial, and disposed of safely only as a last resort." It has as its overall goal and strategy a system for managing solid waste s in Belize that is financially and environmentally sustainable and one that contributes to improved quality of life.

3.6.3 National Culture Policy (Draft)

The Government of Belize believes that the Draft National Culture Policy will provide the framework for identity-building and cultural exchange for the purpose of creating a cohesive and improved quality of life so that people throughout the world come to recognize and appreciate Belize's way of life. An improved waste manage of Belmopan's solid waste will contribute greatly to the improved quality of life of the residents of Belmopan and its environs.

3.6.4 National Gender Policy

The National Gender Policy aims at, *inter alia*, promoting and facilitating women's and men's equal access to, and control over productive resources, services and opportunities. The employment and service opportunities provided by implementation of the project should therefore be available to both genders equally...

3.6.5 Belize Horizon 2030

A key long term goal for Belize up to the year 2030 is to ensure that the Government of Belize is able to make timely investments in key economic infrastructure, especially in the tourism sector though the implantation of solid waste management projects. The closure and rehabilitation of the Belmopan dump-site and the construction of a transfer station is therefore a major contributor to the investment needed in addressing one of Belize's greatest environmental challenges currently negatively impacting Belize's economy.

3.6.6 National Sustainable Tourism Master Plan for Belize 2030

The National Sustainable Tourism Master Plan identifies as a main constraint to tourism development in Belize, the poor level of accessibility on land, mainly due to a small amount of paved roads leading to the tourism assets which results in uneven distribution of tourism flow in

the country, overcrowding in some sites and underutilization of others. The rehabilitation of the GPH in the Project Area will therefore continue to contribute to ready and easy access, for most of the way, to the many tourism destinations in the West.

3.6.7 Government of Belize Policy on Adaptation to Climate Change

One objective of the GOB Policy on Adaptation to Climate Change is to prepare all sectors of Belize to meet the challenges of global climate change. This includes the Solid waste Management Sector identified as one of the major source of greenhouse gas emissions because of current management practices employed in the management of open dumps. The project intends to also address the sites vulnerability to heavy rains and seasonal floods. Belize's waterways also become un-navigable during certain periods. Sea level rise and changes in rainfall patterns could increase the episodes of flooding.

3.7 Environmental and Social Safeguard Policies of the IDB

3.7.1 Environmental and Social Safeguard Compliance Policy

The objectives of the Environmental and Social Safeguard Compliance Policy, is to enhance long-term development benefits by integrating environmental sustainability outcomes and strengthening environmental management capacities throughout the Project. In preparing this ESA, BET is addressing issues of screening and classification, environmental assessment requirements, consultation, supervision and compliance, natural habitats and cultural sites, hazardous materials and pollution prevention and abatement.

3.7.2 Disaster Risk Management Policy

The objective of the Disaster Risk Management Policy is to supporting the SWAMA to systematically manage risks related to natural hazards by identifying these risks, reducing vulnerability and by preventing and mitigating related disasters before they occur. BET has identified those issues of concern as they relate to disaster prevention and is proposing mitigating measures to address these vulnerabilities.

3.7.3 Involuntary Resettlement Policy

It is not projected that there will be a need for any involuntary resettlement as a result of the execution of the project, largely because the activities contemplated under the project rehabilitation will be occupying the same footprint of the existing Belmopan dumpsite and Hummingbird Highway access. It is not expected that there will be any need for compensation as

a result of any the Land Acquisition (Public Purposes) Act since any alignment or widening of the access road to the project site will be occurring on national lands. ". Notwithstanding this, a ***Social Inclusion Plan*** will be prepared at a later stage prior to the start of the works to compensate for any loss of livelihood for the waste pickers.

3.7.4 Gender Equality in Development Policy

The objective of the Policy is to promote gender equality and the empowerment of women. As a consequence, BET will be offering recommendations for involving and protecting women in all possible areas related to project implementation and the operations of the facility.

3.7.5 Access to Information Policy

The Access to Information Policy makes important information on the IDB's funded activities available to the Public. Such information includes EIAs and Environmental and Social Management Reports. This policy is consistent with DOE's procedural requirements which make EIAs available to the public.

3.8 Multilateral Environmental Agreements

Belize is a signatory to approximately thirty international conventions, treaties and agreements that deal in some way or another with the protection of the Environment. Many of these have since found their way into national legislation, particularly in the Environmental Protection Act and its Regulations. These conventions target biodiversity protection such as the Convention on Biodiversity, 1992 (CBD), the Convention on the International Trade in Endangered Species of Wild Flora and Fauna, 1975 (CITES), the Convention on Wetlands of International Importance Especially as Waterfowl Habitat, 1971 (Ramsar),and the Convention on World Heritage Sites, 1972. There are others that focus more on other environmental issues of international concern related to pollution prevention, protection of the ozone layer, climate change and chemicals management and include the UNCCD, UNFCCC, the Vienna Convention and its Montreal Protocol and amendments, Basel Convention, Rotterdam Convention on PIC, The Stockholm Convention on POPs, MARPOL, Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter of 1972 and its 1996 London Protocol, CLC and Fund Convention, OPRC, and the Cartagena convention and its Protocols on Oils Spills and Land Base Sources of Marine Pollution.

3.9 Permits and Licenses

Table 3.13 summarizes the various activities that require permits before construction and post construction.

Table 3.13: Licenses and Permits Required.

Activity	License or Permit Required	Licencee	Permitting Agency
	Pre-Construction		
Development/ Construction Activities	Environmental Clearance	SWAMA	Department of Environment
Earth movement/ excavation for restoration of dump	No permit required but a section of the law requires that the inspector of mines be notified and authorization obtained prior to commencement of activity	SWAMA/ Contractor	Geology Department
Water abstraction well	Water abstraction license	SWAMA	National Integrated Water Resources Commission
Construction of Structures	Building Permit	SWAMA	Central building authority
De-acceleration Lane	It is required that the chief engineer of the MOW be notified and his authorization and approval sought	SWAMA	MOW
Access to Electricity	Facility's electrical system needs to be approved by BEL and the plans to have electricity provided obtained	Contractor	BEL
	Post- Construction		
Effluent Discharge	Effluent Discharge of gray water and effluent from washings and collection of leachate	Operator of Facility	Department of Environment
Water abstraction license	Water abstraction license	SWAMA	National Integrated Water Resources Commission
Operations of Facility	Solid Waste Permit for operations of Facility	Operator of Facility	SWAMA

CHAPTER 4: ENVIRONMENTAL SETTINGS

4.1 Geology of Study Area

4.1.1 General Geology

The study area includes Belmopan and surrounding communities inclusive of Armenia, since the Belmopan waste disposal site lies approximately four and a half miles out of Belmopan and similar distance from Armenia. This study area is underlain primarily by early tertiary sediments of the Doublon Formation/El Cayo Group. It consists of lagoonal laminated limestone and dolomitic sections, marls, numerous gypsum occurrences, bentonitic clays of volcanic origin and chert nodules, which are unconformable overlain by late tertiary Red Bank Group deposits of variegated clays, generally grey to red mottled with some gypsum sands and chert deposits that would be representative of a slag deposit and some Quaternary alluvial deposits, sands, sands and gravels (Figure 4.1).

In general, the study area is predominantly underlain by consolidated marls and limestones. These marls and limestones form a gently undulating topography and tend to be typically massive with little to no variation in composition.

The hillocks near the study area, are primarily limestone outcrops that show bedded crystalline micritic limestones that are tan to white in color, relatively hard and consolidated material with some marl and clay inclusions. This is readily visible from the cutting made of the adjacent hill at the base of the entrance to the site as well as a nearby hill where marl material is currently being extracted. The clay deposits vary in thickness with this to be confirmed for specific project site.

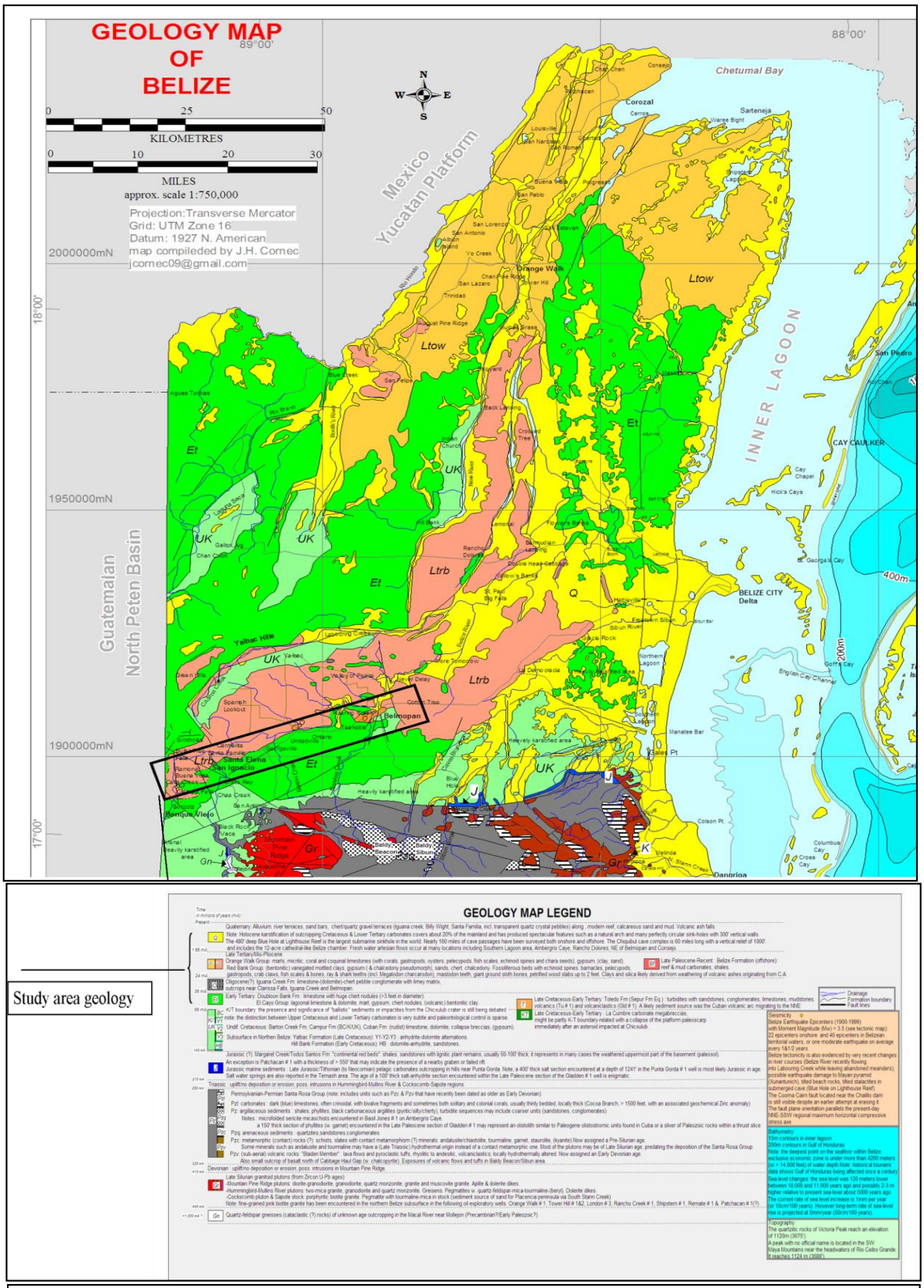

Figure 4.1: Geology Map of the project area

4.1.2 Tectonics

The Study area can be considered tectonically inactive as these faults predate all recent deposits and there is no evidence of recent faulting within the study area. However, there have been several minor tremors felt in the past few years. The project area is said to be more closely subject to the Cayo Wrench system of NE-SW lateral fault blocks, Figure 4.2. This NE-SW lateral wrench system consist of a series of isolated fault blocks and associated escapements, running near parallel to each other showing massive vertical displacement along the thrust faults.

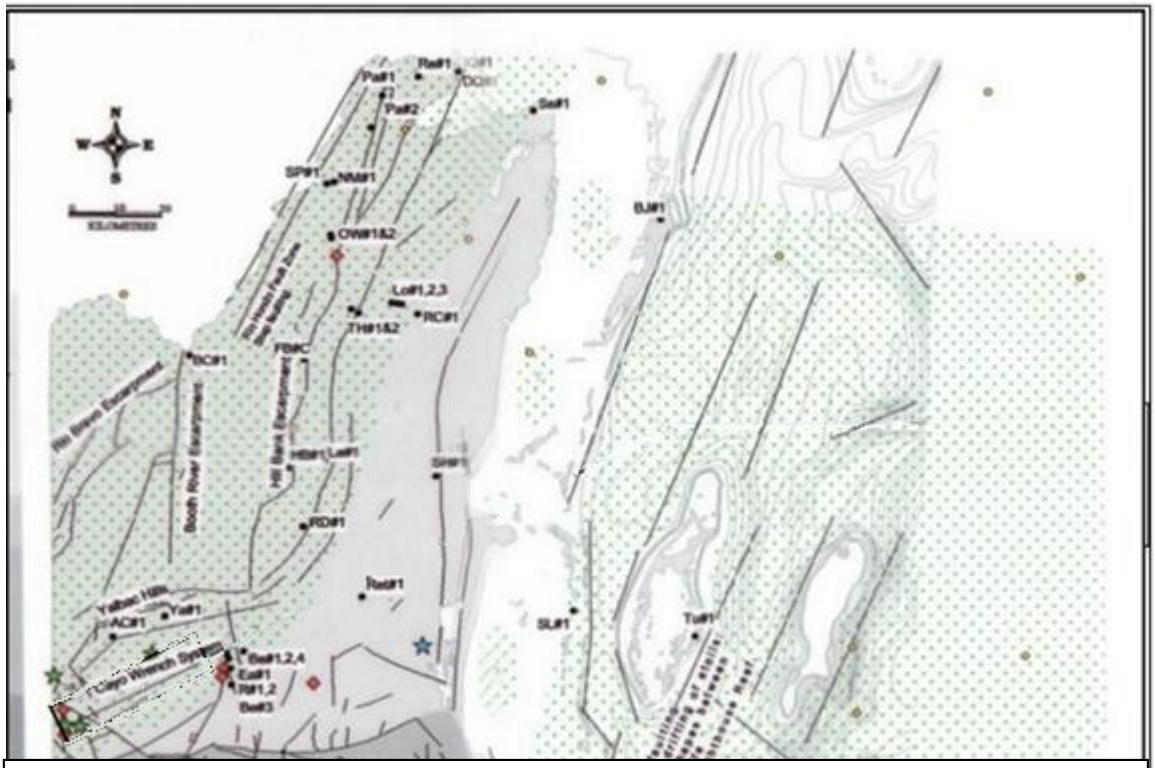

Figure 4.2: Tectonic Features of Project Area - Cayo Wrench System

4.1.3 Topography and Drainage Patterns

Furley and Newey (1979) described the study area as having well developed conical hills and depressions to more open topography exhibiting greater erosion and an overall reduction in relief. The actual project site forms part of a gently elevated sloped parcel of land bordered by a few hillocks on the North West border of the property. The land gently slopes to the north west of the property as can be readily seen by the storm water flow which drains toward the highway and eventually into a creek at the base of the hill on that section of the highway where the

property lies. The south and east sides of the property are bordered by mainly undulating flat land which has been converted for agricultural crops. Within this undulating terrain are numerous gullies and ravines that provide a system of natural drainage to the area. The highest point of the 10 acre project site is located at the far eastern end of the property which had an elevation of approximately 144 m above mean sea level with the lowest near the entrance having an elevation of approximately 138 m above mean sea level (using a handheld GPS - Garmin 72H). As can also be noted from Figure 4.3 the site it was at the top of hill that drained to a creek below at an elevation of 100 meters above mean sea level.

	Sampling Areas	Alt. M
1	Entrance of Bump Site	138.3
2	Proposed Transfer Station Area	138.7
3	Entrance of Last Dump Cell	143.6
4	At Culvert Due South of Dump	122.0
5	At Running Creek Due North of Dump	100.0

Figure 4.3: Altitude of site measured using handheld Garmin GPS instrument

Figure 4.4 provides a more accurate reading of the elevations contained in a more detailed contour map of the site with contour lines at interval of every one meter. As can be seen the project site is gently sloping with several low points bordering it that serves to drain run-off water towards the highway drain where it continues draining toward a creek about one kilometer north as it passes under a box-culvert and connects to the Roaring Creek River that passes nearby on the opposite side of highway. The entire study area is well drained for most of the year by interconnecting gullies and ravines that eventually feed into smaller tributaries of the Roaring Creek River. Figure 4.5 provides an illustration of the drainage pattern of the immediate project area.

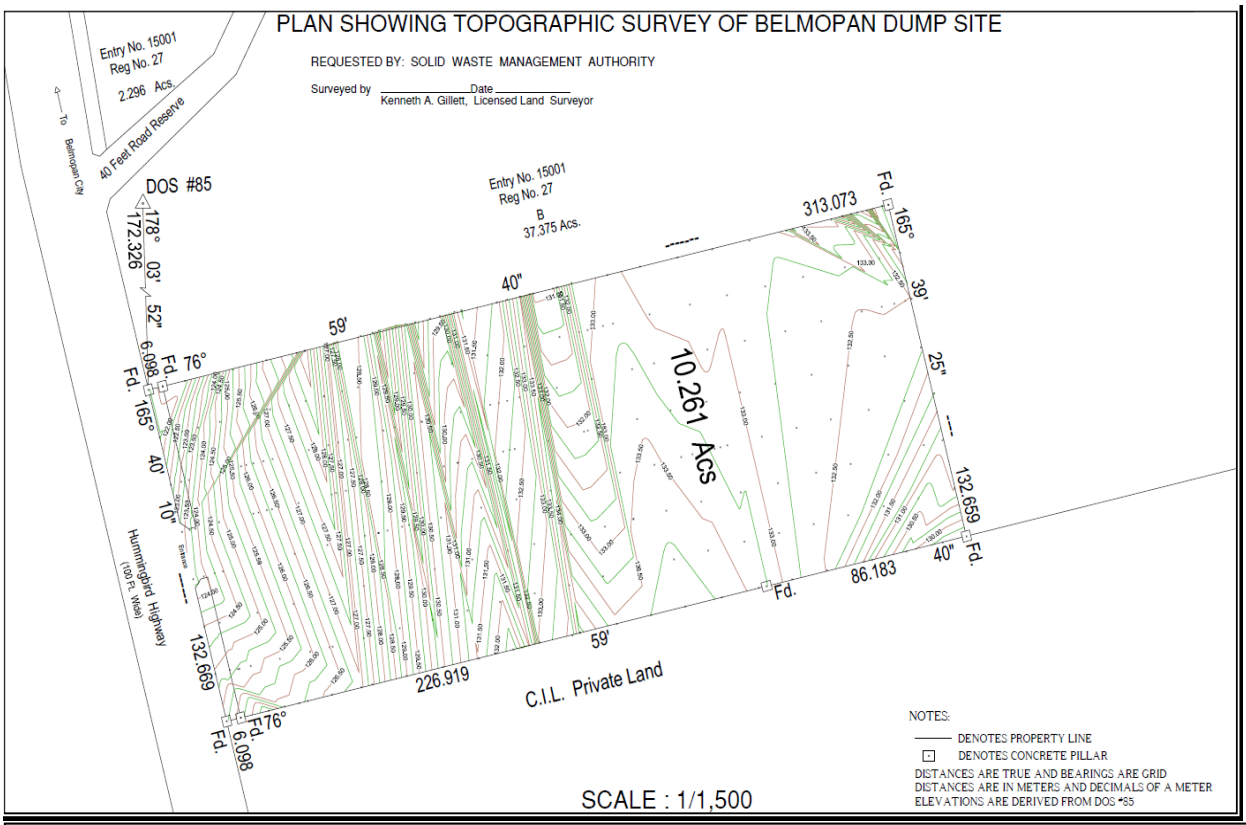

Figure 4.4: Topographic Survey of the Belmopan Dump Site

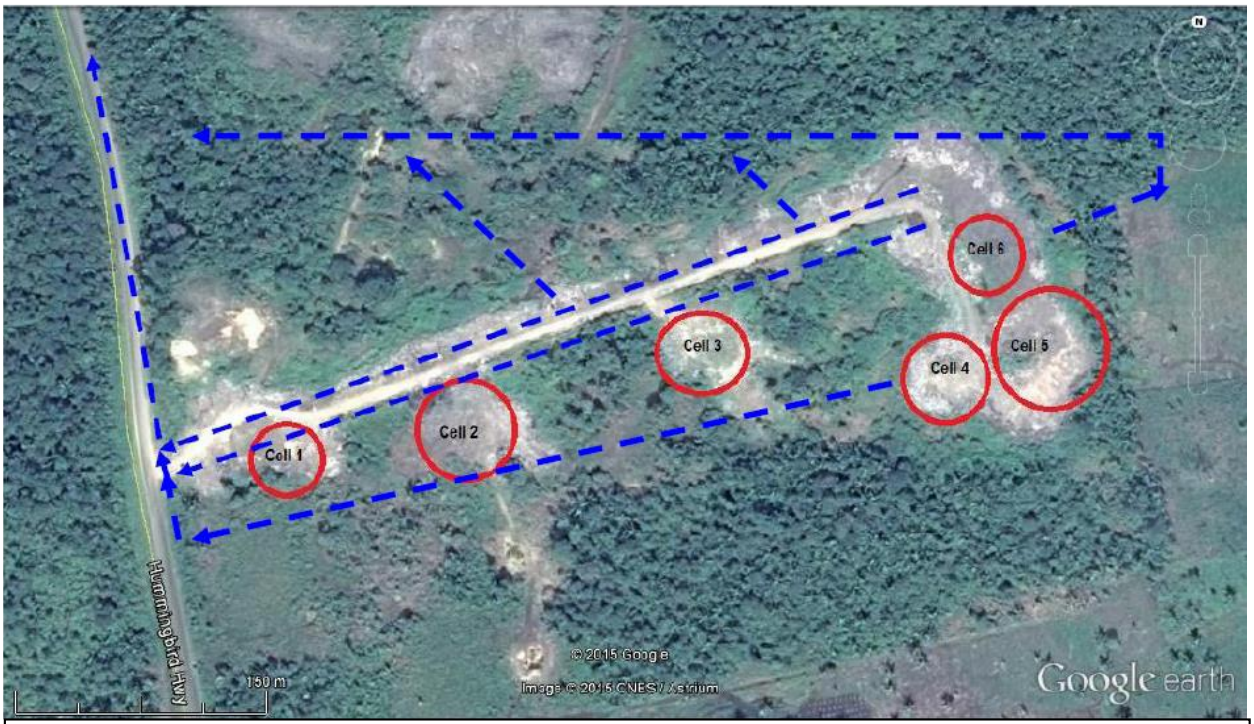

Figure 4.5: Drainage Pattern at Belmopan Dump Site

4.2 Land Use

The land use of the project site shows that a considerable portion of the nearby area is used for agriculture on both sides of the Humming Highway. The actual ten acre project site is bordered on the east and south by plots that have been cleared for rotational crop agriculture and a few small plots for plantains and bananas. These rotational crops are mainly corn, beans and vegetables. In the past as well as presently, shifting cultivation or milpa farming in these areas had been the main agricultural use of the area first practiced by the Mayas and later the mestizos, creoles and Central American migrants that settled the area. The areas to the north have some rounded hillocks with these areas having greater forest cover. The forests in the area appear to be in their early stages of succession.

The study area lies within the Roaring Creek sub-catchment area of the greater Belize River Basin. The land use in the in this sub-catchment is summarized in Table 4.1, highlighting five main land use categories of the area. Figure 4.6 also provides a map of the major land use classification of the area. A more detail description of the land use of the three sections of the study area is provided in the section pertaining to the ecology of the Study Area. The urban areas in the vicinity of the project include Belmopan and its environs and the village of Armenia.

Table 4.1: Land use in Belize River Sub-catchments

Sub-catchment	Total Area in Km^2	Forest	Agriculture	Scrubland	Grassland Savannah	Urban
Roaring Creek	323.16	230.22	19.44	59.21	5.41	8.88

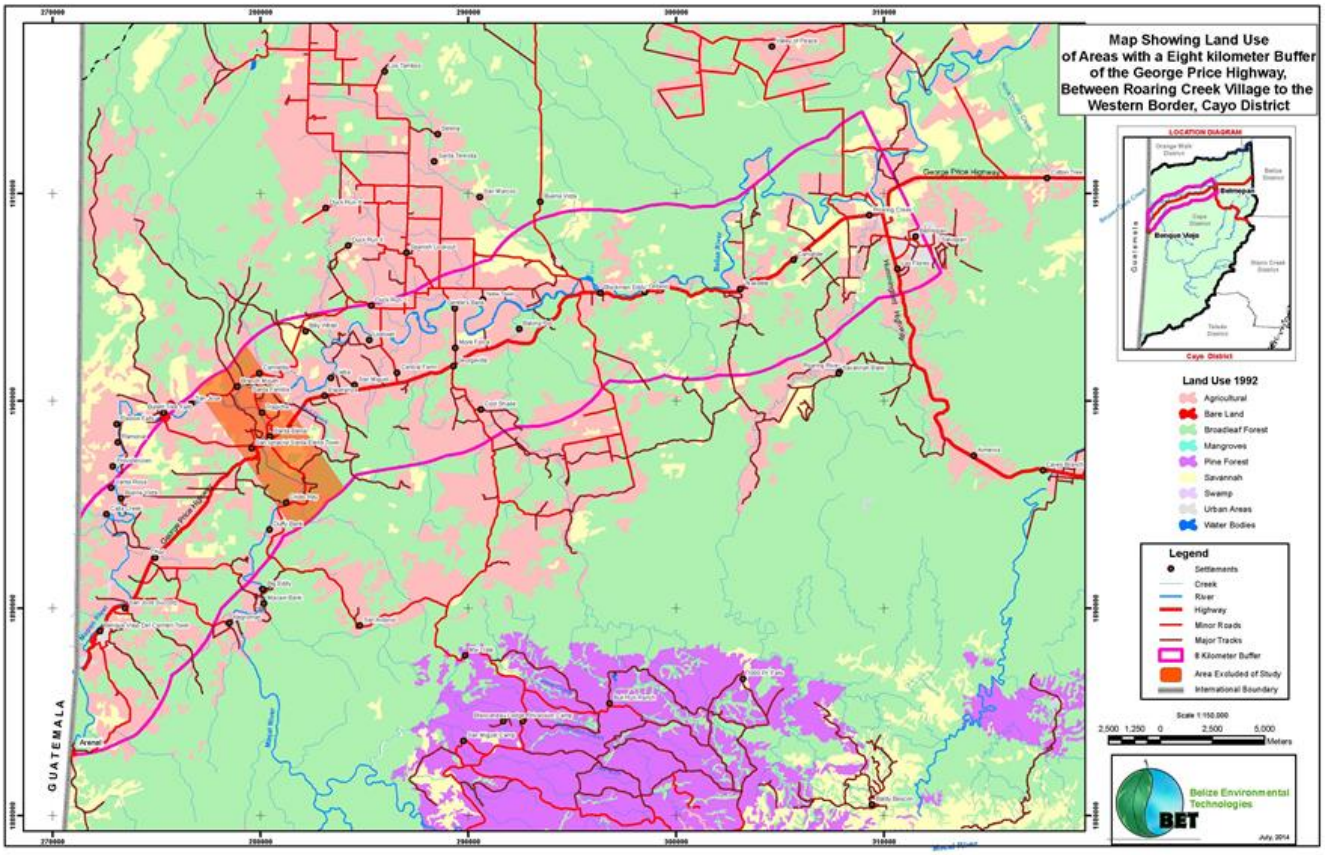

Figure 4.6: Land Use of Area of Interest

4.3 Soils of Project Area

In 1979, Furley and Newey conducted study of two transects that passed very near the project site to study the vegetation of the area and its relationship with the geology of the area. The information in this section has been gleaned from that report supported by BET's site surveys.

The soils of the project area are shallow, rock outcrops are common and the sites are very freely drained. The areas are also much more exposed to wind, increasing evapotranspiration. The effects of the dry season are thus accentuated in these areas.

The soils are nearly all developed over limestones (Figure 4.7), giving rise to rendzina and vertisol profiles of varying colour and drainage, They are referred to as fine textured, pellic vertisols in the F.A.O. classification (F.A.O., 1975). There are also additions to the limestone parent materials from the alluvium derived from the granite, phyllite and sandstone rocks of the Maya Mountains to the south. There are further predominantly alluvial soils (Melinda suite) related to the present Belize river and its tributaries, such as Roaring Creek. It is likely that some

of the clay content is derived from marine muds superimposed on the calcareous formations before uplift (see Quinones & Allende, 1974; Wright, 1967). In patches there are older coastal deposits, usually of coarse texture (Puletan suite).

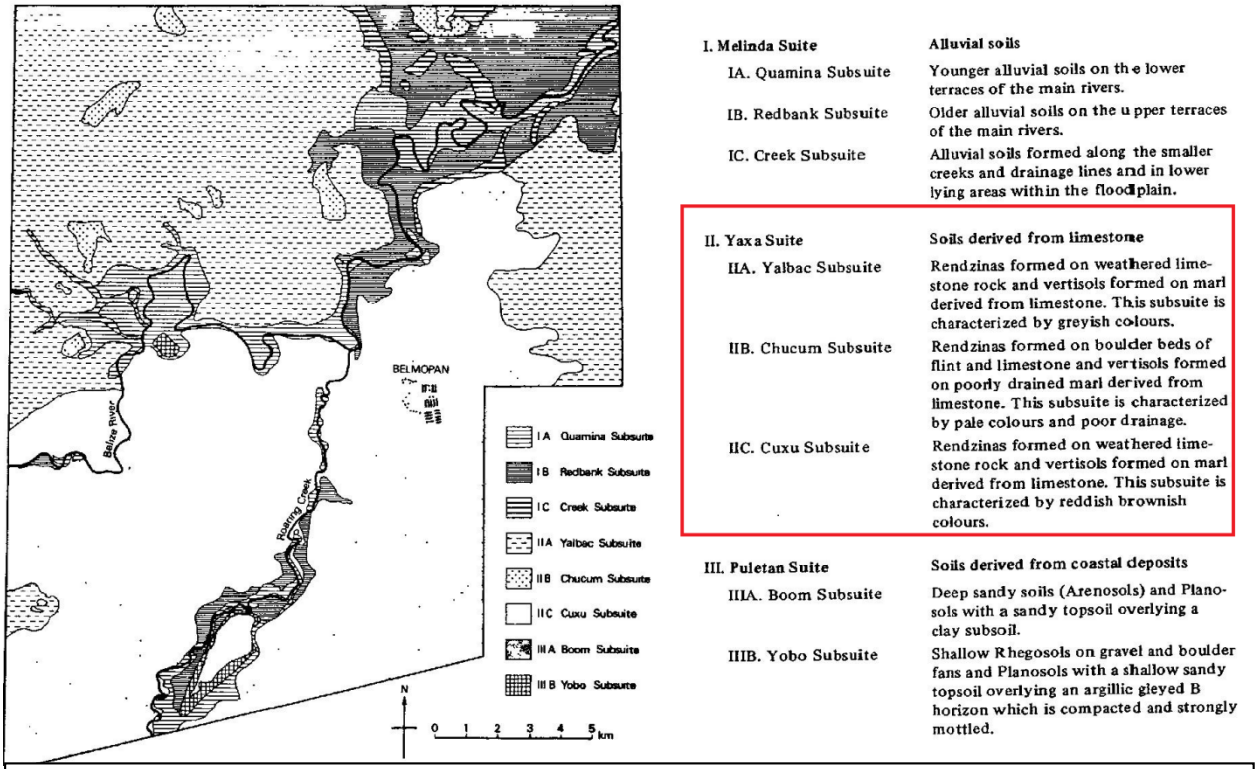

Figure 4.7: Soil type around Belmopan Source (Jenkins 1972)

4.4 Overview of the Hydrology of the Project Area

4.4.1 The Greater Belize River Basin

The project area lies within the Roaring Creek sub-catchment of the Greater Belize River Basin area (See figure 4.8). The Belize River, the largest within the Belizean territory, originates in the western Maya Mountains and eastern Guatemala. Besides being the largest basin in Belize, it is the most complex watershed. The mid- Belize River is a mature river and travels through a well-developed and stable valley. Several major tributaries complement the combined Mopan and Macal contribution, thus maintaining high stages for long periods. Major complementary tributaries include the Iguana Creek**, Roaring Creek,** and Labouring Creek.

In their 2010 study on the vulnerability of the Belizean road systems to flood events, TYPSA identified 10 sub-basins of the GBRB.: (1) Crooked Tree and Northern Lagoon sub-catchment,

(2) Labouring Creek sub-catchment, (3) Beaver Dam Creek sub-catchment, (4) **Roaring Creek sub-catchment,** (5) Iguana Creek sub-catchment, (6) Barton Creek sub-catchment, (7) the Macal River sub-basin, (8) the Chiquibul River sub-basin, (9) the Mopan River sub-basin, and (10) the Belize River sub-basin. Total area of the GBRB covers about 10,500 km^2. Almost a third of the watershed (3,300 km^2) lies within Guatemala and a little over two-thirds (7,200 km^2) is in Belize.

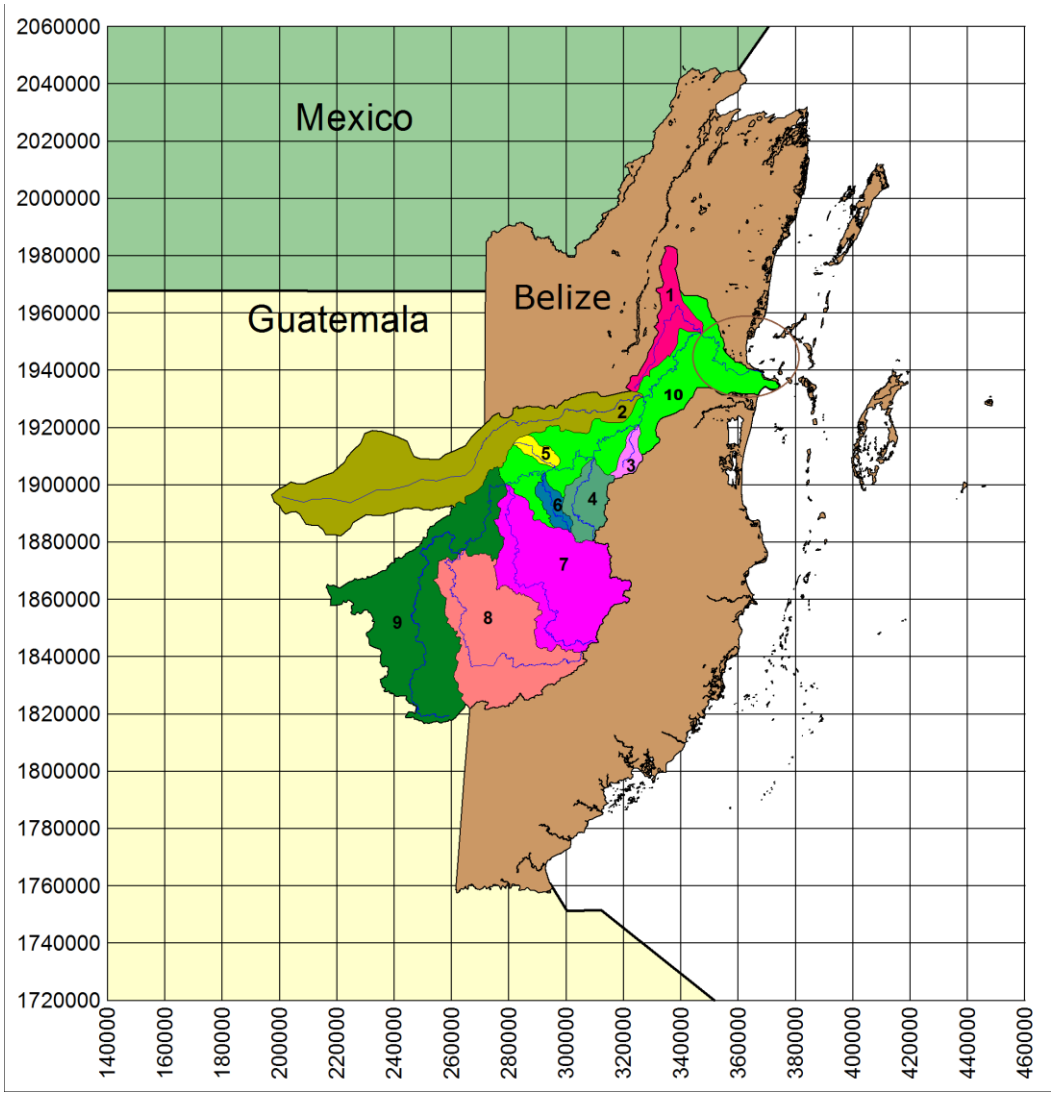

Figure 4.8 Sub-watersheds of the trans-boundary Greater Belize River Basin in Belize and east-central Peten, Guatemala (TYPSA, 2010).

4.4.2 Barton &Roaring Creeks Sub-catchment of Belize River

Barton Creek and Roaring Creek drain the northern karst foothill of the Maya Mountain, Figures 4.9 (a) and (b) respectively. Agriculture activity extends from the Mountain Pine Ridge in the south to the Belize River and onwards to Labouring Creek along the northern edge of this area.

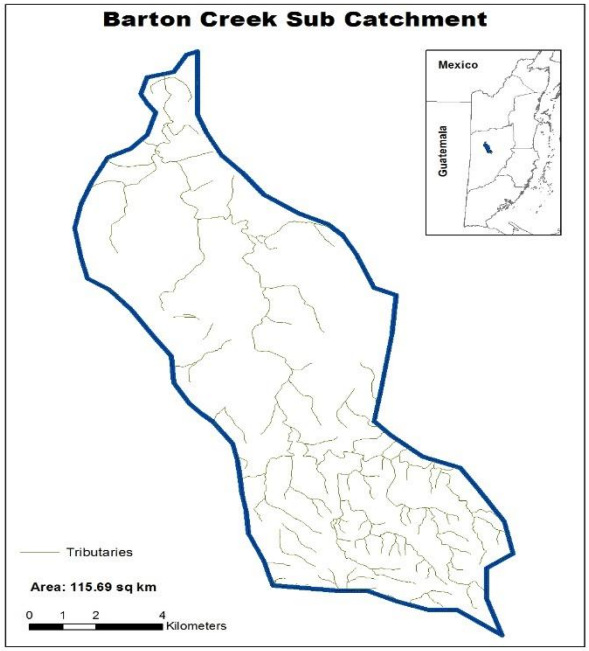

Figure 4.9 (a): Barton Creek sub-basin

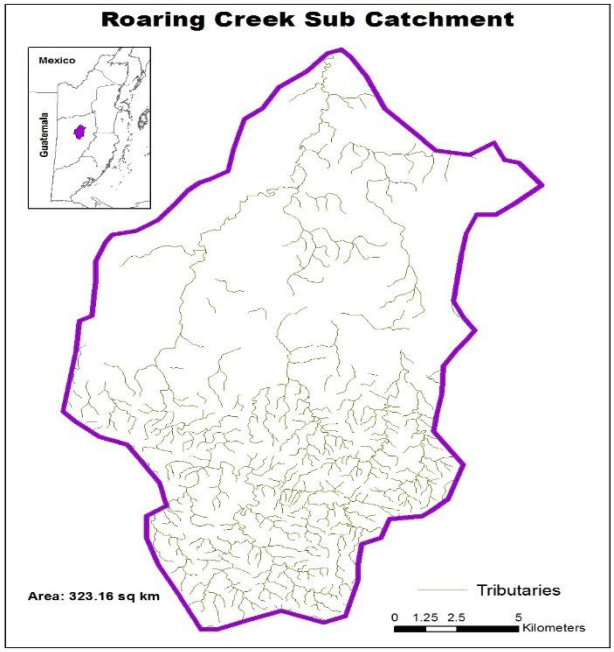

Figure 4.9 (b): Roaring Creek sub-basin

The Barton Creek sub-catchment covers an area of about 115.7 km^2 and like other sub-catchments in the GBRB, consist of dendritic ephemeral and perennial channels. The drainage area of the Roaring Creek is 323.2 km^2. Flow discharge measurements at the Barton Creek Bridge in June 2014 was 0.93 m^3/s, which was relatively low for June, but reflected the below-normal rainfall in the area for the month of June 2014.

Stream discharge measurements conducted in June and July 2014 by BET for the main channels and some tributaries of the middle and western reaches of the GBRB are summarized in Table 4.2.

Table 4.2: Stream Discharge Measurements of Rivers and Main Tributaries of the GBRB

No.	Site	Mile	LAT	LONG	Rivers / Tributaries	Date	Flow m^3/s	Remarks
1	Calla Creek Cable-boat Crossing	73	17.12	89.13	Mopan	5 Jul-14	**23.67**	Rapids 300 meters upstream, moderate flow. Annual flow at Arenal: 36.16 m^3/s (INSIVUMEH, 2004)
2	Low-lying Wooden Bridge, San Ignacio	70	17.09	-89.13	Macal	28-Jun-14	**13.46**	Controlled flow, varies considerably
3	Central Farm Bridge	62 1/2	17.16	-89.07	Burton Creek	28-Jun-14	**0.03**	Very low, with elevated gravel streambed, numerous obstruction
4	Barton Creek Bridge	60	17.20	-88.96	Barton Creek	4 Jul-14	**0.93**	Low to moderate flow. Rocky bed
5	Iguana Creek Bridge, Blackman Eddy		17.22	-88.91	Belize	28-Jun-14	**45.31**	Very rapid flow of moderate depth
6	Rivera, Roaring Creek	46	17.25	-88.80	Roaring Creek	3 Jul-14	**2.68**	Low flow, elevated gravel streambed above stream level

At the Rivera site on the Roaring Creek near Belmopan, the measured flow in June 2014 was 2.68 m^3/s.

4.5 Groundwater Province in the GBRB

Groundwater is product of the rainfall regime and the geology of the landscape. Belize's geology is predominantly limestone, with the notable exception of the Maya Mountains that is composed of igneous, metamorphic, and sedimentary rocks that are from 125-320 million years old. Three main groundwater provinces dominate the GBRB from mid to upper Belize River, the Macal and Mopan River sub-basins (Buckalew, *et al.* 1998). These are the Campur, the Vaca and the Maya Mountain provinces, Figure 4.10.

The Campur Province coincides with the outcrop of the Campur limestone north of the Maya Mountains extending eastward toward Belmopan and the coast and northward to the boundary of the Coastal Plains & Shelf Province. It includes the northern Cayo District and southern Belize district. In this Province, semi-confined and perched aquifers are primarily quaternary alluvial deposits and Miocene-Pleistocene sedimentary materials that overlie the porous and fractured Palaeocene-Eocene limestone formations. Aquifers in this Province are recharged from direct infiltration and runoff from the Maya Mountains.

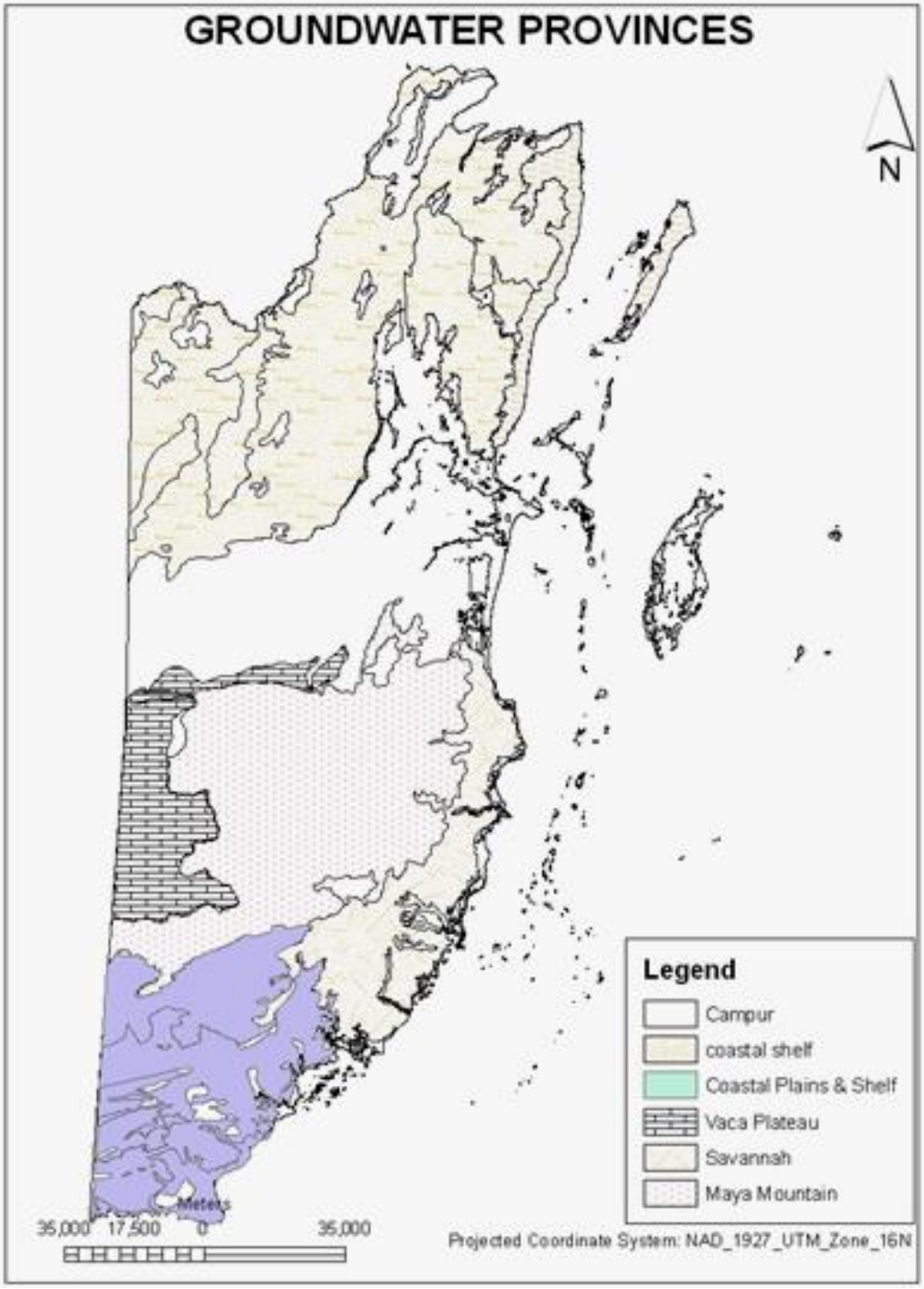

Figure 4.10: Ground Water Provinces of Belize (Belize Environment Profile

Wells in the inland semi-confined aquifers penetrate to depths up to 150 metres with static levels rising to 26 metres below the surface. In the coastal alluvium deposits, well penetrate to a maximum of 32 metres with static water levels rising to near 2 metres below the surface. Confined aquifers were identified at 158 metres in the northeastern portion of this Province.

Maximum inland well yields are near 1125L/min, average hardness is 286 mg/L while in the coastal region maximum yields are near 4000L/min. The confined aquifer yielded 19600 L/min of brackish water.

The Vaca Plateau Province straddles the western border in the northern Cayo district and includes the western slopes of the Maya Mountains. It is composed of fractured and karstic Triassic superior limestone and dolomites. Springs are abundant and aquifers may be semi or unconfined. Aquifers are recharged from surface runoff in the Chiquibul drainage basin.

The Maya Mountains Province: The Maya Mountains Province is composed of late Carboniferous-Permian volcanic material. The rocks have been metamorphosed with abundant dense granitic intrusions. No major aquifer material is expected in this region; however, weathered and fractured metamorphosed mudstones, claystones, phyllites and slates may have exploitable fresh water.
There is no evidence of successful wells tapping this Province. Identification of exploitable groundwater resources in this Province will require advanced remote sensing techniques.

4.5.1 Groundwater Availability of Project Site

The Project area lies within the Campur Province. There is no groundwater wells located near and adjacent to the project area. Almost all nearby communities inclusive of Belmopan obtained their source of domestic water from surface waters (Rivers and Streams). Armenia is believed to be tapping a subterranean stream. There is greater likelihood to tap a subterranean stream than tapping an aquifer within the project area. Anecdotal information, however, indicates that there is a probability of tapping water at depths of 120 to 150 feet below ground.

4.6 Overview of the Climate and Weather of Belize

In accordance with the Köppen climate classification, the climate in Belize can be described as tropical rainforest (Am - Tropical monsoon) in the higher terrain of the central mainland and southern districts, and tropical wet and dry (Aw - Tropical wet and dry) in the remainder of the country, tempered by the Caribbean Sea (WMO, 1997, FAO-SDRN, 1997). The climate also exhibits seasonal subtropical characteristic during the cool, transition period that runs from December through February.

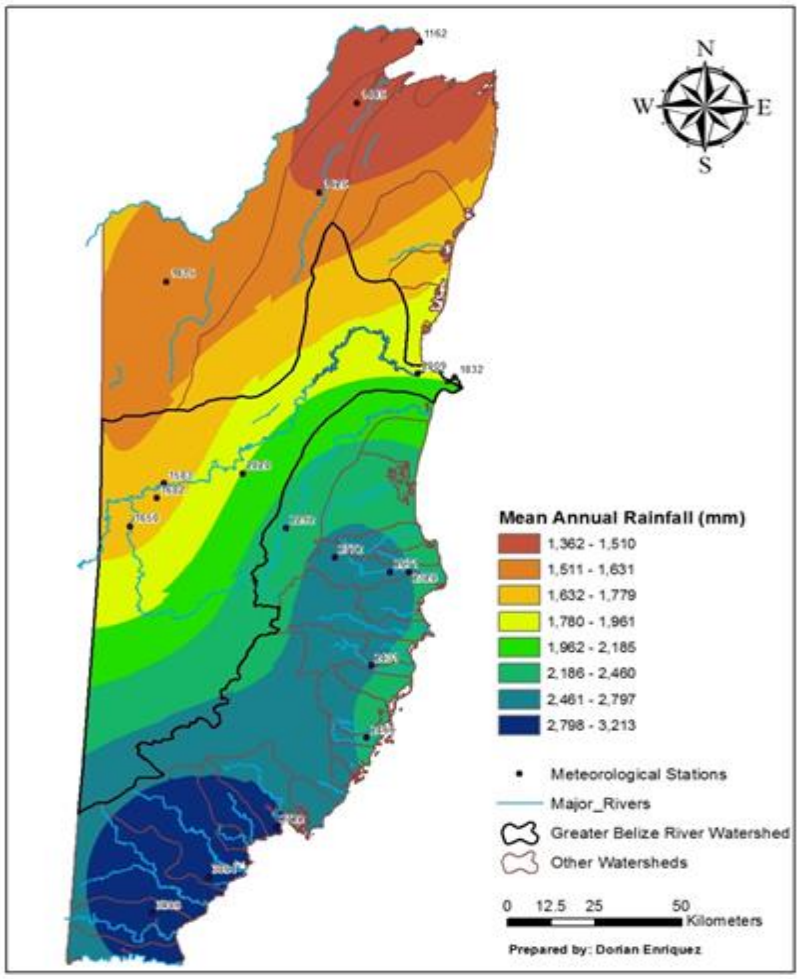

Figure 4.11: Mean Annual Rainfall over Belize

There are two distinct seasons: a wet season, which normally commences around mid-May in the south and early June in the north, and lasts until November; and a dry season, which stretches from mid-February until May. Mean annual rainfall increases from the north to the south of the country, with a mean annual of about 1,400 mm (55 inches) in the northern districts to near 3,864 mm (152 inches) in the south, around the Punta Gorda Agricultural Station at 5 Miles, Figure 4.11. Daily average temperatures in January, the coldest month of the year, vary from 24˚C along the coast to 22˚C in the interior at Central Farm, and 20˚C in the Baldy Beacon area of the Mountain Pine Ridge. In July, it ranges from 29˚C over the coast to 28˚C inland and 25˚C in the elevated terrain inland. Extreme maximum temperatures in excess of 38˚C often occur in the exposed interior and northern districts in April and early May, the height of the dry season.

The annual mean Relative Humidity is 82%, but conditions can become oppressively humid from June until September, especially over coastal regions. The hurricane season in Belize runs from June 1 until November 30.

From mid-May to November, the winds are predominantly northeasterly to easterly. These trade winds or tropical easterlies have moderate to deep moist layers that feed perturbations or disturbances in the easterlies, which generate the tropic rain showers events of the wet season. Winds during the cool, transition period are mainly northerly to north-easterly and are generally drier. Squally weather often accompany the passage of cold fronts during the cooler months, which may produce turbulent and dangerous sea conditions. The dry season winds are generally from the southeast and east and are characteristically gusty and dry.

4.6.1 Climatic Conditions in the Greater Belize River Basin

The Greater Belize River Basin is a trans-boundary catchment system comprising of ten sub-basins. Two of these, the Mopan and Chiquibul are shared with Guatemala, while the remainder is in Belize. Figure 4.12 is a map of the GBRB and portions of the main roads that traverse the basin in Belize and Peten, Guatemala. More on the surface hydrology of the GBRB is presented in the Hydrology Section.

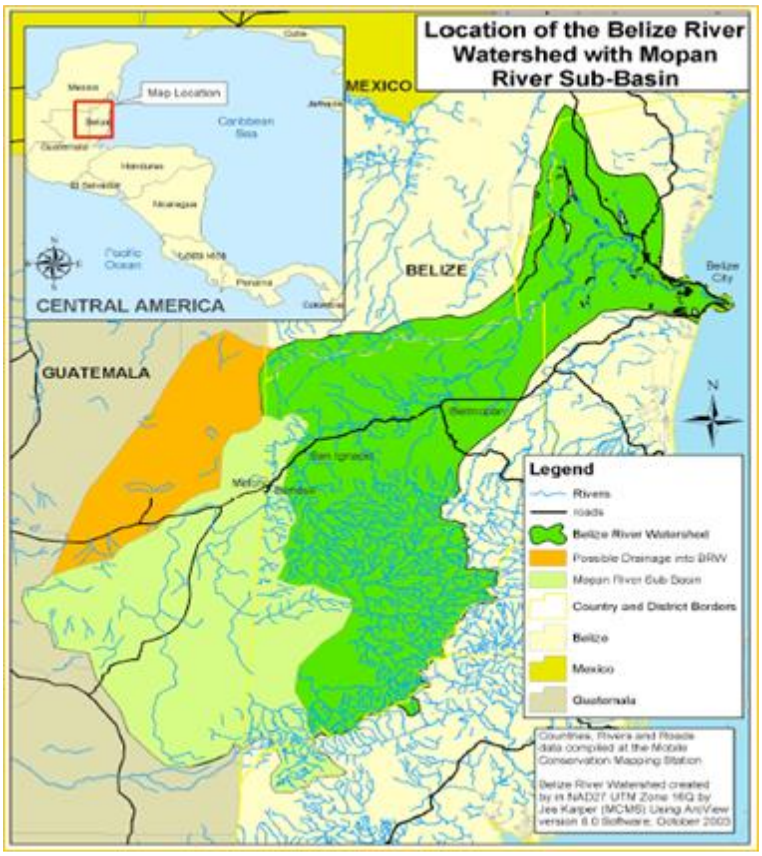

Figure 4.13 (a) and (b) are climate charts for Central Farm and Belmopan. The mean annual rainfall range from about 2000 to 2800 mm in the southern Cayo District to around 1600 - 2000 mm in the northern and north-western border. Peak maximum rainfall occurs in July and October at Central Farm and in June and September at Belmopan. Rainfall surplus is evident from June until January. The mean maximum temperature varies from 29°C to near 35°C in Belmopan and from 28 – 35 at Central Farm.

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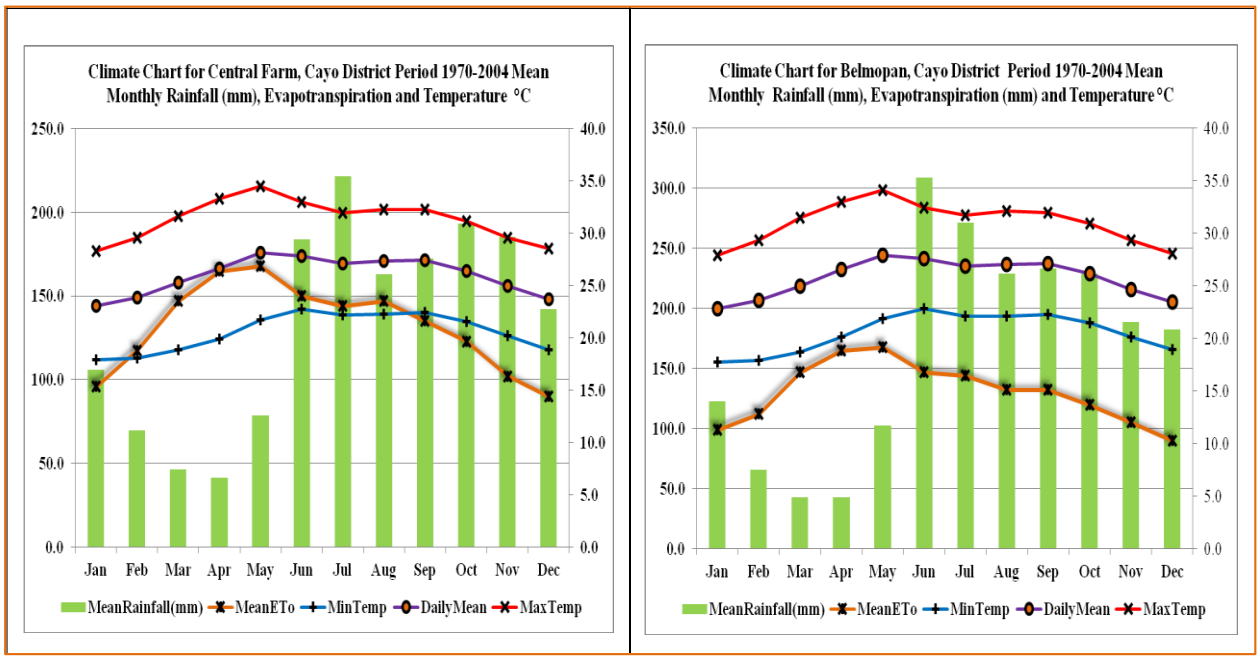

Figure 4.13 (a) and (b): Climate Chart for Central Farm, Cayo District

The warmest month is May, the coolest month is January, and the highest historic maximum temperature recorded in western Belize was 43 °C in May 1976 at Belmopan and 41 °C in May 1974 at Central Farm. The record daily rainfall was 267 mm in April 1983 at Central Farm and 334 mm in June 2002 at Belmopan, associated with a meso-scale convective disturbance over central Belize that undermined the Beaver Dam Bridge on the George Price Highway.

Figure 6.7 is a Moisture Deficit/Surplus graph (Precipitation P – Evapotranspiration E) for western Belize. Rainfall deficit (Precipitation–Evapotranspiration, P-E) extends from February to May (Figure 4.14). The peak of the water deficit is April. The local climate in the West Central zone is described with a UNEP aridity index (AI) of 1.0 − Moist. The Annual Aridity regime is 3 months and the annual Rainfall Deficit is -369 mm at Central Farm to -346 mm at Belmopan. The onset of the rainy season is normally in the first ten days of June. Figures 4.15 (a) – (d) show the mean seasonal rainfall for the Greater Belize river Basin. The higher mean seasonal rainfall in the Basin is concentrated in the elevated terrain of the east-central and southeastern region. During the period DJF, the

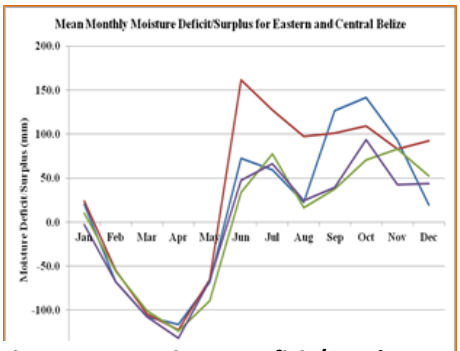

Figure 4.14: Moisture Deficit/Surplus

mean seasonal rainfall in the eastern side of the Basin range from 458 mm – 768 mm, in MAM it range from 200 mm to 244 mm, 572 mm to 768 mm in JJA and 718 mm to 921 mm in SON. The drier region of the Basin is in the northwestern and western areas in DJF, MAM, and JJA, and extends into the higher terrain of the southeast in SON.

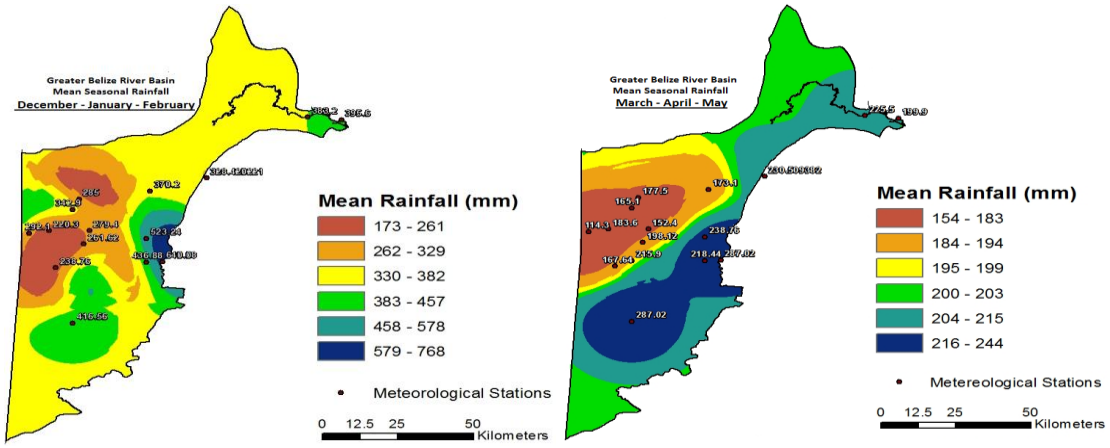

Figure 4.15 (a-b): Mean seasonal rainfall for the GBRB for DFJ, and MAM.

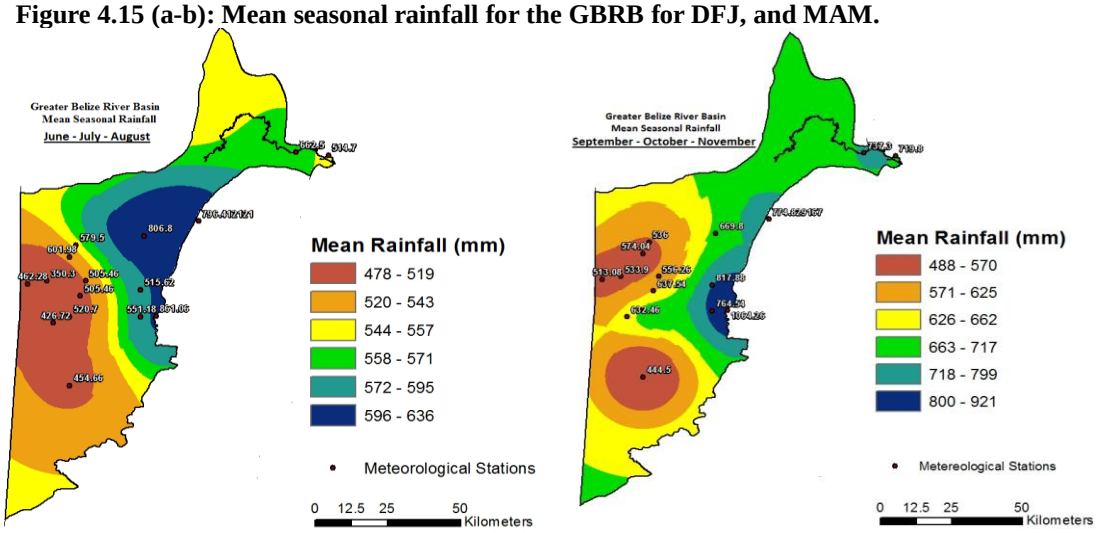

Figure 4.15 (c-d): Mean seasonal rainfall for the GBRB for JJA, and SON.

Table 4.3 provides the seasonal rainfall statistics for key stations in the middle and upper reaches of the watershed. As can be observed, the dry season rainfall accounts for roughly 9 - 14 percent of the mean annual rainfall in the Greater Belize River Watershed, while the rainfall during the cool, transition period is about 18 percent of the mean annual total. The remaining 68 per cent of the mean annual rainfall occurs during the wet months of JJA and SON.

Table 4.3: Seasonal Rainfall Statistics for key Meteorological Station in the Central Zone of Belize

Key Stations in	Mean Seasonal Rainfall (mm)				Annual Mean	Percent of Mean Annual Rainfall (%)			
GBRB (Cayo)	DJF	MAM	JJA	SON	(mm)	DJF	MAM	JJA	SON
PSWGIA	383.2	225.5	662.5	737.3	2008.5	19	11	33	37
Belmopan	370.2	173.1	806.8	669.8	2019.9	18	9	40	33
Central Farm	343.4	164.7	600.7	572.6	1681.5	20	10	36	34
Spanish Lookout	285.0	177.5	579.2	536.0	1578.0	18	11	37	34
Chaa Creek	220.3	183.6	250.3	533.9	1288.1	17	14	27	42
Barton Creek	280.4	151.1	505.4	557.1	1494.0	19	10	34	37
Mollejon	238.8	167.6	426.7	632.5	1465.6	16	11	29	43
Douglas'D Silva	307.3	215.9	520.7	706.1	1750.1	18	12	30	40

(Data Source: 1970-2000, NMS, Belize)

4.6.2 Extreme Rainfall Events

Generally three types of events result in intense rainfall throughout Belize. In June and July tropical waves and disturbance produce widespread thunderstorm activity, which generate intense but localized rainfall. Soil moisture is often below field capacity after the long dry season and runoff would not achieve its full potential, except in urbanized areas. In late August, September and October, Belize normally experience significant and prolonged rainfall during the height of the hurricane season. Substantial runoff occurs, resulting in localized flash floods in the hilly terrain, ponding and inundation along floods plains and low-lying areas. In November through January, significant but less intense rainfall can occur, caused by incursions of frontal systems across the area. During extended and intense dry seasons, ground water table may drop and base flow is the only source of water for the major rivers and tributaries.

Record daily maximum rainfall of 450 mm was recorded at the Philip Goldson International Airport in October of 2000 associated with hurricane Keith. The second highest rainfall record amounting to 234 mm was recorded at the capital Belmopan in June 2002 associated with a strong disturbance centered in the central region of Belize, which generated a vigorous flood event that severely undermined the Beaver Dam Bridge and caused widespread inundation in the Roaring Creek and Belmopan area. Central Farm also recorded a daily maximum of 267 mm in April 1983, associated with a late season cold front interacting with warm, unstable tropical air (see Figures 4.16 and 4.17).

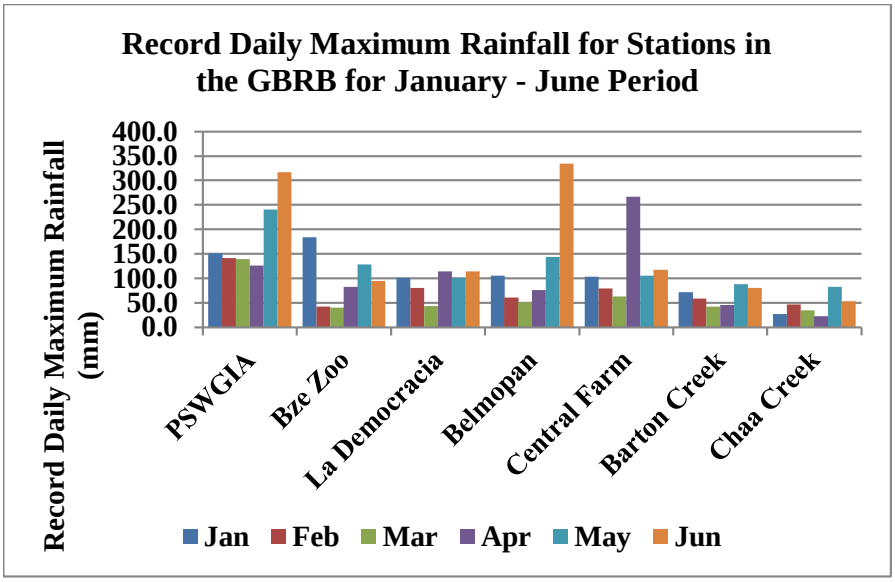

Figure 4.16: Record Daily Maximum Rainfall in the GBRB Jan-June

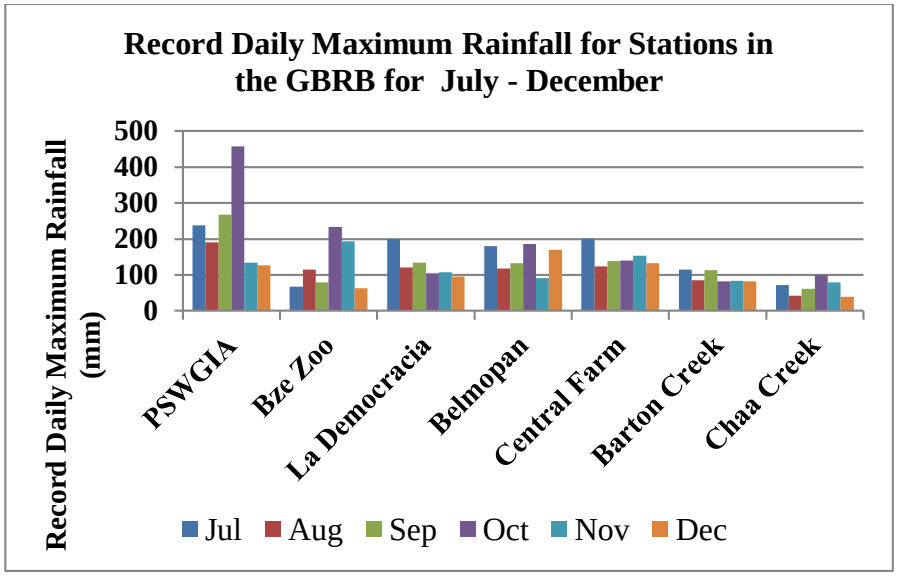

Figure 4.17: Record Daily Maximum Rainfall in the GBRB, Jul. - Dec.

4.6.3 Tropical Cyclones and Hurricanes

The past two decades saw an upsurge of extreme hydro-meteorological and related events that exposed the vulnerability of the Belize's productive sector, infrastructure and the environment to the destructive effects of the weather. These events ranged from widespread and devastating

inundations associated with tropical depression 16 of October 2008 that affected almost a third of country's population that resides and works in the Greater Belize River Basin; to the droughts and heat waves of 2000-2003, and a pandemic Southern Bark Beatle infestation that resulted in a die back of almost 70 percent of Pine forest stands in the Mountain Pine Ridge and the Southern Coastal Pine forest over the three year period of 2001 – 2003. Table 4.4 below is a summary of recent tropical cyclones that made landfall over Belize.

Table 4.4: Tropical Cyclones and Depressions that made landfall on BELIZE, from 2000 to Present

NAME		YR	MONTH	DAY	CATEGORY	SPEED (MPH)	LANDFALL
1	**Richard**	2010	October	24	I	90	20 mls SSW of Belize City
2	**Matthew**	2010	September	25	Tropical Storm	40	Near Monkey River Town
3	**Karl**	2010	September	15	Tropical Storm	60	18 mls NE of Corozal Town
4	**Alex**	2010	June	26	Tropical Storm	65	North of Belize City
5	**TD 16**	2008	October		Tropical Depression		Southern Belize/Honduras/Guatemala
6	**Arthur**	2008	May	31	Tropical Storm	40	Northern Belize
7	**Dean**	2007	August	21	Cat. V	165	Corozal
8	**Iris**	2001	October	8	Cat. IV	145	Stann Creek
9	**Chantal**	2001	August	22	Tropical Storm	60	Corozal & Orange Walk
10	**Keith**	2000	October	1	Cat. V	160	San Pedro Ambergris Caye

Table 4.5 contains a list of six tropical cyclones that affected Belize recently and the estimated costs in losses and damages in US dollars. As can be observed in Table 4.6, the grand total was in the range of 526.2 Million dollars. In the detailed damage assessment per event, it was observed that the agriculture and infrastructure sectors experienced the greatest impacts.

Table 4.5: Estimated costs of impacts caused recent tropical cyclones affecting Belize

No.	EVENT	Date	Sector	Direct Cost	Indirect Cost	Total Damage
			Impacted	US $	US $	US $
1	H. Keith	Oct 1, 2000	ALL	204,779,630	0	204,779,630
2	TS Chantal	Aug. 22, 2001	ALL	8,737,005	11,771,000	20,508,005
3	H. Iris	Oct. 8, 2001	ALL	107,841,500	53,250,925	161,092,425
4	H. Dean	Sep. 21, 2007	ALL	50,279,000	45,350,000	95,629,000
5	TS Arthur	May 31, 2008	ALL	42,806,908	0	42,806,908
6	TD 16	Oct. 30, 2008	ALL	1,390,937	0	1,390,937
						526,206,905

4.7 Climate Change

The impacts of climate change resulting from global warming are expected to threaten the sustainability of social, economic and ecological systems. Coastal zones in tropical regions are

especially vulnerable. Rising sea levels are expected to threaten low-lying coastal areas and islands, with increase evidence of erosion, flooding, inundation, and salinization of surface and groundwater resources.

Climate change is expected to intensify the hydrological cycle. Warmer temperatures caused by an increase in the amount of greenhouse gases are expected to increase the rate of evaporation and the capacity of the atmosphere to hold water vapor. Differential heating between different land and sea surfaces will result in enhanced convection over some areas and increased subsidence in others at different times of the year. This will result in more intense storm events and incidences of drought. Seasons may change by becoming shorter or longer.

Global projections of future sea level rise range from 0.18 to 0.59 meters relative to the average for 1980-1999 by 2099, however sea level rise are not expected to be geographically uniform. Sea level rise in the Caribbean region by the end of the 21st century is expected to range from 0.44 m to 0.70 m for the high climate model scenario.

The future climate for Belize will likely be characterized by increasing temperatures and declining levels of precipitation possibly arising due to a shift in the rainy season and extended dry season. One study projected a median temperature increase of 2.0 degrees Celsius (3.6 degrees Fahrenheit) for the Caribbean region and 3.2 degrees Celsius (5.7 degrees Fahrenheit) for the Central American region, and they project a median decrease in annual precipitation of 12% for the Caribbean region and 9% for the Central American region (Belize and Climate Change: The Costs of Inaction, 2009). Average annual temperatures are expected to increase 3.5 degrees Celsius (6.4 degrees Fahrenheit) over the 90-year period, while average rainfall is expected to decrease by 100 mm (IPCC, 2007). The damages to infrastructure from sea level rise and economic effects to tourism losses being the largest contributor to Belize GDP, will be highly impacted (Belize and Climate Change: The Costs of Inaction, 2009, UNDP). Haites *et al.* (2002) cite potential effects of climate change on the coastal zone, including the loss of beaches due to erosion, degradation of ecosystems (e.g. coral reefs), inundation and damage to infrastructure.

4.8 Baseline Water and Air Quality and Background Noise

4.8.1 Water Quality

In this rapid assessment, no baseline data on water quality was collected. Hence, the information in this section is more qualitative in nature but which remains important to consider in project design and implementation. It is important that the baseline water quality of the Roaring Creek tributary receiving storm water run-off from the project area, and from the Roaring Creek itself. The following provides information on a *much* summarized form on the basic parameters that ought to be included.

Water Temperature: Ambient water temperature for these water bodies in Belize are generally higher during the summer months, and may differ slightly.

pH: The pH of surface waters is important to aquatic life because pH affects the ability of fish and other aquatic organisms to regulate basic life-sustaining processes, primarily the exchanges of respiratory gases and salts with the water in which they live. Failure to adequately regulate these processes can result in numerous sub-lethal effects (e.g., diminished growth rates) and even mortality in cases when ambient pH exceeds the range physiologically tolerated by aquatic organisms. The pH of water affects the normal physiological functions of aquatic organisms, including the exchange of ions with the water and respiration. **The normal pH range that is considered satisfactory for fish and other freshwater aquatic life is 6.5 -9.0.**

Iron: Generally speaking, few surface water supplies have high enough levels of either to cause problems. Occasionally discharge of acid industrial wastes or mine drainage may increase iron or manganese to problem levels in surface water. Usually iron and manganese do not exceed 10 ppm and 2 ppm, respectively, in natural waters.

Orthophosphates: If too much phosphate is present in the water the algae and weeds will grow rapidly, may choke the waterway, and use up large amounts of precious oxygen (in the absence of photosynthesis and as the algae and plants die and are consumed by aerobic bacteria.) The result may be the death of many fish and aquatic organisms. Phosphorus is one of the key elements necessary for growth of plants and animals. Phosphates PO4--- are formed from this

element. Phosphates exist in three forms: orthophosphate, metaphosphate (or polyphosphate) and organically bound phosphate.

Nitrate: Outside of agricultural practices, nitrates can also come from septic systems and, to a much lesser extent, naturally decaying organic matter (CAST 1992). Nitrate is highly soluble and can thus migrate easily through the soil. Nitrates are naturally formed in the environment by nitrogen-fixing bacteria, as well as in high temperatures such as those found in lightning (Bunce 1993). Nitrogen, like phosphorous, is a required plant nutrient and so is added to soil to improve crop yields. Nitrates are a form of nitrogen, which is found in several different forms in terrestrial and aquatic ecosystems. These forms of nitrogen include ammonia (NH_3), nitrates (NO_3), and nitrites (NO_2). Nitrates are essential plant nutrients, but in excess amounts, they can cause significant water quality problems. Together with phosphorus, nitrates in excess amounts can accelerate eutrophication, causing dramatic increases in aquatic plant growth and changes in the types of plants and animals that live in the stream. This, in turn, affects dissolved oxygen, temperature, and other indicators. The natural level of ammonia or nitrate in surface water is typically low (less than 1 mg/L).

Sulfate: Anthropogenic sources of sulfate may come from mine drainage wastes through pyrite oxidation, reverse osmosis reject water, cooling tower blowdown, etc. Table 4.6 summarizes the water quality guidelines for sulphates.

Table 4.6: Summary of Water Quality Guidelines for Sulphate

Water Use	Dissolved Sulphate as mg/L SO_4
Drinking Water (Aesthetics)	500
Freshwater Aquatic Life	*100 **50
** Maximum concentration, not to be exceeded at any time. ** Alert level to monitor health of aquatic moss populations on an occasional basis*	

The atmosphere is the main vehicle for transport of sulphur from various sources. Sulphates are discharged into the aquatic environment in wastes from industries that use sulphates and

sulphuric acid, such as mining and smelting operations, kraft pulp and paper mills, textile mills and tanneries.

Turbidity: Turbidity is a water quality term that refers to fine suspended particles of clay, silt, organic and inorganic matter, plankton and other microscopic organisms that are picked up by water as it passes through a watershed. Turbidity in surface water bodies usually has organic and inorganic matter. Turbidity levels are much higher in water from surface water sources (e.g. streams, rivers, and lakes) than from groundwater sources. Some surface water sources exhibit high turbidity levels during periods of high precipitation. At turbidity of 25 NTU water is considered murky.

Conductivity: Conductivity is a measure of water's capability to pass electrical flow. This ability is directly related to the concentration of ions in the water. These conductive ions come from dissolved salts and inorganic materials such as alkalis, chlorides, sulfides and carbonate compounds. The more ions that are present, the higher the conductivity of water. Likewise, the fewer ions that are in the water, the less conductive it is.

Total Dissolved Solids (TDS): TDS combine the sum of all ion particles that are smaller than 2 microns (0.0002 cm). This includes all of the disassociated electrolytes that make up salinity concentrations, as well as other compounds such as dissolved organic matter. Depending on the ionic properties, excessive total dissolved solids can produce toxic effects on fish and fish eggs. In water with a very high TDS concentration, cells will shrink. These changes can affect an organism's ability to move in a water column, causing it to float or sink beyond its normal range.

Alkalinity: Alkalinity is a measure of the capacity of water or any solution to neutralize or "buffer" acids. This measure of acid-neutralizing capacity is important in figuring out how "buffered" the water is against sudden changes in pH. Alkalinity is important to aquatic organisms because it protects them against rapid changes in pH.
Typical alkalinity range for surface water is 10 – 500mg/L.

Chlorides: Chlorides are present in both fresh and salt water, and are essential elements of life. Chlorides may get into surface water from several sources including:

- rocks containing chlorides,
- agricultural runoff,
- wastewater from industries,
- oil well wastes, and
- effluent wastewater from wastewater treatment plants

Chlorides can contaminate freshwater streams and lakes. Fish and aquatic communities cannot survive in high levels of chlorides.

Hardness: The two main cations that cause water hardness are calcium (Ca) and magnesium (Mg). Calcium is dissolved in water as it passes over and through limestone deposits. Magnesium is dissolved as water passes over and through dolomite and other magnesium bearing formations. Because groundwater is in contact with these geologic formations for a longer period of time than surface water, groundwater is usually harder than surface water (Table 4.7).

Table 4.7: Calcium Hardness as $CaCO_3$ (mg/L)

Soft: 0-20	**Moderately soft: 20-40**	**Moderately hard: 40-80**
Hard: 80-120	**Very hard: > 120**	

When water passes through or over mineral deposits such as limestone, the levels of Ca^{2+}, Mg^{2+}, and HCO_3^- ions present in the water greatly increase and cause the water to be classified as hard water

Fluoride: Fluoride is most toxic to freshwater aquatic life and to people undergoing dialysis. Fluoride accumulates, permanently, in the long bones of vertebrates, causing fluorosis, when present in excessive amounts. In Belize, we have very low concentration of naturally occurring fluoride in our water (groundwater and surface water). This was shown in a study done by the Ministry of Health (1999 and 2014).

Bacteriological Quality: The *coliform* bacteria group consists of several genera of bacteria belonging to the family *enterobacteriaceae*. These mostly harmless bacteria live in soil, water,

and the digestive system of animals. Fecal *coliform* bacteria, which belong to this group, are present in large numbers in the feces and intestinal tracts of humans and other warm-blooded animals, and can enter water bodies from human and animal waste. While fecal *coliform* are not pathogenic (disease causing), they are commonly found alongside pathogenic organisms such as those responsible for dysentery, gastroenteritis, and hepatitis A. It is easier to test for fecal *coliform* than for pathogenic organisms; therefore, the presence of fecal *coliform* in a water sample is used to indicate potential contamination. If a large number of fecal *coliform* bacteria (over 200 colonies/100 milliliters (ml) of water sample) are found in water, it is possible that pathogenic (disease- or illness-causing) organisms are also present in the water.

It should be noted that the WHO Guideline for Total Faecal Coliform in drinking water is 0 counts/100ml. Therefore, these waters should not be used as drinking water without first boiling it or chemically treating it. Table 4.8 provides a listing of the acceptable potable water standards and guideline values from BWSL and WHO.

Table 4.8: Acceptable Limits (BWSL) and Guidelines (WHO).

Parameter	Acceptable Limits (BWSL)	Guideline Values (WHO)	Remarks on water quality parameters
Temperature	25˚C	none	
pH	6.5 – 7.5	6.5 – 8.5	Value of 7 indicates a neutral condition
Color		15 TCU	Less than 10 units is unnoticed, water with 100 units resembles black tea
Turbidity	5 units	5 NTU	Pure distilled water turbidity is 0 NTU
TDS	500 mg/l	1,000 mg/l	TDS of 0-1000 mg/L is considered fresh and non-saline
Conductivity	N/A	none	Range of 50-1500 µS/cm found in natural surface water
Hardness (total)		none	Water with hardness less than 120 mg/L is deemed desirable, in excess of 500 mg/L undesirable for domestic and industrial use
Alkalinity	250 mg/l	N/A	Generally acceptable water quality range for alkalinity is 30-500 mg/L
Chlorine-free	N/A	5 mg/l	
Coliform (total)	1/100 ml	0/100 ml	
E-coli	1/100 ml	0/100 ml	

Nitrate - N	10 mg/l	10 mg/l	
Chloride	250 mg/l	250 mg/l	250 mg/L is the acceptable value for drinking water
Fluoride	0.5 – 1.5 mg/l	1.5 mg/l	
Phosphate	N/A	none	
SO_4	250 mg/l	250 mg/l	Concentrations up to 500 mg/L acceptable
Mg^{+}	N/A	none	
Al^{3+}	N/A	0.2 mg/l	
Ca^{2+}	N/A	none	
Fe	0.3 mg/l	0.3 mg/l	
Pb	N/A	0.01 mg/l	

(Source: NARMAP Environmental Water Quality Monitoring Program: Final Report and Annexes, DOE/USAID, June 1995)

4.8.2 Noise and Air Pollution

4.8.2.1 Sound Pollution

It is common practice to define noise simply as unwanted sound. However, in some situations noise may adversely affect health in the form of acoustical energy (WHO 1999). Literature review indicates that ambient noise level is normally below or about 40 decibels (dB). Therefore, levels that exceed this can be considered as noise pollution. It is well documented that exposure to high decibel noise can result in some adverse effects on human health such as acoustic trauma to the ears caused when they are subjected to the sound of an intensity of 85 dB or more without respite. Table 4.9 provides a summary of the noise levels normally produced by different equipment against ambient noise levels and standards.

Table 4.9: Noise levels of Common Sources

Source of Sound	Distance from Source (m)	Sound Pressure Level Decibels (dB)
Ambient and Standard Noise Levels		
Ambient noise level		40
Normal conversation face to face	1	40 -60
EPA-maximum to protect against hearing loss		70
WHO Maximum –Industrial Work Place Less than for bedroom for good night rest Less than for classroom teaching		75 30 35
Construction Noise Levels		
Air Compressor	15	81
Backhoe	15	80
Chainsaw	1	110
Compactor	15	82
Compactor (Plate)	15	101
Concrete Mixer	15	85
Concrete Vibrator	15	76
Crane Derrick	15	88
Crane Mobile	15	83
Dozer	15	85
Generator	15	81
Grader	15	85
Impact Wrench/Pneumatic Tool	15	85
Jack Hammer	15	88
Loader	15	85
Paver	15	89
Pile Driver (Impact)	15	101
Pump	15	76
Rail Saw (Steel-Stone)	15	90
Rock Drill	15	98
Roller	15	74
Saw	15	76
Scraper	15	89
Shovel	15	82
Tractor without cab	15	120
Traffic (Heavy Equipment)	10	90
Traffic (Heavy Traffic)	15	80-89
Traffic (motorcycle/ATV)	15	96-100
Traffic (Passenger car at 65 mph)	10	77
Truck (Concrete Pump)	15	82
Truck (Dump)	15	88
Truck (Pickup)	15	75

Noise levels in five (5) sampling areas were measured to describe the existing noise environment, and identify major noise sources (See Figure 4.18).Ambient noise levels were

Figure 4.18: Taking Noise level measurements

measured using a Sper Scientific Sound Level Pen 840018, a full function Type 2[2] sound meter. The results are shown in Table 4.10

Table 4.10: Noise Level Results

	Sampling Areas	Time	Noise Level		Wind	Temp	Alt.
			dBA		mph	°F	M
			Normal	Traffic			
1	Entrance of Bump Site	9:58	40	65	3.5	89.7	138.3
2	Proposed Transfer Station Area	10:30	40	50	3.8	88.5	138.7
3	Entrance of Last Dump Cell	10:42	40	50	3.8/4.6	89.4	143.6
4	At Culvert Due East of Dump	11:05	32.3	91.8	3.2	88.5	122.0
5	At Running Creek Due West of Dump	11:30	29.8	90.5	0	89.1	100.0

[2] Meets ANSI S1.4 Type 2 and IEC61672-1 Class 2. See Appendix IV for monitoring instruments used.

The five sites sampled (Figure 4.19) gave ambient noise levels ranging from 29.8 dB to 40. Three readings within the site itself were all similar irrespective of elevation. The major variation in background noise levels would increase slightly as a result of the highway traffic on the Hummingbird Highway.

Figure 4.19: Areas Sampled for Noise Level

4.8.2.2 Air Pollution (Dust and Emissions)

Construction and its associated activities of excavation, and transportation increase the suspended particulate matter in the air, which is harmful to the health of the workers exposed to this type of environment. Fine dust inhaled by workers leads to diseases related to lungs and liver such as “silicosis”, “bronchitis”, “asthma” and “tuberculosis” (Chauhan 2010). During the site visits to the dump site, the team noted that it was far away from any human dwellings and hence, only workers in the area would be affected. During the rainy season, dust may not be a problem; however, during the dry season invariably greater dust pollution does occur making it necessary for greater monitoring and personal protection.

Results of Ambient Air Sampling

Baseline data on ambient air was gathered from five sampling sites using a JDC -Flowatch Flow Meter for wind speed, a Casella MicroDust Pro- Particulate Monitor for particulate matter and

BW Technologies by Honeywell Gas Alert Multi-Gas (4) Meter for hydrogen Sulfide (H_2S), carbon monoxide (CO), Oxygen (O_2) and combustible gases (%LEL) (See Appendix 4).
The general weather was fair and sunny with a maximum temperature of 32°C. The wind was blowing from a North –North East direction. The wind speed ranged from 0 knots at to 4.6 mph.

Table 4.11: Wind Speed and Ambient Air Testing

Recorded Nov. 30, 2015			Wind	Temp	Alt	PM10	H_2S	O_2	CO	LEL
Sampling Sites		Time	MPH	^0F	M	µg/m^3	ppm	%	ppm	%
1	Entrance of Bump Site	9:58	3.5		138.3	0.45	0	20.9	0	5
2	Proposed Transfer Station Area	10:30	3.8		138.7	4.21/12.75/450+[2]				
3	Entrance of Last Dump Cell	10:42	3.8/4.6		143.6	0.324/4.0[3]	0	20.9	0	0
4	At Culvert Due East of Dump	11:05	3.2		122.0	0.045	0	20.9	BDL	0
5	At Running Creek Due West of Dump	11:30	0		100.0	0.09	o	20.9	BDL	0
		Knots= 1.852 Kilometers Per Hour (KM/HR) BDL = Below Detectable Level								

Particulate matter concentrations (PM10) refer to fine suspended particulates less than 10 microns in diameter that are capable of penetrating deep into the respiratory tract and causing significant health damage. The readings ranged from as low as 0.09 µg/m^3 at sample point no 5 to a high of 450 + at sample point 2 where burning of garbage was occurring and these would be blown during wind gusts towards sampler. The readings with the exception of those areas directly near the where burning was occurring are considered relatively low when compared to the World Bank published estimates in Table 4.12.

Table 4.12: Particulate Matter Concentrations (PM10) World Bank Estimates

	Avg	Avg	
Country Name	1991-2000	2001-2010	2011
	micrograms per cubic meter (µg/m3)		
Belize	20.37	20.05	17.98
Data Source: http://data.worldbank.org/indicator/EN.ATM.PM10.MC.M3/countries/1W?display=graph			

It is also worthy to mention that during the dry season February to May, the country of Belize experience forest and brushfires due to spontaneous combustion of dry undergrowth, agriculture clearing or just wanton burning of these dry vegetation and undergrowth. The residents of the City of Belmopan and its environs are affected on a constant basis. It is assumed that during these occurrences the PM10 in these affected areas are relatively high (See Figure 4.20).

Figure 4.20: Burning of Tires to salvage the metal

The detection of hydrogen Sulfide (H_2S), carbon monoxide (CO), and combustible gases (%LEL) were either below detectable level (BDL) or zero indicating the ambient air quality is essentially very clean. Oxygen level at all sites was 20.9%, which is the naturally occurring concentration in atmospheric air.

4.8.3 Vegetation

In an undisturbed natural environment, floristic patterns are strongly determined by soil types, topography and soil moisture. Furley and Newey (1979) conducted a plant community survey near the project area. Sample were taken from two hills transects LT3 and LT 4 (see Figure 4.21).

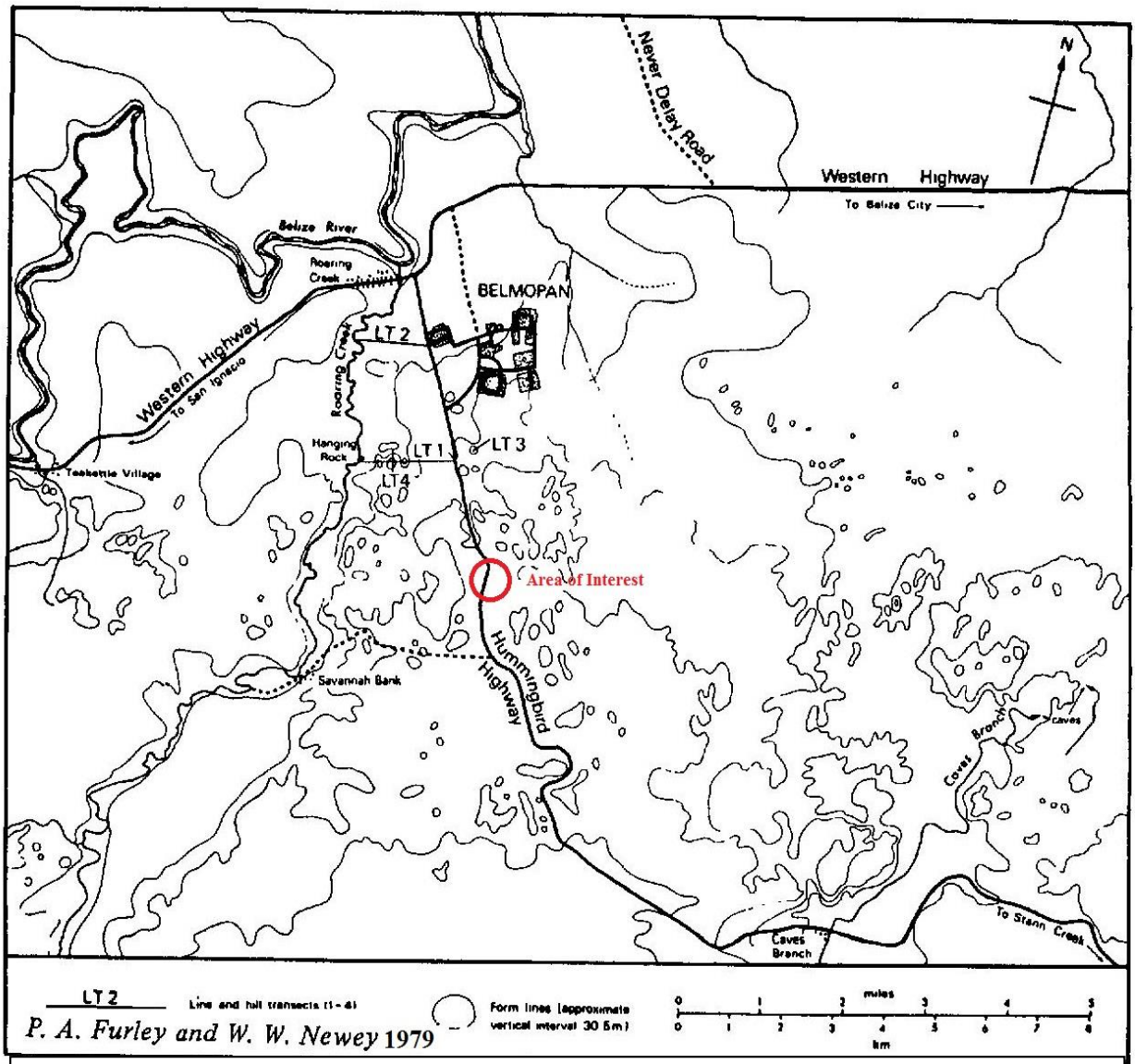

Figure 4.21: Location of Transect Line in Relation to Project Area

The vegetation which has developed over the limestone in the Belmopan area has been described as broadleaved, deciduous seasonal forest, with some semi-evergreen forest particularly on the

alluvial soils (Romney, 1959). In another survey (Jenkins et al., 1976) indicates that there is a considerable area covered by mixed broadleaf forest and palmetto plus secondary thicket (Figure 4.22).

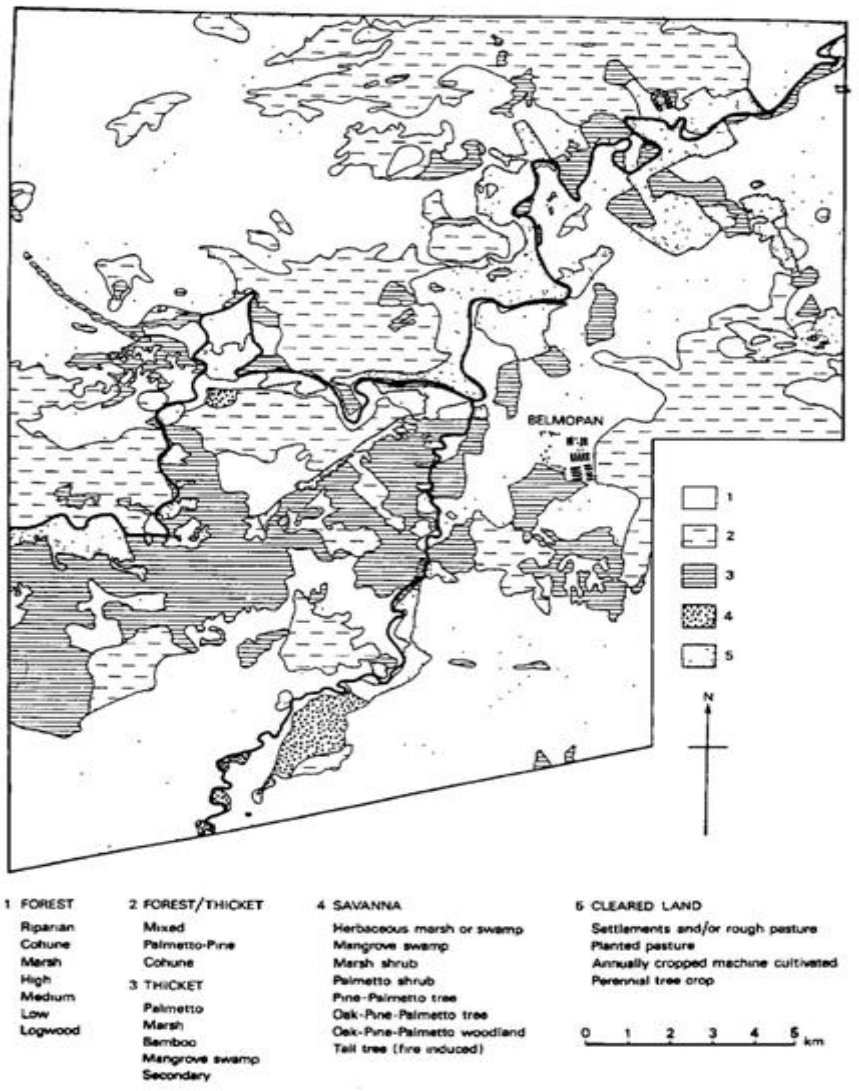

Figure 4.22: Vegetation map of Belmopan Area (Adapted from D.O.S 3149, 1972 after Jenkins 1973

The vegetation appears to resemble the semi-evergreen seasonal climax forest described by Beard (1944) with local variations according to drainage and ground water. It differs from true rainforest in height, species composition and stratification, and the presence of limestone has resulted in a plant cover rich in calcicole species. The area was described as being in its early stage of secondary growth following the devastation caused by Hurricane Hattie in 1961 and by

forest fires and animal invasion (such as that of beetles). The hurricane destroyed most species in the highest stratum of the forest, and fires seriously damaged vulnerable species that had formed the subordinate layers.

The survey showed that although each of the transects showed differing combinations of species, three types of vegetation could be distinguished, composed of varying types of secondary forest and scrub, each associated with distinctive site conditions such as soil, slope and by the particular stage of the sere attained at an individual site: (1) the valley bottoms and depressions situated between limestone hills; (2) the slopes of the hills; and (3) the limestone hill summits. Figure 4.23 and 4.24 illustrates characteristic life-forms in each of these habitats.

Presently, the site visit revealed that most of the 10.26 acres has been disturbed with only the perimeter having secondary growth serving a buffer zones between the other plots. To the east and south of the project area the land has been cleared and is being cultivated with hot peppers, and plantain and beans respectively. To the north there is a buffer zone of secondary forest growth.

4.8.4 Fauna

Habitat lost to wildlife has resulted not only from highway construction but also from timber harvesting, agricultural conversion, urban and residential development, and other factors. Habitat fragmentation is commonly observed in Belize as few species use all the patches of a landscape. Their survival depends on their ability to move from one patch to another. As landscapes become increasingly fragmented by busy roads, housing developments, commercial areas , and other human activities, wildlife habitat is divided into ever-smaller pieces of land for animals to accomplish everything they require; find food and water, establish territory, reproduce, and meet the rest of the specific living requirements. Smaller populations are less stable and over time, face extinction from predators or natural causes. They may also be more susceptible to inbreeding and to genetic defects.

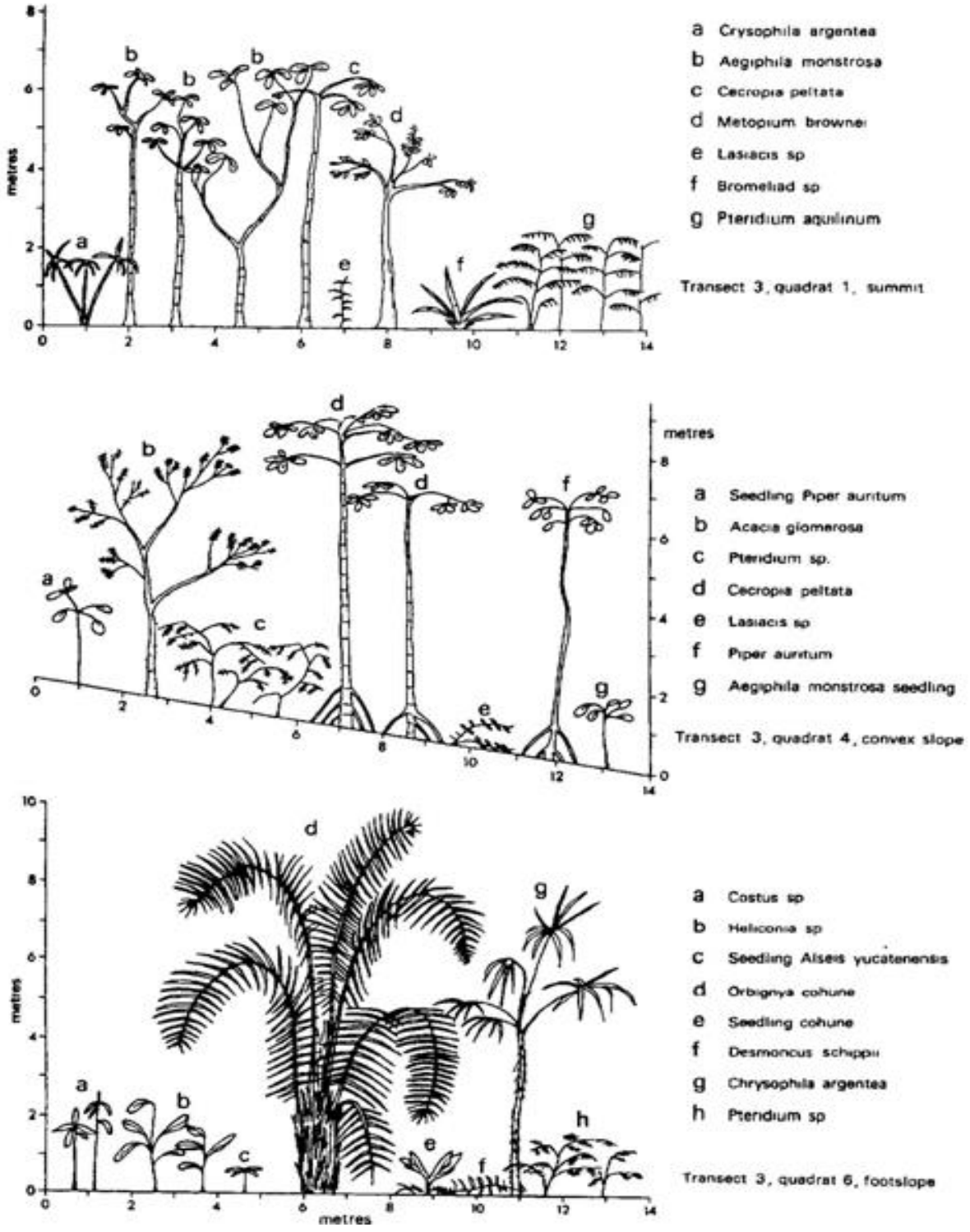

Figure 4.23: Life Form of Plants found along the diagonal transect of sample quadrants (10 X 10 m

Figure 4.24: Vegetation Coverage along the Hummingbird Highway

Black-faced Ant-trush (*Formica riusanalis*), Belted Kingfisher (*Megaceryle alcyon*), Smoky-brown Woodpecker (*Veniliornis fumigates*), Magnolia Warbler (*Setophaga magnolia*), Red-lored Parrot (*Amazona autumnalis*), Black-headed Trogon (*Trogon melanocephalus*), the Bright-rumped Attila (*Attila spadiceus*) and the Great Kiskadee (*Pitangus sulphuratus*).

During the site visits no terrestrial mammals were observed but the ever present black vulture (*Coragyps atratus*) was in abundance as well as the great kiskadee, a large tyrant flycatcher (Figure 4.25).

Figure 4.25: Black Vulture (*Coragyps atratus*) and the Great Kiskadee

4.8.5 Aquatic Fauna

In regards to the available of data, there is general information on the species occurring within the area and the most comprehensive has been the species listed in previous work by Thomerson and Greenfield (1972, 1997). Other fish species profile for Belize can be accessed in the Fish Base website (www.fishbase.org) as well as in the Belize biodiversity (http://biological-diversity.info/Fish_freshw.htm) information website. Independent researchers and consultants have conducted very little technical work in the project area. There exist a little more information on the aquatic ecosystem of the Macal River given its associated developments of three established dams for hydroelectricity generation and post-development assessments of the aquatic ecology.

The continental fish of Belize are classified into three different categories a) freshwater fish that live only on freshwater whose evolution has been freshwater, b) freshwater fish that live primarily on freshwater but that have salt tolerance and have distant relatives from the sea and c) peripheral freshwater fish that have great salt tolerance. It is interesting to note that among the continental fish faunas there are low number of ostariophysans (minnows, catfishes and relatives) (Greenfield and Thomerson, 1997).

The primary freshwater fish are represented by three main families: *Characidae, Pimelodidae* and *Ictaluridae*. The secondary freshwater fish are represented by five families: *Poeciliidae, Cyprinodontidae, Rivulidae, Cichlidae* and *Synbranchidae* while the peripheral freshwater fish are represented by thirty-five families consisting of seventy-seven species.

4.8.6 Rapid Fish Survey of the Project Area

A rapid fish survey was carried out between June and July of 2014 by Belize Environmental Technologies to establish the range of species within the headwaters of the Belize River, including the Mopan and Macal rivers, as well as those species in the three main creeks draining in the mid-reaches of the Belize River – the Garbutt Creek, Barton Creek and the Roaring Creek. The project area falls within the Roaring Creek sub watershed catchment.

In general, the species distribution within all sampling points was consistent in which a total of 24 fish species were documented during the studies. The species composition was limited to 20 species commonly occurring in all of the sampled sites, with three species found in the three rivers. The small Cichlid species such as the Yellowbelly cichlid (*ex-Cichlasomasalvini*) and the Blue-eyed cichlid (*Cryptoherosspilurus*) were commonly occurring in all sampled sites as well as Green swordtail (*Xiphophorus helleri*), the Shortfin molly (*Poecilia Mexicana*), the 'Butasi' (*Rhamdiala ticauda*), Belize silversides (*Atherinella spp.*), Pike killifish (*Belonesox belizanus*) and the Central tetra 'Billum' (*Astyanax aeneus*). The presence of larger cichlids was also recorded, as well as the Blue catfish (*Ictalurus furcatus*) in the area of study.

In general, the fish diversity and abundance were low in numbers in fast flowing shallow areas which ranged between three to six feet in depth with clear waters and highest fish densities found in deeper open areas of smooth laminar flows. The most abundant species recorded was the 'Billum' followed by the Shortfin molly.

The survey conducted provided a rapid assessment of the species present within the study area as the methodology used during the survey was the most effective method in capturing the highest probable number of specimens at any given time. However, the validity of any system of assessment is associated with the frequency and period in which the study was conducted. Given the scope of the fieldwork and short time-frame in which the survey was conducted the results can only provide a limited snap shot of some species inhabiting those ecosystems.

CHAPTER 5: ASSESSMENT OF ALTERNATIVES

5.1 The EIA Process and Consideration of Alternatives

As part of the EIA requirements, there is the need to assess alternatives to a proposed development and its associated activities. In considering the implementation of a proposed conceptual plan, there is often a consideration of the various developmental alternatives that a project proponent would have to consider prior to a decision to move forward with the plan. There are usually two or more important developmental alternatives for each proposed activity to think about.

The evaluation of alternatives may encompass a wide range of economic, social, and environmental considerations associated with the various available options. This section focuses on the evaluation of alternatives inclusive of the 'No Action Alternative' to closure of the Belmopan dump site and its conversion to a transfer station where all domestic waste currently received at the site would be temporarily stored and transported to the Mile 22 Sanitary Landfill Site on the George Price Highway which is approximately 37 miles away by road from the overall proposed development. It focuses on the options that are most practical.

Preliminary baseline information indicates that the major issues associated with the closure of the Belmopan dump-site and its conversion to a transfer station are those primarily associated with the:

a. location of the facility;
b. closure and restoration of the dump-site;
c. improvements to access road because of the danger it poses to motorists and the;
d. provision of utilities (water, electricity and telephone).

In addition, baseline information was specifically obtained to help assess the alternatives being considered to address these most critical issues, while planning for projected climate change impacts and disaster risk management. The previous chapters informed the assessment of alternatives discussed below and the final selection of the recommended options.

5.2 The 'No Action Alternative'

In the analysis of the various alternatives, the option with the highest cost benefit, the most technically feasible and with the least residual environmental and social impacts is usually identified as the preferred option. In most instances the option with the least negative impact is the "no action alternative."

The no action alternative only becomes a viable option where it is determined that a project's environmental and social impacts would far outweigh any net economic and social benefit, which is not the case in this instance. In this instance because the project has as one as its primary goal the improvement of solid waste management, the "no action alternative" would be deemed also as the alternative with the highest negative environmental impacts since the present operations of the Belmopan dump-site have been deemed as less than desirable.

The **'No Action Alternative'** although discussed and required to be considered, often represents an option in these types of projects, that is not always the least impacting and in the best interest of the general public, or proponent, from an environmental, economic and social point of view. In these instances, both the proponent and regulatory agency need to consider the environmental and social opportunities a project of this nature presents to the residents of the study area.

The project provides a good opportunity to reduce the negative environmental and social impacts the current operations of the dump is having on the environment, resources, and health of the residents of the study area, by closing the dump and rehabilitating the area and converting it into a solid waste transfer station. This also helps improve the economic sustainability of the central sanitary landfill where the garbage will go for final disposal. This will also further enhance Belize's tourism potential in the area. Hence, the no-action alternative is not an economically, environmentally and socially viable option.

The **'No Action Alternative'** is primarily being used as a bench-mark from which to assess the impacts of the proposed implementation of the project. The identification of options is therefore centered on the assessment of alternatives to mitigate against issues of concerns associated with the implementation of the project. A choice was then made on the option that was most

economically viable while at the same time resulting in the least negative environmental and social impacts or external costs.

At the end, the success of any project depends on the implementation of adequate mitigation measures, which are derived by identifying a combination of a lesser environmentally damaging alternatives, and those that are the most economically and socially feasible to implement.

5.3 Critical Issues of Concern and Alternatives

5.3.1 Location of Facility

In assessing the alternatives associated with the potential closure of the current dump and the construction of a transfer station that would meet the needs of Belmopan, three alternatives were evaluated inclusive of the no action alternative. The evaluation looked at the following three alternatives:

Alternative 1: Closing the present dump, carrying out rehabilitation of this site and locating the construction and operations of transfer station at the site where the dump once existed about one mile out of Belmopan ;

Alternative 2: Closing the present dump and carrying out rehabilitation of this site and locating the construction and operations of transfer station at the same site.

Alternative 3: No-Action Alternative

Closing the dump and rehabilitating the current site remains a constant for options one and two because of the following reasons and hence, the discussion is more on the location of the transfer station and its operations:

- The negative impacts which the burning of solid waste is having on the environment and health of residents of the study area.
- The negative impacts which contaminated storm-water run-off is having on the Roaring Creek, and health of residents who utilize this source of water for recreational and potable purposes.
- The potential negative impacts which the leachate may be having on ground water resources of the area.
- The negative impacts to the aesthetics of the area.

Table 5.1 provides a comparative summary of the options evaluated for this activity.

Table 5.1 Comparative summary of the options evaluated

Alternatives	Parameters to be Considered:		
	Environmental	**Social**	**Economic**
No 1 construction and operations of a transfer station at the site where the dump once existed	The negative impacts to the aesthetics of the area could be an issue because of its proximity to the highway and limited vegetation growth. **The site is also very much constrained by its small area to accommodate future solid waste management needs.** The potential impacts associated with vermin (houseflies, rats etc.) because of the site's close proximity to Belmopan could become an issue of concern	The negative impacts to the aesthetics of the area could negatively impact the livelihoods of those involved directly or indirectly in the tourism industry. The construction of a transfer station will lead to improvements on the working sanitary conditions of waste pickers and potentially to their health; safety.	Lower construction and operational cost because of its closer proximity to Belmopan and access to utility lines that are not that distant. Its construction and operation increases the financially sustainability of the central sanitary landfill,
No. 2 Construction and operations of a transfer station at existing dumpsite	Improved aesthetics of the area, since the facility would not be easily seen from the highway because of setback distance and vegetation cover that exists; There is sufficient land available for expansion of activities of the Station in the future	The improved aesthetics of the study area could positively impact the livelihoods of those involved directly or indirectly in the tourism industry. The construction of a transfer station will lead to improvements on the working sanitary conditions of waste pickers and potentially to their health & safety.	Slightly higher construction and operational cost than option one due to investments that would need to be made in meeting the project's energy , water and telephone needs and increase transportation cost. Its construction and operation also increases the financially sustainability of the central sanitary landfill,
No. 3 No-Action Alternative	Has the highest environmental impact because of potential impacts associated with current situation? Burning of waste impacting on decreased air quality of area, Negative impacts to surface and ground water within study area from run-off and leachates, vermin and disease vectors.	Has the highest social cost because of the current unsanitary working conditions of waste pickers and negative impacts the current operations is having on the livelihoods of those involved directly or indirectly in the tourism because of the aesthetics of the area.	Highest economic cost when one factors the cost to impaired air and water quality of the resources of the area and health of residents and the negative impact this option could be having on the tourism industry.

Preferred Option: In consideration of the environmental, social and economic factors, Option No. 2 would be the preferred option since this site has greater space, and allow for future expansion.

5.3.2 Closure and Restoration of the Dump-site

An essential component of the project focuses on the closure of the present dump site. This site has been in operation since 2009 and has garbage spread in much of its area. Some of this garbage has been covered with bushy and shrubby vegetation and is not readily visually apparent. The areas that have been under recent operation are readily seen as they have been pushed to the outer perimeter of the access road and other active areas. The older piles all show signs that they had been burnt to reduce the volume of the water. Burning of waste at this dump is a standard practice and is only affected during the wet periods when it is difficult for the garbage to be lit.

During periods of heavy rains storm water is readily drained from the property because of its natural contour into a number of channels and drains that connect to the highway drains and eventually into a tributary of the Roaring Creek which eventually empties into the Belize River. During prolonged period the working area's accessibility becomes severely affected and garbage is allowed to be dumped along the edges of the access road where storm-water runoff passes through.

In evaluating the closure of the site the options examined took into consideration that the site would be closed and the use of the area would be replaced with that of a transfer station. The closure looked at the following:

1. the spreading of the garbage and its covering,
2. the construction of a cell where the garbage from the project site would be pushed and moved to, then covered: and finally;
3. stockpiling of garbage and transferring this to the central sanitary landfill:
4. the ***no action*** alternative.

This is summarized in Table 5.2.

Figure 5.2: Evaluating the Closure of the Dump Site

Alternatives	**Parameters to be Considered:**		
	Environmental	**Social**	**Economic**
1. the spreading of the garbage and its covering	Reduced impacts to water quality from contact with garbage; increased turbidity from erosion of cover	Improved sanitary conditions of area and improved working conditions of waste recyclers	Limited economic cost associated with cost of cover material and cost of spreading and covering of garbage

	material. Reduced population of vermin within project area. Greatly enhanced aesthetics	and others using and working in the area.	improves the economic value of the site and reduces impact to the Tourism Industry
2. the construction of a cell where the garbage from the project site would be pushed and moved to then covered	Reduced impacts to water quality from contact with garbage; increased turbidity from erosion of cover material. Reduced population of vermin within project area. Greatly enhanced aesthetics.	Improved sanitary conditions of area and improved working conditions of waste recyclers and others using and working in the area.	Somewhat higher cost than option one but allows for removing garbage that has been piled along water access channels further reducing impacts to water quality, increases tourism/economic value of area.
3. stockpiling of garbage and transferring this to the central sanitary landfill	Reduced impacts to water quality from contact with garbage; Reduced population of vermin; improved aesthetics	Improved sanitary conditions of area and improved working conditions of waste recyclers and others using and working in the area.	Cost may be somewhat more expensive than options one and two depending on cost of cover material. Its cost would be more associated with the transportation cost of waste to central landfill but this would be done utilizing the same larger trailer trucks.
4. No action alternative and allow natural restoration of area	This option has the highest environmental impacts since the garbage would take a long time to decompose and would remain as a source of contamination for many years. Possibility of spontaneous fires.	Highest social cost since exposed garbage would continue to attract vermin and vectors that could potentially spread disease & loss of lives.	In the immediate the cost appears as the lowest but in the long term its economic cost is the highest because the site would continue to be a major site of contamination.

The Preferred Option is alternative Option 2, providing the cover material can be source on site or nearby, and that the area has a natural clay layer that would mitigate against the impacts of leaching. If not then option 3 becomes the preferred option.

5.3.3 Improvements to Access Road

It is important that the access road to the site be improved to improve road safety when accessing or exiting the site from the Hummingbird Highway. To improve safety several alternatives were considered. These options included the following:

1. having two accesses - one for entrance and one for exiting;
2. widening the existing exit and construct deceleration lanes where vehicles could pull off until the traffic is clear before entering the site; and finally
3. the no-action alternative

The considerations in selecting the preferred options are summarized in Table 5.3.

Table 5.3: Access Road Considerations

Alternatives	Parameters to be Considered:		
	Environmental	Social	Economic
1: having two accesses; one for entrance and one for exiting;	Increased sedimentation problem during construction of new road, possible alteration to drainage of project area	Improved traffic safety for users of site due to improvement made to address problems with existing narrow access road. Traffic safety related to accessing site from the Hummingbird Highway would remain virtually the same.	Highest economic cost associated with the construction of another access and traffic safety related issues are only slightly improved.
2: widening the existing exit and constructing a deceleration lane.	The environmental Issues would be similar to that of option 1 but less reduced...	This option would allow for improved traffic safety within the project site and also for motorists on the Hummingbird Highway.	Its economic cost would be lower than that of option 1 even though it would include the construction of a deceleration lane for vehicles accessing the site from the Humming Bird Highway.
3: the No-action Alternative.	This option is not considered an alternative as it does not solve the traffic safety issues.		

5.3.4 Provision of Utilities (Water, Electricity and Telephone

This section primarily focuses on the provision of water as the other utility lines are a more readily accessed as they pass nearby the project site and is not foreseen as presenting any major challenge. The provision of water to the facility to meet its projected water needs for running of the office and waste pickers facilities and their associated domestic water needs, and washing of equipment, facility floors and vehicles, required careful consideration of various issues. The main issues to be considered are the overall projected needs, the absence of nearby water source

whether surface water or ground water. In the instance of surface water the nearest available source is a considerable distance away and the investments required to supply the facility's limited water need would not be justified. The probability exists that an aquifer or subterranean stream could be tapped at depths beyond 150 feet. It would be advisable that SWAMA employ the assistance of Rural Water and Sanitation for assistance to reduce the cost of drilling the exploratory well perhaps at the peak of the property or just off the property where there lies the greatest probability. Failing this, the options become limited and rainwater harvesting and trucking during the dry periods will need to be considered since sufficient water can be harvested from the roofs of the facilities although this water would not be recommended for human consumption. Table 5.4 summarizes the issues of consideration.

Table 5.4: Sourcing Utilities

Alternatives	Parameters to be Considered:		
	Environmental	**Social**	**Economic**
1. sourcing water from Belmopan or Roaring Creek	The environmental impacts would be minimal and the cumulative impacts from this additional demand would be negligible.	Provision of water to the site would lead to improved sanitary conditions within the project site and would go a long way in improving the working conditions of those presently operating at the site...	Highest economic cost; does not appear as financially feasible.
2. drilling a ground well.	The environmental Issues are those that would need to be considered in drilling any well which includes ensuring the well are properly sealed to prevent contamination, and that it is properly sited away from potential sources of contamination or flooding.	The social impacts would be similar to option one.	This option would be moderately expensive with a probability that the well bored will need to be extremely deep rendering this also very challenging, This option however, becomes the most practical option to meet the water need of the facility.
3. rainwater harvesting	The environmental impacts are marginal and have to do more with protecting this water from contamination and treating with chlorine as would be required anyway for surface water.	The social impacts would be similar to that of the other options.	This option would be the least expensive but could pose problems during dry periods.
3: the No-action Alternative.	This option is not considered an alternative as it does not solve the issue associated with meeting the project's water needs.		

CHAPTER 6: POTENTIAL ENVIRONMENTAL & SOCIAL IMPACTS

6.1 Introduction

This Chapter of the ESA presents the assessment of the potential environmental and social impacts associated with the proposed closure of the Belmopan Waste Disposal Site and the construction of a transfer station. As with most solid waste infrastructure project, the overarching goal is to improve the lives of the resident population, specifically those of the study area. Hence, despite the fact that one of the major objectives of the project is the improvement of solid waste management with its intended net positive environmental and social impacts, it is important that special consideration be given to several potential environmental and social issues in the planning and implementation of the project. In addition, it is important that where negative impacts are identified that these be mitigated and that a proper monitoring plan be developed to monitor the effectiveness of these measures and the extent of both the negative and positive impacts of the project.

For each relevant environmental and social parameter, the potential impacts are discussed. The evaluation of potential environmental and social effects aims to be as accurate and objective as possible, whilst providing as much detail as is available according to the proposed design. Many of the potential impacts have also been taken into account in the preparation of the preliminary designs described in chapter one. The proposed mitigation measures for addressing potentially adverse environmental and social impacts are also presented in this chapter as the impacts are discussed.

The evaluation of environmental and related socio-economic impacts related to the closure of the Belmopan Waste Disposal Site and the construction of a transfer station has been prepared through the examination of individual environmental components that are potentially affected by the proposed activities.

The nature of the impacts may be categorized in terms of:

- Direction -positive or negative

- Duration -long or short term
- Location -direct or indirect
- Magnitude -large or small
- Extent -wide or local
- Significance -large or small

6.2 Environmental Impacts

An environmental impact is defined as *"any change to an existing condition of the environment*". The environmental issues looked at included to be considered are as presented below:

- Air Quality/ Odour
- Water quality (Surface and Ground)
- Soils and Terrain
- Vegetation and Wildlife
- Current Land Uses
- Traffic
- Climate change and Disaster Preparedness
- Social Impacts

The impact of these during the construction and operational phases of the project are discussed.

6.3 Summary Potential Environmental Impacts

While the proposed closure of the dump and the construction of a transfer station is projected to have significant positive social and economic benefits it has the potential to affect the surrounding air and water quality; exacerbate soil erosion, and the hydrology and drainage of the area as well as nearby or adjacent ecosystems within the project area during the construction phase.

Tables 6.1 and 6.2 provides two different types of impact matrices summarizing the potential environmental impacts associated with the activities foreseen in the closure of the dump and the construction of a transfer station and its ancillary structures. The first matrix, Table 6.1, assesses the direction, duration, location, magnitude, extent and significance of the projected impacts. Table 6.2 looks at the activities and provides a quantitative assessment of the impacts of the

various environmental elements of concern relative to each other.

As can be seen from the matrices most of the negative impacts are predicted as either minimal to medium, are very localized and of short duration. In the instance of the positive impacts that are associated with the post closure of the dump and the operations of a transfer station, the opposite results are obtained. Here, the impacts are major of long duration and significant. The activity with the highest negative potential negatively impact was that associated with the deceleration lane. The impacts associated with the closure and rehabilitation of the dump and the construction of the Transfer Facility were rated to have similar levels of impacts, Despite this most of these impacts identified are readily mitigated though the implementation of best practices.
The remainder of this chapter presents a discussion of impacts for each environmental and social component, in terms of the potential impact, the proposed mitigation to prevent/reduce adverse impacts, and anticipated *residual* impacts (i.e., the degree of impact and issues remaining after mitigation has been implemented).

Table 6.1, Assessment of the direction, duration, location, magnitude, extent and significance of the projected impacts.

ACTIVITY/IMPACT	DIRECTION		DURATION		LOCATION		MAGNITUDE		EXTENT		SIGNIFICANCE	
	Pos[1]	Neg[2]	Long	Short	Direct	Indirect	Major	Minor	Wide	Local	Large	Small
1. Closure of Dump Construction Activity												
Increased erosion		x		x		x		x		x		x
Limited vegetation Removal		x		x	x			x		x		x
Reduced burning	x		x		x		x		x		X	
Increased infiltration/runoff		x		x	x			x		x		x
Air pollution from vehicular emissions		x		x	x			x		x		x
Noise		x		x	x			x		x		x
Increased traffic from construction activity		x		x	x			x		x		x
Aesthetics		x		x		x		x		x		x
2, Post Closure Of Dump												
Air quality	x		x		x		x			x	x	
Water quality	x		x		x		x		x		x	
Impact to ecology	x		x		x		x			x	x	
Improved sanitary conditions	x		x		x		x			x	x	
Reduced vermin population	x		x			x	x			x	x	
Air quality	x		x		x		x			x	x	

3. Construction of Transfer Station and Facilities												
Drainage	x		x		x			x		x		x
Habitat alteration		x	x		x			x		x		x
Water quality impacts		x		x	x			x		x		x
Sedimentation		x		x	x			x		x		x
Traffic		x		x	x			x		x		x
Air quality impacts		x		x	x			x	x			x
Sanitation		x		x	x			x		x		x
Noise		x		x	x			x		x		x
4. Construction of Deceleration Lane												
Water contamination		x		x	x			x		x		x
Suspended solid runoff		x		x	x			x		x		x
Noise		x		x	x			x		x		x
Dust		x		x	x			x		x		x
Visual intrusion (During Construction)	x		x		x		x			x		x
Visual intrusion (Post Construction)		x		x		x		x		x		x
5. Construction Crew												
Sewage generation		x		x	x			x		x		x
Solid waste generation		x		x	x			x		x		x
Emergency response		x		x	x			x		x		x
Water Consumption		x		x		x		x		x		x
Food Hygiene		x		x		x		x		x		x
Employment	x			x	x			x		x		x
6. OPERATIONAL PHASE												
Improved sanitation	x											
Landscape & Replanting	x											
Vegetation/habitat reintroduction	x		x		x		x		x		x	
Employment												
Occupational health	x		x	x	x		x			x	x	
Air quality	x		x		x		x			x	x	
Water quality	x		x		x		x			x	x	
Littering of highway	x		x		x			x		x	x	
Lighting		x	x		x			x		x		x
Traffic accidents		x	x		x			x		x		x
Aesthetics	x		x		x		x		x		x	
7. Water supply and consumption												
Sustainable supply	x		x		x		x			x	x	
Water conservation methods	x		x		x		x			x	x	
Sewage treatment needs	x		x		x		x			x	x	
1. Negative 2. Positive												

6.4 Impacts Related to Air Pollution

The potential impacts of the closure of the dump and the replacement of its operation with that of a transfer station was assessed as significantly positive when compared to the present impact the operations of the dump is having on the environment and health of the residents of the area.

The air pollution issues are mainly those presently associated with the burning of the garbage which produces significant amounts of smoke (particulates) and other greenhouse gases such as carbon dioxide.

The burning of dumps was identified as one of the major sources of dioxins and furans in Belize by a report prepared in 2004 by the Department of the Environment. These contaminants are believed to be contributing to the respiratory ailments being experienced by residents of the area. However, there has been no study so far that has established these links and which have been able to quantify these impacts. Another issue of concern is the issue of odor, in this instance particularly to those that frequent the site and work there. Because of its distance from the communities of Belmopan and Armenia this issue has not been identified as being of major concern.

It is safe to assume that a reduction in the overall emissions of the dumps would lead to reduced respiratory ailments as a result of improved air quality of residents and workers within the area of influence. Nevertheless, there remains the need to deal with the residual impacts associated with the construction and operational phase of the project.

Table 6.2 Matrix Quantifying Impacts of Critical Areas

Environmental Effects	Terrestrial Ecosystem				Impacts on land				Aquatic Environment			Air quality and Noise			Water Quality				Hydrology of Area-Rivers and Streams						Total
Development Activities	Habitat loss	Deforestation	wildlife	Protected Areas	Land Use	Erosion	Landslides/slip	drainage	Fish & species loss	Fish Movement	Aquatic Plants	Emissions	Dust	Noise Level	Oil/ hydrocarbons	Siltation-TSS	Bact. contamination	Dissolved Oxygen	Siltation	Flow regime	Drainage	Drinking water	Bank Erosion	Riparian vegetation	
Closure of dump/ construction activity	-1	-1	-1	0	0	-2	0	2	-1	0	0	-1	-2	-2	-1	-2	-1	-1	-2	1	1	-1	0	0	-10
Post Closure Of Dump	1	0	2	0	1	1	0	0	0	0	0	2	2	0	0	1	1	0	2	0	0	1	0	0	13
Construction of Transfer Station	0	0	0	0	0	-1	0	0	0	0	0	-1	-1	-1	-1	-2	-1	-1	-2	0	1	-1	0	0	-11
Construction of Deceleration Lane	-1	-1	-1	0	-1	-2	0	-2	-1	-1	0	-1	-1	-2	-1	-2	-1	-1	-2	-1	0	0	0	0	-21
Construction Crew	-1	-1	-1	0	-1	-2	0	0	-1	0	0	--	--	--	- 1	-1	-1	-1	-1	--	-	-	--	--	-12
Operational phase of facility	0	0	1	0	0	0	0	2	0	0	0	2	1	-1	1	2	1	1	2	1	0	0	0	0	13
Water supply and consumption needs	0	0	0	0	0	1	0	--	0	0	0	-	--	--	-	--	-	-	--	--	--	--	-	-	1
Impacts: -3 High negative; -2 Medium negative; -1 Low negative 0 none; 1 Low positive; 2 Medium positive; 3 High positive																									

6.4.1 Dust and Smoke

The construction and operational phase of the facility have the potential to adversely affect air quality. The release and dispersion of dust will occur as a result of earth moving operations during site preparation and the transportation of material, movement of heavy construction equipment and traffic. In addition, the operation of heavy machinery both during the construction and operational phases will adversely affect air quality through the emission of air pollutants beside the dispersion of dust.

The increased levels of suspended particulate matter in the air can be harmful to the health of the workers exposed to this type of environment. Fine dust inhaled by workers can lead to diseases related to lungs and liver such as “silicosis”, “bronchitis”, “asthma” and “tuberculosis” (Chauhan 2010). During the site visits to the dump, it was noted that the waste recyclers were being directly exposed to smoke. During the rainy season dust may not be a problem; however, during the dry season invariably greater dust pollution does occur making it necessary for greater monitoring and personal protection.

During the construction phase of the dump, the worksite will involve earth moving activities. These tasks along with the vehicular traffic associated with them, invariably will cause dust and emissions pollution. It is believed that these issues will become minimal during the operational phases requiring very little active intervention to mitigate.

Air pollution through emissions occurs with the operation of the construction equipment and vehicles. The impacts from these emissions will be primarily localized and are not predicted to significantly increase the baseline measurements, which were all below detectable limits for all locations.

6.4.1.1 General Air pollution Mitigation Measures

The Department of the Environment, through the Pollution Regulations, has developed mechanisms to monitor and control air and noise pollution. These Regulations prohibits the releases into the environment of contaminants, unless done so with a permit issued by the Department of the Environment and at acceptable levels of contaminants from certain installations.

The regulation states that no person shall cause or permit a building or its appurtenances, **open area**, **or road or alley to be used, constituted, repaired, altered** or demolished without taking reasonable precautions to prevent particulate matter from becoming airborne. It requires that dust and other types of particulates be kept to a minimum by such measures as wetting-down, covering, landscaping, paving, treating, and detouring or by other reasonable means.

The regulation further states that "no person shall cause or permit the extracting, crushing, screening, handling or conveyance of materials or other operations likely to give rise to airborne dust without taking reasonable precautions, by means of spray bars or wetting agents, to prevent particulate matter form becoming airborne." The regulation also prevents any person from discharging into the atmosphere any contaminant from a gasoline or diesel engine in excess of the quantity specified by the Minister for a motor vehicle operating under normal conditions.

To mitigate against the occupational hazards associated with the generation of dust and emissions, workers will be required to use appropriate PPE's (dust masks). In addition, dust suppression measures may need to be employed to reduce the negative effect in particular during the dry season...

The impact of air and dust pollution can best be minimized at source by proper maintenance and hauling of construction equipment and by providing appropriate protective working gear (masks, goggles etc.) as required.

To avoid unnecessary emissions, contractors will adopt the practice of shutting off equipment whenever they are not in use. They will also ensure that their vehicle fleet and construction equipment are serviced on a scheduled basis to maintain good operation standards. If purchasing new equipment for the project, ensure that these have factory installed emission control devices.

The general mitigation measures that can be implemented to avoid the impact of air pollution include:

- Utilization of methods and devices that control, prevent or minimize the discharge of contaminants to air including smoke, dust or soil, including appropriate storage of potentially ‘dusty’ material.
- Avoid burning of materials,
- Use dust suppressants along with the application of water to control dust pollution.
- Limit speed around construction zone, place barriers to slow down traffic
- Shut down equipment when not in use and maintain vehicles and heavy equipment in good operating conditions.
- Plan site properly for the placement of equipment and construction storage material
- Dust causing activities and storage of sand should be located away from sensitive areas and downstream of prevailing winds. Enclose stockpiles or keep them securely sheeted. Avoid the use of long-term stockpiles. Keep stockpiles or mounds away from the site boundary, watercourses and surface drains.
- Ensure that all loads entering and leaving site to be covered and that vehicles and heavy equipment are in good operational conditions.

6.4.2 Odour

Odours from decaying waste material are produced at solid waste management sites, particularly when waste high in organic material (e.g., animal waste, domestic waste, fecal waste) is disposed. It is noted that the nearest community is located within four to five miles downwind of the site from the proposed landfill. The facility can prevent odors from being a problem to downwind users of the facility and nearby lands by making sure the dump is properly rehabilitated and that the operations of the facility ensures that the garbage is removed regularly and transported to the central sanitary landfill and the area cleaned on a regular basis.. This would reduce or eliminate the problems of odour, litter dispersion, animal scavengers and pests including disease vectors.

6.4.3 Noise

It is common practice to define noise simply as unwanted sound. However, in some situations noise may adversely affect health in the form of acoustical energy (WHO 1999). The assumption is that ambient noise levels, which are constant in nature, will increase and will be comparatively higher during the construction phase of the project either due to the operation of heavy

equipment at the work sites or by the traffic to and from the specific work sites. Trucks, tractors and heavy machinery like excavators also generate noise levels beyond tolerable limits.

The noise levels at a construction site operation ranges from 96 to 125 dB. These are above the limits of 75 dB prescribed by WHO for day time industrial areas. The exposure for longer periods to these higher levels of noise is likely to affect the ear diaphragms of the workers (Chauhan 2010) if the use of PPE's is not made mandatory.

The greatest difficulty in summarizing the effect of road noise on wildlife is the fact that very few studies have directly addressed this issue (FHWA, 2014). Wildlife faces far more problems than humans because of noise pollution since they are more dependent on sound. Animals develop a better sense of hearing than we do since their survival depends on it. Studies have shown that noise can have a detrimental effect on wild animals, increasing the risk of death by changing the delicate balance in predator or prey detection and avoidance. However, because the project will occur within an existing operational site any additional impact from noise on wildlife is assessed as minimal and the general mitigation measures prescribed for noise pollutions would suffice in addressing impacts to wildlife.

6.4.3.1 Noise Attenuation and Mitigation

Noise pollution from the construction sites and material transportation is predicted to average 12 hours per day. This in itself helps to control noise pollution since noise generation will be limited to 12 hours. In addition, the contractor will ensure that vehicular transportation, earth moving equipment and hand tools shall be maintained and fitted with mufflers (where appropriate) during operation. Equipment and vehicles shall also be turned off when not in use. Carry out regular checks on site equipment to ensure it is running smoothly and efficiently. The road construction company will also need to ensure that workers wear Personal Protection Equipment (PPE) (e.g. earplugs to minimize the effect of noise).

6.5 Issues Related to Water Pollution

The assessment indicates that during the operational phase of this project there should be significant improvements made to the current existing baseline situation as it relates to the pollution of the water resources of the study area. The introduction of contaminants to surface

runoff water that has been in contact with wastes from the landfill to adjacent offsite surface waters is an issue of major concern.

Presently, there is hardly any mitigation measure in place to ameliorate the issues related to surface and ground water contamination. The current impacts to surface water from the operations of the dump can be readily appreciated since the area lies on a gently rounded hill where storm water flowing through the garbage was being readily discharged via drains and gullies to a small tributary of the Roaring Creek. At the time of the assessment water was running through this tributary which during the dry periods would also remain dry.

The possible groundwater contamination from leachates produced is more difficult to assess but considering the geology of the area (Karstic) it can be deducted that if the operations at this site remains as is the groundwater in the study area could also become contaminated from this source. The impacts are believed to be ameliorated by the projected depth of the ground water and the possibility that the dumpsite area may be underlain with clay.

The closure and restoration of the site and its conversion to a transfer station will greatly reduce the present impacts but it would still be necessary that the project consider mitigating the potential issues associated with the construction and operational phase of the project.

The parameter of greatest significance is the potential increase in turbidity and suspended solids during the construction phases and then the issues with chemical and bacteriological contamination during its operational phases from sewage discharge and chemical spills (fuels, oils, etc.).

Construction activities can adversely impact water quality by means of the following;

1. discharges of contaminants to receiving waterways and water bodies
2. accidental spillage of fuel, oils or Cementous material,
3. earth moving activities increasing the potential for erosion and siltation.
4. The water quality parameters of specific interest that will need to be monitored are turbidity, total suspended solids, oil in water and total and fecal coliforme.

6.5.1 Mitigation Measures to prevent Impacts to Water Quality

The following measures are recommended to avert adverse impact on the water quality of the surrounding area as a result of project implementation:

- Minimize problems with soil erosion and sedimentation from earth moving activities by employing BMP for soil erosions as recommended in the section on geology.
- Construction activities should be managed to prevent entrance, or accidental spillage, of solid matter, contaminants, debris and other pollutants and wastes into drains and water courses.
- Provide proper sanitation facilities for worker at work spots and base camps.
- Dewatering road sections under construction or earthwork operations this should be conducted in a manner to prevent muddy water and eroded materials from entering the drains and streams by constructing of intercepting ditches, check dams, siltation curtains, by-pass channels, barriers, or settling ponds.
- Ensure the responsible storage and handling of petroleum products. Limit refueling on the project site as much as possible.
- Maintain equipment in good operational conditions -free from any oil and fuel leaks.
- In the event of a spill, use absorbent material to clean up and place contaminated material in a plastic drum that is to be kept covered at all times and report any spill immediately to DOE.
- Ensure that any aboveground fuel storage tank is placed within a bunded area that it is able to contain 20% by volume of the largest tank. Store waste-oil within bunded area in sealed plastic containers and contact DOE for final disposal.
- Construction workers will be required to ensure that the area is kept free from litter at all times and that all domestic waste are properly containerized and disposed of.
- If a campsites will be located on the project site this should be strategically located away from drains and serviced on a regular basis.
- Ensure that the closure of the dump, that the surfaces be contoured and re-vegetated in such a way as to prevent erosion and resulting sedimentation of adjacent drains.

During the operational phase of the Transfer Station the following mitigation measures are recommended**:**

- The waste stream should be screened at the transfer stations to remove household and other hazardous materials such as batteries, solvents, used oil, chemicals, etc., which normally contribute high levels of contaminants such as heavy metals and toxic organics to the waste stream.
- Ensure that the office facility and other ancillary facilities are provided with proper sanitation facilities.
- Ensure that the facility is properly secured and fenced to avoid litter being blown into nearby drains.
- Ensure that sewage waste is properly treated by means of a properly designed and sized septic tank and leach field.
- Floor washings from the Transfer Station Building should also be directed to a screened drain and a leachate collection system and a storage tank where this could be taken for proper treatment at central sanitary landfill's treatment system before it is released into the receiving environment.
- Storm water drains around the site should be properly maintained and should have weirs that are regularly cleaned to prevent waste being carried away from the site.
- Regular monitoring of surface water quality at key locations should be conducted at critical points prior to construction and throughout the operational life of the facility.

Provided the above measures are implemented during the construction, operations and closure phases of the landfill development, no significant adverse impacts on surrounding surface waters are anticipated. With the groundwater protection that will be provided by the natural clay at the site and the mitigation and monitoring measures outlined in the Environmental Management Plan, no significant effects on ground water is anticipated

6.6 Impacts Related to Geology (Soils and Terrain)

Currently, approximately 75% of the area is bare and has been used at some point of the dump's operation to receive garbage. The areas that are actively being used become quite muddy and

inaccessible at certain periods of heavy rainfall. Hence, this issue has been assessed as having a net positive impact following the closure and restoration of the dump.

The impacts to the soils and terrain are primarily associated with the following factors**:**

- The erosion of bare slopes during construction and operational phases
- The potential for ongoing slope erosion in post-closure condition

In any construction activity involving land movement and excavation, there is the potential for soils to erode or lose stability when surface water drains over them. Particulate matter and in this instance litter and other contaminants, may be carried offsite in surface runoff, with consequent negative effects on surface water quality, unless provisions are made through interception mechanisms to control this. This is of particular importance for this site since it lies within a gently sloping hill that readily drains into a nearby tributary of the Roaring Creek.

6.6.1 Mitigation Measures to Reduce Earth Movement Activities Impacts

The key to avoiding erosion problems is to reduce water flow over bare, erodible soils, and particularly reducing the velocity of water as it drains over the terrain or through drainage courses. This can be accomplished using effective contouring to reduce slope grades, ditch blocks or check-dams to reduce runoff velocities and prompt and effective re-vegetation of bare ground whenever possible, which stabilizes the soil and helps to reduce run-off water velocities.

The contractor should be required to employ Best Management Practices and engineering standards during earth moving operations. Careful soil stripping and storage, as well as site restoration will ensure that the potential geological impacts are minimized. Road embankments for the deceleration lane will need to be adequately sloped to stabilize and restore impacted areas as well to prevent soil erosion due to heavy rains since this area lies on a hill. Measures also include soil restoration and planting with appropriate vegetation to ensure stabilization of slopes where needed.

General Recommended Mitigation Measures:

- Road side slopes and cuts should have slopes of 1.5:1 ratio to prevent land slippage from road cut embankments;

- To prevent excessive siltation during the deceleration lane construction and the transfer station's access ramp for the trailers transporting garbage to the sanitary landfill, storm-water will need to diverted away from the construction area and storm-water generated within the construction area will employ the use of check dams, Figure: 7.12, along the storm-water drains before discharging into the receiving environment.

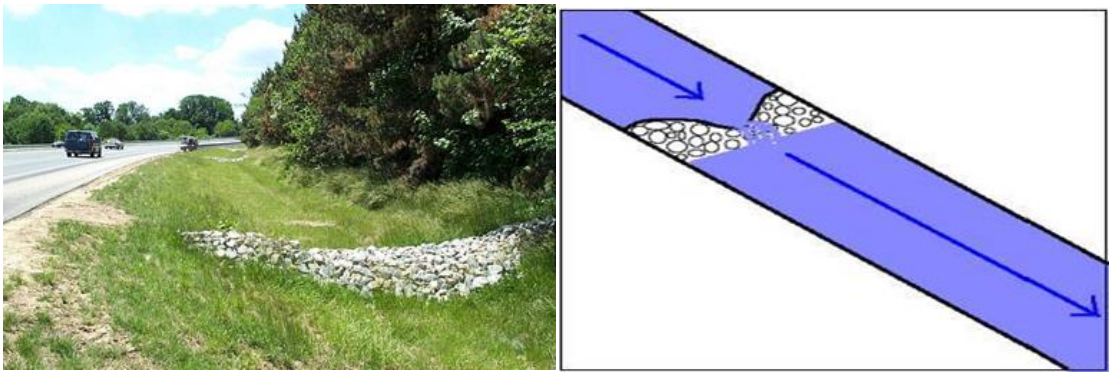

Figure: 6.1: Check dam made of gravel

- Soil Material removed during the construction phase will be stockpiled at locations away from active drains and possibly used as cover material or to rehabilitate other areas.

It is expected that if these measures including the storm pond are put into effect, the dump could be closed and rehabilitated and the transfer station constructed, operated and decommissioned with no significant adverse effects to soils or to surface water through the effects of soil erosion.

6.7 Impact to Land Use

The negative environmental impacts associated with land use and tenure is expected to be minimal during both the construction and operational phases of the project. The ten acres project area lies within a much larger fifty acre parcel of land belonging to the Belmopan City Council and the immediate area around it is used primarily for agriculture with no residence being near to the site. As discussed earlier in the report, the land use of the study area consists of both developed (residential, community, agricultural and municipal lands) and undeveloped lands that are located adjacent to the property.

6.8 Ecological Impacts

It is important to note that the impacts to the study area will be temporarily minimal because much of the activities will be occurring in an area that is already being operated as an open dump. In fact it is believed that at the end of the project there would be a net positive impact due to the restoration of the place and the reduced number of feral and wildlife that frequent the dump. In addition, the reduced number of vermin could reduce the impacts of diseases being spread. Nevertheless, there will be short-term impacts that can temporarily affect the general biodiversity of the area which can be addressed quite readily.

Overall, the road rehabilitation project is assessed as having minimal impact to the ecology and biodiversity of the study area. Campsite employees can pose temporary problems with respect to wildlife hunting along undeveloped areas which can adversely impact wildlife species, particularly those traditionally hunted.

6.8.1 Recommended Mitigation Measures

- It is recommended that employees are informed of a no-hunting policy which will be enforced by management.
- In terms of vegetation, all trees and shrubbery, that is not specifically required to be cleared or removed for construction purposes, shall be preserved and shall be protected from damage.
- The facility should be fenced to prevent access by wildlife and feral animals.
- The area could be landscaped with ornamental and suitable trees.
- Disturbed areas such as campsites and others will be vegetated where possible and seeded.

6.9 Impacts to Traffic

The impacts to traffic and traffic safety are assessed as having a small net negative impact that could be considered as insignificant. The impacts identified area those associated with the following:

- An increase in truck traffic on the GPH and HBH highways, with consequent reduction in traffic safety and efficiency;

- The safety risk due to trucks entering or exiting the access road to the transfer station and central sanitary landfill; and
- Possible damage to highway from increased truck traffic

6.9.1 Proposed Mitigation Measures

Although no data on traffic densities by hour of the day were available, the Western Highway from Belize City to Belmopan is heavily used in the morning and evening periods, as those who live in Belize City and work in Belmopan commute. The Traffic on the Humming bird highway is much less.

- It is recommended that the traffic densities be monitored at intervals to ascertain that waste management vehicles travelling to and from the Mile 22 Sanitary Landfill facility are not posing a safety or traffic flow problem on the George Price Highway.
- Schedule transfer vehicles where possible to avoid busy periods.
- The location of the transfer station's access point, lies at a point of a hill where visual obstruction is affected by the top of the hill for vehicles travelling from Dangriga to Belmopan. Adequate speed reducers and signs can be erected to reduce risk of accidents.
- A deceleration lane for vehicles accessing the site from Belmopan will be constructed to reduce traffic risk while entering the site.
- It is recommended that the access road be a high standard gravel road or paved to prevent tracking of mud unto the highway from the site during rainy period.

With the above mitigation measures in place, there should not be a significant reduction in traffic safety or efficiency of traffic flow as a result of the operation of the landfill facility.

In addition, it is recommended that the operator of the landfill post a BZ$100,000 performance security that can be accessed by the Department of Environment, if any remedial actions related to poor operational procedures are required.

With the measures of the Environmental Mitigation and Monitoring plans fully implemented, it should be possible to prevent significant adverse impacts in the form of disturbances to neighbouring institutions or residences.

6.10 Climate Change Impacts and Disaster Risk Management

6.10.1 Hazards

Hazards are potentially damaging phenomena, whether natural or man-induced. Belize is located in an area prone to natural hazards. Foremost among these is the annual occurrence of North Atlantic tropical cyclones and hurricanes that reach the northwestern Caribbean or develop over the Caribbean area itself. The records also show that Belize is prone to eastern Pacific tropical cyclones that traverse northern Central America and impact the country directly or indirectly. Associated hazards include high winds, storm surges, torrential rains, flash floods/inundations, and tornadoes.

Secondly, Belize is bordered by three Central American countries that themselves are prone to volcanic eruptions, earthquakes, tsunamis, and mudslides. Even though, historically, Belize has not been impacted directly in a major way by these latter occurrences, it has experienced secondary impacts (NEMO, 2010). A thorough understanding of these phenomena, their intensities, frequency of occurrence and likely impacts are paramount in reducing Belize's vulnerability to these hazards.

6.10.2 Risks

Risk is the potential damage that could arise from the occurrence of a hazard with a given degree of uncertainty. Risk is the probability of occurrence of a hazard. There is also a need to distinguish between *risk* and *hazard*. A *hazard* is a source of danger, while *risk* involves the likelihood of a hazard developing into some adverse occurrence that may cause loss, injury, or some other form of damage. *Risk* may also be defined as: *Risk = Hazard x Probability of occurrence*. It should be noted that the consequences of *risk* may be contained if safeguards are put in place. However, hazards cannot be reduced to zero unless the hazard itself is removed.

6.10.3 Assessment of Hazards

Table 6.3 below provides a summary of the risks to natural hazards that communities within the study area face from time to time. As can be observed, all communities are vulnerable to both natural and man-made hazards.

Table 6.3: Hazards and Risk faced by communities in the Study Area

Location / Risks / Hazards	Roaring Creek	Camalote	Belmopan	Armenia	Springfield
Flooding	Yes	Yes	Yes	Yes	Yes
High winds	Yes	Yes	Yes	Yes	Yes
Earthquake					
Chemical fire and spill	Yes	Yes	Yes	Yes	Yes
Oil spills	Yes	Yes	Yes	Yes	Yes

6.10.4 Tropical Cyclone and Hurricanes

The climatology for North Atlantic hurricane activity indicates a cyclical trend in periods of high and low hurricane activity in the Basin. In short, it is very likely that over the next few decades' tropical cyclone frequency, intensity and spatial distribution globally, and in individual basins, will vary from year to-year and decade-to-decade (SPM-WG I, IPCC, 2013). Recent research has shown that we are experiencing more storms with higher wind speeds, and these storms will be more destructive, last longer and make landfall more frequently than in the past. Because this phenomenon is strongly associated with sea surface temperatures, it is reasonable to suggest a strong probability that the increase in storm intensity and climate change are linked.

The construction of the transfer station and administration building need to consider the areas vulnerability to hurricane related hazards during its projected operational life-span. Consequently, the structures are being designed to withstand a Category three (3) Hurricane. The area's vulnerability to flooding is minimal given the site lies atop of a hill.

6.10.5 Assessment of Man-made Hazards

Man-made hazards that can impact the study area include: a man induced fire, a chemical fire and chemical spills mainly fuel. These man-made hazards are becoming more evident along the Belizean Highways with the transportation of crude oil via oil tankers from the Belize Natural Energy, Spanish Lookout oil field to the Big Creek port in Independence. Hazardous substances

and material enter Belize from the western and northern border frequently and transported via the Humming Bird Highway to the banana and citrus industry in the south of Belize or elsewhere.

6.10.6 Impacts of Climate Change

Frequency. It is likely that the global frequency of tropical cyclones will either decrease or remain essentially unchanged owing to greenhouse warming. We have very low confidence in projected changes in individual basins. Current models project changes ranging from -6 to -34% globally, and up to +/-50% or more in individual basins by the late twenty-first century.

Intensity. Some increase in the mean maximum wind speed of tropical cyclones is likely (+2 to +11% globally) with projected twenty-first century warming, although increases may not occur in all tropical regions. The frequency of the most intense (rare, high-impact) storms will more than not increase by a substantially larger percentage in some basins.

Rainfall. Rainfall rates are likely to increase. The projected magnitude is in the order of +20% within 100 km of the tropical cyclone centre.

In response to the impacts of climate change and other hazards the structure is being planned to ensure resiliency to these impacts by its location where it removed from active flood plains, its ability to withstand a category three hurricane, incorporating a sustainable source of water and its own back-up generator and fire suppression equipment. An emergency response plan will be required of the operators of the facility and a training programme for its staff to effect the plans.

6.11 Social Impacts and Mitigation Measures

The social impact assessment is designed to ensure that the Project's potential impacts on individuals and groups of people are understood, so that positive impacts can be enhanced by project design while negative ones are mitigated, without compromising the economic efficiency of the project and its benefits.

For the Social Impact Assessment, an impact indicator is defined as any human/ social/environment indicator considered important or valuable and thus meriting consideration in the SIA process.

The methodology used to assess impact significance differs from that for environmental impacts in that the 'human environment' comprises social, health, cultural, demographic and economic

aspects and it is not possible to categorize the 'sensitivity' of social valued receptors to different impacts simply as 'low', 'medium' or 'high'. This is because the 'sensitivity' of social parameters relates to a complex mix of the vulnerability of different groups and individuals to Project impacts and to their perception of potential impacts. This is important because public perception of potential impacts is a key factor in relation to social risk, i.e. even if there is no clearly apparent scientific basis for a perceived impact, it still may contribute to social risk if people believe a project activity may have a negative or positive impact. Sources of key social issues impacting the project that may occur across life cycle stages are presented in Table 6.4.

Table 6.4: Key Social Issues Across Project Cycle

Project Phase/Activity	Social Issue
Construction	Noise and Dust
	Impeded Access
	Site Safety
	Construction Labour Force
	Employment and Employment Practices
Operation	Company and Worker Relations with end users of facility
	Employment and Employment Practices
	Waste Management

6.11.1 Social Impact Assessment

Social impacts may be caused by different Project activities and may be direct, indirect or cumulative in nature. As noted above, because it is not possible to definitively measure and classify social impacts the way it is done for environmental impacts, the evaluation of the significance of social impacts has some differences to that used to classify environmental impacts.

In contrast, the social impact evaluation used the following three basic criteria for assessing the significance of an impact:

- Magnitude: The importance of the impact for people's quality of life, health, livelihoods and social relations;
- Spatial extent: Also known as the impact area of influence which is the population and/ or geographical area over which the impact is experienced;

- Duration: The length of time or level of permanence over which the impact will be experienced.

6.11.2 Identified Social Impacts

Before the social impact issues are evaluated, the potential impacts as perceived by the persons affected by the project (PAPs) and identified through analyses are presented below in Table 6.5.

Table 6.5: Socio-economic Impact Categories, Indicators and Nature of Impact

Impact Category	Impact Issue/Indicator	Nature of Impact (Positive or Negative)
Community Governance, Organization and Local Institutions	✓ Community governance/ participation ✓ Access to decision-making	The Project has the potential to positively impact community governance and contribute to restoring public confidence in local and central level government. The ability of individuals to influence Project decision-making processes and protect their interests may be negatively or positively impacted by the Project, partially dependent on effectiveness of consultations.
Employment, Livelihoods and Income Generating Activities	✓ Employment ✓ skills ✓ Development of Businesses and informal livelihood activities.	Employment is a potential positive impact of the project. Poor governance practices and lack of skills however limit access to jobs which could be a negative impact. Project can have positive impacts directly through employment on the Project and indirectly through improving livelihoods of waste pickers. Project employment and training could positively impact the local skills base. Businesses and livelihood activities may be indirectly positively impacted by the Project.
Health	✓ Health problems related to pollution ✓ Communicable disease ✓ Injury ✓ Occupational Health	The project has the potential to positively impact pollution related health problems in the long term but may negatively impact during construction. Influx of labour force and transport workers may increase exposure to communicable diseases. Construction, transport and operations could expose workers and local people to the risk of injuries or accidents. The Project may positively or negatively impact Occupational Health.

6.11.3 Socio-economic Impacts and Proposed Mitigation Measures

This section analyses perceived impacts with those identified on the basis of literature review and consultation. The discussions assess impacts in relation to each category, specifying which Project Phase and the significance of each impact, proposed mitigation and the significance of each impact after mitigation (residuals).

6.11.4 Health Impacts Resulting from Pollution

The key health problems identified from the literature review conducted in the baseline study relate primarily to those associated with vector diseases and to some degree respiratory health (dry cough, difficult breathing, chest wheezing/asthma) and thus the valued receptors most at risk from negative impacts are those already vulnerable to respiratory problems e.g. school children, asthmatic children/adults, smokers and the elderly. From the present operations of the dump it is clear that there is a high probability that present operations are contributing to air pollution and thus causing further health risks.

During the operational phase asthmatic children could be negatively impacted by increase in dust. Pollution (quality of life associated with environment conditions) is the major respiratory health risk factor raised by the local communities. The impacts of the Project on pollution related health problems are assessed as negative during construction, especially for those with existing respiratory problems, children and women who spend most of the day at home. The impacts during the operational phase are considered to be significantly positive because of the reduced burning, dust and chemical emissions.

During the construction phase, best management practices will be implemented to ensure excavation and construction activities minimize dust and noise-related pollution for the workforce and neighbouring communities.

6.11.4.1 Injury and Accidental Health Damage Impacts and Mitigation

Project activities, in particular construction activities, could expose workers to the risk of accidents. Transport vehicles and traffic in the area could expose both workers and residents to the risk of traffic accidents. There is a risk of small scale but potentially frequent traffic and construction accidents and less frequent but potentially larger scale operations accidents both of which could impact on the health and safety of workers and local communities.

Risk of accidents from construction and operations is rated as moderately high, in particular risk of accidents from increased traffic.

While a major incident may be improbable, the project could benefit by the development and implementation of an Accident Preparedness Plan. To mitigate these issue traffic control measures to limit the risk of construction, operational and transport accidents which could endanger the health of community members will be put in place;

6.11.4.2 Worker Health and Safety and Mitigation Measures

Construction and operational activities could expose workers to health and safety risks. In particular, the following activities could have negative health impacts: noise and dust from demolitions and excavations (stress, ear and eye problems); working with heavy equipment (strains and accidents); heavy lifting, and working under noisy conditions (hearing and stress/psychological impacts). Excavations and transportation of materials may cause further health and safety negative impacts. Occupational health and emergency health services for the construction labour force will be at risk of negative health impacts which cannot be quantified, until clear plans emerge.

The need for an on-going, proactive workers health and safety plan applies for the full life cycle of the project. Contractors should be required to have an operational/fully functional Health and Safety plan and health training for workers since the risks of worker health and safety are high.

6.11.5 Social Risk Context

Despite the mitigation measures being put in place to reduce negative impacts and enhance positive impacts, the Project potentially faces social risks due to the national and local context in which it will be operating.

Past Relationship between Government and some community members reveals a level of mistrust that many local residents have for central governments and to a lesser extent the local governments in the Study Area. These are based on a perception that promises by governments in the past have not been honoured and that local people are generally not the beneficiaries of employment opportunities generated by these development projects. Responding to this mistrust requires on-going engagement, transparency and effective implementation of agreed social and environmental management measures; to this end, the risk could be reduced to medium/low.

CHAPTER 7 ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

7.1 Environmental Management Plan

This section of the ESA Report provides a summary of the assessment of the potential environmental impacts the project could have on the environmental and social setting of the study area. In most cases, it is possible to reduce potential adverse impacts to the point where the impacts are insignificant or negligible, either through effective design, the use of green technologies and best practices or through sound operational management of the proposed project and its accompanying activities.

The key in any successful mitigation measure is to adequately identify the potential negative impacts and their implications and to develop a supporting environmental management plan. As with all management functions, effective management tools and best practices based on a process of constant improvements is what is required. The implementation of environmental management standards, best practice, and the use of established protocols is important in helping to reduce environmental impacts as measured by some objective criteria. Thus the environmental management plan proposed for this project and supporting activities involves the close integration of the following:

3. ***Environmental Impact Mitigation Plan*** – Impact mitigation is the most critical component of the environmental study process. It aims to prevent adverse impacts from occurring and keeps those that do occur within an acceptable level.
4. ***Environmental Monitoring*** – Environmental monitoring provides information that can be used for documentation of the impacts that result from the construction and operational activities. This information enables more-accurate prediction of the associated impacts and the necessary feed- back mechanism essential in adjusting the EMP. Therefore, the monitoring system is a platform of measuring projected impacts and also in identifying unanticipated adverse impacts or sudden changes in impact trends essential in the implementation of an environmental management program based on the concept of constant improvement.

7.1.1 Environmental Impact Mitigation Measures

Identifying the appropriate mitigation measure for an identified impact must take into consideration its cost- effectiveness as these have the potential for significant financial implications. The outcome however must effectively address the impact with little or no residual repercussion to the environment. Thus, there will be continuous mitigation measures throughout the project's cycle that will be implemented to protect and conserve the environment and social setting of the project area as best as possible.

Considering the continuous improvement in impact mitigation, the implementation of the project's ESMP will have as its objectives to:

1) find better alternatives and ways of doing things;
2) enhance the environmental and social benefits of the beneficiaries of the facility;
3) avoid, minimize or remedy adverse impacts; and
4) Ensure that residual adverse impacts are kept within acceptable levels.

7.1.2 Mitigation Plan for Environmental Impacts

Table 7.1 provides a summary of the proposed mitigation measures during the construction phase of the project to ameliorate the negative impacts identified in the impact assessment section of the ESA. The proposed measures for the operational phase of the facility are contained in Table7.2 these two tables forms the basis of the of the environmental and social management plan in a summarized form.

Table 7.1 Environmental Management Plan for Construction Phase

Table 7.1: Summary of the Proposed Mitigation Measures					
Activity	Environmental Effects	Mitigation Measure(s)	Monitoring Indicator(s)	Monitoring and Reporting Frequency	Party (ies) responsible.
AIR EMISSIONS					
Earth movement operations, transportation of materials and operation of heavy machinery.	Release and dispersal of dust.	Ensure workers wear PPE.	Visual inspections.	Monitor daily report monthly	Contractor/ SWAMA
		Use dust suppressant measures.	Visual inspections and document complaints	Monitor as required and report monthly	Contractor/ SWAMA /DOE
		Ensure vehicles loads are covered.	Visual inspections and document complaints.	As require report quarterly	Contractor/SWAMA/DOE

		Store dusty material in appropriate locations.	Visual inspections and documented complaints from villagers.	As required; report quarterly	Contractor/PEU/DOE
		Limit and enforce speed around construction zone.	Visual inspections.	Monitor daily report monthly	Contractor/PEU/DOE
Operating construction equipment.	Generation of smoke and other contaminants.	Shut off equipment when not in use and maintain in good operating condition.	Visual inspections and document complaints.	Monitor daily report monthly	Contractor/PEU/DOE
Burning of garbage	Release smoke greenhouse gases and chemical contaminants	Prevent burning though closure of dump site, cover garbage to mitigate against spontaneous fires	Record fires and causes	Monthly , report quarterly	Contractor/ SWAMA/ DOE
		Ensure equipment has emission control devices.	Visual inspections and engineering instrumentation verification.	Monitor weekly report monthly	Contractor/PEU/DOE
ODOUR					
Decaying waste material	Foul odours, and nuisance	Restore site by covering or moving waste	Visual inspection, document actions	Monitor weekly' report monthly	
NOISE					
Operations of heavy equipment	Health impacts on auditory senses, nuisance	Have ear plugs for workmen available, limit prolonged exposure periods	Visual inspection, record any complaint	Daily, monthly report	Contractor, SWAMA
		Do not leave equipment idling	Visual Inspection	Daily, monthly report	Contractor /SWAMA
		Have equipment properly maintained and outfitted with mufflers	Visual inspection and record of equipment	Daily, monthly report	Contractor/ SWAMA/ DOE
WATER QUALITY					
Construction and earth movement activities	Soil erosion, and Sedimentation and pollution of streams,	Employ BMP; Construct intercepting ditches, check dams, by-pass channels, barriers, or settling ponds	Visual inspections and documentation of specific measures implemented	Weekly inspections and monthly report	Contractor/ SEWAMA/ DOE
		Provide proper sanitation facilities at workers camps.	Visual inspections and laboratory testing of nearby water bodies.	Weekly inspections and report quarterly; lab analysis to be done monthly	Contractor/SWAMADOE
		.	Visual inspections and laboratory testing of nearby water bodies.	Same as above	Same as above

Accidental spillage of fuels, oils or other contaminants		Ensure responsible storage and handling of petroleum products and maintain equipment free from oil and fuel leaks. Post appropriate signs.	Visual inspections and documented proof provided.	Weekly inspection report monthly	Contractor/SWAMA/DOE
		Maintain spill clean-up kits and report spills to DOE.	Visual inspections and documented proof provided.	As required	Contractor/SWAMA/DOE
		Erect above-ground fuel tank in bunded area and store waste oil in sealed containers and contact DOE for disposal.	Visual inspections and documented proof provided.	As required	Contractor/SWAMA/ DOE
		Properly containerize all hazardous waste	Visual inspections and documented proof provided.	Weekly inspection and report monthly	Contractor/SWAMA/DOE
		Ensure no motor vehicle washed in stream.	Visual inspections and laboratory testing.	Monitor weekly report quarterly	DOE /Contractor
Work Camp Activities	Sewage and litter, fecal contamination	Locate camp sites away from drains	Visual inspections and maintain records.	As required	Contractor/SWAMA/DOE
		Provide, portable toilets for crew	Visual inspections and maintain records	Daily inspections and monthly report	Contractor/ SWAMA/ DOE
		Post signs at work camp	Visual and maintain record	Check for signs monthly	Contractor/ DOE
GEOLOGY RELATED IMPACTS					
Earth movement while constructing	Siltation.	Diversion of storm water from construction area.	Visual inspections.	Monitor weekly and report monthly	Contractor/ SWAMA/DOE
		Use of check dams along storm water drains.	Visual inspections.	Monitor during construction activities	Contractor/ SWAMA/DOE
		Works to take place during dry periods.	Visual and documented proof to be provided.	Monitor weekly and report monthly	Contractor/ SWAMA/DOE
Erosion from bare slope following closure of dump and scraping of garbage	Siltation and damage to aesthetics of area. Man induced land denudation.	Re-vegetate area and carry out landscaping activities utilizing trees indigenous to the area and ornamentals	Visual and documented proof to be provided. Take pictures	Monitor monthly and report quarterly	SWAMA to implement and doe to monitor/DOE
Cutting of embankments to widen road for deceleration lane	Siltation. And potential contamination with petroleum products from machinery	Road sides slopes of 1.5:1 ratio to prevent slumping'; maintain equipment free of leaks.	Visual inspections, document inspections	daily monitoring during implementation of activity and weekly reports	Contractor/ SWAMA/ DOE

ECOLOGICAL IMPACTS					
Construction activities.	Noise pollution affecting wildlife.	Schedule work between 8 to 12 hours per day.	Visual inspection and documented proof of working hours provided.	Monitor weekly and report monthly	Contractor/ SWAMA/DOE
		Fit equipment with mufflers and turn off when not in use.	Visual and auditory inspections.	As required	Contractor/SWA MA/DOE
		Service and maintain construction heavy duty equipment.	Visual and auditory inspections.	As required	Contractor/SWA MA/DOE
		Maintain vegetated buffer around the perimeter of the facility.	Visual inspections.	Same as above	Contractor/PEU/ DOE
		Preserve all roadside trees and shrubbery not required to be cleared.	Visual inspections.	Monitor weekly and report quarterly	Contractor/SWA MA/ DOE
Construction Camp	Hunting and fishing by workmen	Designate work areas and camp sites "no hunting zones, Post "no hunting" signs at camp sites, prohibit the presence of guns within the campsite only security to be permitted. During safety signs for wildlife crossings.	Visual inspections.	Monitor and report as required	Contractor/SWA MA/ DOE
		Vegetate and seed disturbed areas of campsites.	Visual inspections.	Monitor as required and report quarterly	Contractor/SWA MA/DOE
IMPACTS TO TRAFFIC					
Construction vehicles	Mud tracking on highway	Scrape excessive muds from wheels before exiting sites	Visual inspections and record measures taken and possible incidents	Monitor as required during construction phase and provide a report at end of activity	Contractor/ SWAMA/DOE
	Increased risk of accidents while entering and leaving site	Have drivers alerted on the need to exercise extreme caution while entering and leaving site	Same as above	Same as above	
Construction of deceleration lane	Increased risk of accident, disturbance to traffic flow	Have speed reducers and proper sing installed. Use flaggers to increase road safety	Same as above	Same as above	

DISASTER RISK MANAGEMENT					
Extreme hydro-meteorological events in the form of flash floods, inundations, and high-winds associated with the passage of tropical cyclones and hurricanes.	Changes the hydrology of the catchments resulting in flooding from increased runoff, increased siltation and clogging of channels.	Ensure that the design of the facility include the following climate change resiliency features: design structures to withstand a category three hurricane, include a sustainable source of potable water, and provide a backup energy generation plant.	Visual inspections and engineering design plans.	Provide report of measures used	SWAMA
		Stabilize disturbed areas to avoid slippage or landslide during torrential rain events.	**Visual inspections and engineering instrumentation verification.**	**Monitor monthly and quarterly**	Contractor/ SWAMA/DOE

Table 7.2 Environmental Management Plan for Operational Phase

Activity	Environmental Effects	Mitigation Measure(s)	Monitoring Indicator(s)	Monitoring and Reporting Frequency	Party(ies) responsible
AIR EMISSIONS					
Operating construction equipment.	Generation of smoke and other contaminants.	Shut off equipment when not in use and maintain in good operating condition.	Visual inspections and document complaints.	Monitor daily report monthly	Operator of Facility SWAMA
Vehicular emissions	Release smoke green- house gases and chemical contaminants	Ensure equipment has emission control devices.	Visual inspections and engineering instrumentation verification.	Monitor weekly report monthly	/ Operator of Facility SWAMA
ODOUR					
Decaying waste material	Foul odours, and nuisance	Remove garbage on a regular daily basis, Wash floor and equipment as needed	Visual inspection, document actions	Monitor weekly' report monthly	Operator of Facility SWAMA
WATER QUALITY					
Leachate production,	Contamination of surface and ground water	Employ BMP; maintain leachate collection system, and ensure it is properly treated before discharging it;	Visual inspections. and documentation of specific measures implemented	Weekly inspections and monthly report	Operator of Facility SWAMA

Sewage production	Fecal coliform contamination	Provide proper sanitation facilities within facility.	Visual inspections and laboratory testing of nearby water bodies.	Weekly inspections and report quarterly; lab analysis to be done quarterly	Operator of Facility SWAMA
Accidental spillage of fuels, oils or other contaminants		Ensure responsible storage and handling of petroleum products and maintain equipment free from oil and fuel leaks. Post appropriate signs.	Visual inspections and documented proof provided.	Weekly inspection report monthly	Operator of Facility SWAMA
		Maintain spill clean-up kits and report spills to DOE.	Visual inspections and documented proof provided.	As required	operator
		Erect above-ground fuel tank in bunded area and store waste oil in sealed containers and contact DOE for disposal.	Visual inspections and documented proof provided.	As required	Operator
		Properly containerize all hazardous waste	Visual inspections and documented proof provided.	Weekly inspection and report monthly	Operator of Facility SWAMA
Prevent litter being blown into drains where they could enter waterways	litter contamination, reduced aesthetics	Maintain compound fenced	Visual inspections.		operator
ECOLOGICAL IMPACTS					
Operations of Facility and food scraps.	Attracts feral animals and pest	Properly containerize food scraps , ensure fence keeps out wild and feral animal	Visual inspection	daily	Operator
DISASTER RISK MANAGEMENT					
High-winds associated with the passage of tropical cyclones and hurricanes.	Vulnerability of assets	Ensure that a hurricane response plan and a fire prevention and response plan are developed. The plan should also address accidental incidences.	Plan in place	Operator to provide copies of plans to SWAMA within six months of commencing operations	Operator

7.1.3 Environmental Monitoring Requirements

Monitoring is a supportive component to the aforementioned mitigation measures. As such, the monitoring program is intended to provide information necessary to ensure that the recommended mitigation measures set out in the design of the transfer station are implemented in accordance with the requirements of existing legislations and recommended mitigation measures. The result of monitoring are also used to determine the need for additional measures at an early stage. In addition, compliance monitoring by DOE is also supported by a series of other environmental monitoring requirements using predetermined key indicators to ensure that pollution or other related problems are discovered in time to prevent or repair adverse effects.

There are numerous advantages in implementing a monitoring program to track the course of the transfer station works. In essence the monitoring will provide:

- Information that will enable more accurate prediction of impacts;
- Warn the Contractor of unanticipated adverse impacts to the environment;
- Information that can be used to evaluate the effectiveness of the mitigation measures; and
- Ensure that all the respective targets and deadlines are met in an environmentally responsible manner.

7.1.4 Proposed Monitoring Program

The monitoring program has been developed not only in relation to satisfying the legal and contractual obligation of the project implementer, but also as a consequence of the need to ensure the proper design and implementation of the project. The parameters chosen for the monitoring program are those that have been identified primarily for the construction phase of the project since upon completion, the impacts during operation would be minimal and with net positive environmental and social impacts.

7.1.4.1 Water Quality Monitoring

Water quality monitoring is often recommended for a transfer station to provide assurance of compliance with regulatory and contract requirements and to ensure that the quality of the surface and ground water at risk are not compromised. The project will encourage the implementation of monitoring where there is potential for adverse environmental impacts from the proposed works. The water quality monitoring program aims to effectively identify potential water pollution problems associated with transfer station construction, the cause of the problems

and the mechanisms to manage any identified issues. In the instance of monitoring the impacts on water quality it is recommended that this also be done prior to the construction phase to establish baseline information.

A range of monitoring techniques is discussed in this section. A combination of field tests with probes and laboratory analysis is provided. The use of probes for water quality analysis is a good means to undertake water quality monitoring at reasonable cost.

Analyses of collected water samples should be done using the Standard Methods for the Analysis of Water and Wastewater.

7.1.4.1.1 Sampling Sites

The project will entail both construction and post construction monitoring sites. During construction, monitoring will be generally downstream of the works from the Roaring Creek tributary when it is flowing and from the Roaring Creek itself at the point of discharge of the tributary draining the project area.

7.1.4.1.2 Sampling frequency

As the construction works mainly have an impact on the receiving waters during times of site discharge, downstream samples should be taken as soon as practical following rainfall events. Rainfall events refer to times when runoff from the site is entering the receiving waters through on-site sedimentation controls such as silt-curtains or when sedimentation traps require maintenance discharge to restore their design capacity. Samples should be collected at the rate of:

- Two times per year: one during the rainy period (June) and the other at the end of the year (December).

Post construction monitoring will be collected twice a year, similar to preconstruction sampling.

7.1.4.1.3 Monitoring Parameters

Monitoring parameters will be analyzed for the same parameters being monitored during the rainy period (June) for the Belize City Transfer Station (see Table 7.3).

Table 7.3: Parameters monitored during the rainy period (June).

PARAMETER	LOD	LOQ	UNIT OF MEAS.	SAMPLE 1	SAMPLE 2	SAMPLE 3	METHOD
PHYSICAL							
PH							
Conductivity							
Total Dissolved Solids							
METALS							
Manganese							
Iron, Total							
Copper							
INORGANIC COMPOUNDS							
M Alkalinity (as CaCo3)							
P Alkalinity (as CaCo3)							
Carbonate							
Chloride (Cl)							
Total Hardness (as CaCo3)							
Ammonia							
Nitrate							
Phosphate							
Salinity							
Sodium Chloride							
Sulfate (SO4)							
ORGANIC CHEMISTRY							
Oxygen Demand, Chemical							
Oxygen Demand, Biochemical							
MICROBIOLOGICAL ANALYSIS							
Fecal Coliform							

(Note: pH and turbidity should be recorded in-situ with a portable probe and meter. Turbidity measurements may be substituted for TSS analysis provided a correlation has been established between the two parameters on a site specific basis within the project).

The parameters monitored for December should be reduced to the following indicator parameters:

1. Dissolved Oxygen 2. Biological Oxygen Demand 3. Chemical Oxygen Demand

4. pH 5. TSS 6. Turbidity 7. F. Coliform 8. E Coli

7.1.4.1.4 Interpretation of Results

The monitoring program will incorporate a feedback loop to provide rapid dissemination of the results (visual, in-situ or laboratory) to the contractor to ensure problems are rectified as soon as possible. If repeated results demonstrate that the site or parts of the site have stabilized, upstream and downstream sampling parameters, frequencies and locations will be reviewed in order to reduce or discontinue monitoring.

The program will include a process for reporting and responding to exceeding the water quality criteria and/or targets for the project that should include but not be limited to:

- validation of result(s) showing exceeded criteria
- repeated or further monitoring.
- investigation to determine cause and source of the exceeded criteria
- review of pollution controls and/or construction activities or procedures
- Reporting to the Contractor.
- Reporting to the Department of the Environment.
- Documentation of all of the above.

7.1.4.2 Ambient Air Quality

This Ambient Air Quality Plan will monitor air and noise pollution generated as a result of the construction activities and post construction operation. The plan aims to address the control of fugitive and airborne dust emissions as well as vehicular exhausts emissions and related above normal noise generation. The sources of air and noise pollutants at the different phases of the road rehabilitation project are categorized as follows:

i) ***Construction Phase*:** Construction works include road surface removal, movement of vehicles, transportation of materials, camp erection, infrastructure provision and any other infrastructure activities. The major temporary air pollution is dust generated as a result of these construction works.

ii) ***Operational Phase***: The major permanent sources of air pollutants are the vehicle emission from traffic on the roads.

The primary objective of this monitoring plan is to formulate a strategy for controlling, to the greatest extent practicable, fugitive or airborne dust emissions and exceeding levels of noise disturbances. This will be accomplished by identifying specific sources and activities that have the highest potential to produce or generate the disturbances. This plan describes the engineering controls necessary to minimize and control dust emissions from those sources and activities as well as the reduction of noise generated by the activities. As necessary, the scope of this plan will be revised to reflect changes in dust control strategy as site conditions or activities may change in the future.

This plan recommended is to monitor air quality by using dust, smoke and visibility as indicators of air quality. Perhaps DOE could be requested to do this on an occasional basis with field monitoring testers as those used in gathering the baseline survey. The ambient air quality should be measured at the same point where baseline information contained in this report was generated from.

The monitoring program will incorporate a feedback loop to provide rapid dissemination of the results (visual, in-situ or laboratory) to the contractor to ensure problems are rectified as soon as possible. If repeated results demonstrate that the site or parts of the site have stabilized, then the parameters will be reviewed in order to reduce or discontinue monitoring. Table 7.4 provides a form for recording results.

7.1.4.2.1 Reporting and responding to exceeded criteria

The program will include a process for reporting and responding to exceeding the limits set by the DOE's Pollution Regulation criteria.

Table 7.4: Environmental Quality Template with File Numbering System

Date:	
FILE	

	Sample Location	SPM	SO_2	CO	NO_x	Noise levels	Blank
0001							
0002							
0003							
0004							
0005							

7.2 Monitoring Cost

The monitoring will incur a cost to the project and therefore a budget allocation will be required. Environmental monitoring of the road rehabilitation will be done by assigned qualified personnel and with the assistance from the Department of the Environment. The project intends to attach a technician from the Department of the Environment to the project so he/she can be a part of the monitoring team. This capacity building measure should benefit the Department's role in identify the impacts, institute mitigation measures and devise a monitoring plan to verify its effects and make corrective actions. The costs presented below in Table 7.5, are all indicative and will be refined at the start of the construction contract.

Table 7.5. Cost of Water and Air Monitoring Plans

Monitoring Plans	Indicative Costs ($)	Duration	Notes
Water Quality – transportation to sampling sites, collection and storage and analyzing all samples.	15,000	Pre and post construction (2 months)	Sample includes parameters and assigned personnel
Environmental Quality – monitoring of air and noise pollution.	25,000	Pre and post construction (2 months)	Costs include purchase of monitoring meter

7.3 General Reporting Requirements

In the general context of the monitoring plan, there must be established target goals and objectives in terms of monitoring the anticipated impacts. The results of these plans must be reported to the DOE as part of their requirement. Likewise, any adverse or potentially adverse impact must be reported immediately to the DOE and SWAMA as well as other regulatory

agencies. Table 7.6 provides a template that could be used by the Contractor, SWAMA or Doe Officer assigned to the project to monitor compliance with the ECP and ESMP.

Table 7.6: Monitor Compliance with the ECP and ESMP

Name of Person Filling Form:_____				**Date:_____**	
Activity	Environmental Effects	Mitigation Measure(s)	Monitoring Indicator(s)	Monitoring and Reporting Frequency	Party Responsible
List all activities in ESA that received a "negative determination with conditions." **Do not list any other activities.**	List main environmental effects that require mitigation	If mitigation measures are well-specified in the ECP quote directly from ECP If they are not well-specified in the ECP define more specifically here.	Specify indicators to (1) determine if mitigation is in place and (2) successful. For example, visual inspections for seepage around pit latrine; sedimentation at stream crossings, etc.)	For example: "Monitor weekly, and report in quarterly reports. If problem arises, immediately inform project manager or DOE."	If appropriate, separately specify the parties responsible for mitigation, for monitoring and for reporting.
Signature of Person completing Form:_____					

7.4 Social Management Plan

The Social Management Plan (SMP) describes the overall management and monitoring of these mitigation measures. It specifies the responsibilities, timings, institutional structures, human resources and estimated annual costs required to effectively implement the plan. Since many of the social issues of concern were primarily linked to health related issues associated with pollution and occupational and traffic safety issues these issues are not included as part of the recommended plan since they are essentially the same as those required to mitigate the environmental impacts.

The aim is to ensure that the social and economic environment, for workers, waste pickers and other stakeholders not to suffer adverse impacts during the development and life cycle of the Project.

7.4.1 Social Impact and Risk Management

Management of Social Risk: Social risk will be managed through mitigation and a Participatory Public Participation Process, inclusive of a the maintenance of a complaints register, and the developing good relationship with stakeholders during project implementation;

Complaints and Accidents Register: It is recommended that the project maintain a complaints register on site and that this register be reviewed weekly by management of the project to ensure that complaints are promptly responded to. Below (Table 7.7) is a sample of the complaints form to be maintained within the register. In addition, a Social Inclusion Plan will be prepared at a later stage prior to the start of the works to compensate for any loss of livelihood for the waste pickers.

Table 7.7 Complaints Form

					Contact Information
Full Name:				◯	◯
	(first)		(last)	Male	Female
Address:					
Phone:					
e-mail:					
Issue of Concern					
Complainant Category:	◯ Resident	◯ Local Business	◯Village Chairperson	◯ Councillor	◯ NGO/CBO
	◯ Contractor	◯ Contractor Employee		Other:_____	
If with an Agency:					
	Name of Agency			Position with Agency	
Description of Grievance (when relevant, please provide specific names, dates and locations of incidents):					
Recommendation for resolving the grievance?					
Signature			Date		

Community and Worker Welfare, Safety and Health Requirements

- Work during daylight not exceeding 12 hrs.

- Ensure workers from local communities are hired with minimum of 30% quota for women;
- Inform communities of construction activities.
- Ensure that the contractor responds appropriately to complaints from communities.
- Improve road safety, especially at point of access to site.
- Maintain and regularly check tools fitted with mufflers where appropriate.
- Provide training to waste pickers on the occupational health and safety issue associated with their livelihood.
- Ensure workers and waste pickers wear Personnel Protective Equipment.
- Provide proper sanitation facilities at workers camps.
- Ensure fire and medical response for the campsites.
- Prepare and Implement a Social Inclusion Plan to compensate for any loss of livelihood for the waste pickers.

Table 7.8 provides a checklist to be used in checking worker welfare are being addressed.

Table 7.8: Site Safety Checklist

Equipment	Operators	Site Work Crew	Traffic Control	Technical Staff
Site Name:			**Day:**	
PPE				
Hard Hat				
Safety Vest				
Ear plugs/muffs				
Respirator				
Traffic				
Signs				
Cones				
Speed Bumps				
Flaggers				

7.4.2 PPP Activities

The Participatory Public Participation Process (PPP), presents an opportunity for stakeholder engagement. The consultation process plays an essential role in reducing social risk by building relationships with stakeholders in particular the waste pickers that make their livelihood from the

current dump. In consideration of this the consultants met at least on three occasions to inform of the proposed project and the potential benefits which the project will have on their working conditions through the improvements of the sanitary facilities and working under a roof. However, they were also informed of the fact that they would be required to work under rules and conditions that will not allow children below the age of 14 years to work within the facility, the need for them to wear PPE and to maintain order and respect for each other. They were shown pictures of the Belize City Transfer Station and explained how the waste sorting takes place and what could be expected of them. They all seemed very supportive. A consultation with them on the completion of this report was promised to them.

It is important that the consultation be conducted to counteracting the spread of misinformation about the Project and ensuring that stakeholders have the means to communicate their legitimate concerns on any issue of concern they may have with respect to the project.

7.5 Management Mechanisms and Organizational Capacity

The implementation of the SMP is the direct responsibility of the SWAMA while he contractor will be required to apply international standard quality assurance procedures and management system and to comply with the environmental management plan.

It is recommended that SWAMA hire the support of sanitary engineer (to be contracted and housed in the SWAMA offices) who will report to the Director in the implementation of the project. It is recommended that DOE also identify a compliance enforcement officer to be partially assigned to the project during its implementation phase to monitor compliance of contractor with the Spend to provide basic training to waste pickers.

7.6 Overall Indicative Costing of Mitigation Measures

Table 7.9 provides an indicatives costing for the implementation of the recommended mitigation measures to address the environmental and social impacts associated with the construction of the Belmopan Transfer Station and accompanying activities. The costs are those primarily associated with capacity building and institutional strengthening of the executing and regulatory agencies involved in ensuring compliance monitoring of the ESMP. It must be borne in mind that the major costs associated with mitigation measures have been included in the design features of the

project and are part of the pre-feasibility and preliminary engineering design estimates provided by A. Thurton and Associates. In addition, many of the mitigation measures recommended are based on the implementation of best management practices and good industry standards which are intended to be included as conditions in the contracts that would be issued in respect to the implementation of the project.

Table 7.9: BET Advanced Preliminary Estimates

Environmental Assessment & Management Plan for the building Belmopan Waste Transfer Station

	ITEMS/DESCRIPTION	QTTY	UNITS	RATES	COST USD
A	**Environmental Quality and Impact Management Measures.**				
1	**Capacity Building**				
a	Personnel: Environmental Technician (60% Staff time for life of project)	1	yrs	9,000.00	9,000.00
	Personnel: Sanitation Engineer (full time supervision of work)	1	yrs	60,000.00	60,000.00
b	**Training**				
	Risk Identification and Management in Solid Waste Management	1	only	5,000.00	5,000.00
	Performance Monitoring Evaluation (compliance monitoring)	1	only	5,000.00	5,000.00
	SWaMA Water, Air and Wind Sampling Techniques	1	only	1,000.00	1,000.00
	Waste Pickers OHS training	3	only	3,000.00	9,000.00
c	**Evaluations**				
	Performance Monitoring Evaluation Impact Mitigation Measures (end of Project)	1	only	3,000.00	3,000.00
	Water Quality	1	only	1,000.00	1,000.00
	Air and Noise Quality*	1	only	0.00	0.00
	Wind*	1	only	0.00	0.00
d	**Equipment**				
	Air Quality Monitoring Equipment	1	only	5,000.00	5,000.00
	Anemometer	1	only	500.00	500.00
	Gas Alert Multi-Gas (4) Meter	1	only	700.00	700.00
	Noise Meter	1	only	250.00	250.00
	Totals				**99,450.00**

*Investing in equipment will enable in-house monitoring

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APPENDICES

Appendix I: Cirriculum Vitae of Consultants

Appendix II: The Terms of Reference – IADB

Appendix III: Transfer Certificate of Title

Appendix IV: Sample Testing Instruments

Appendix V: Persons Consulted

Appendix I: Curriculum Vitae of Consultants

Principal
Ismael Fabro M.Sc., Managing Director and Environmental Specialist – Team Leader

Environment and Health and Safety
Juan R. Rancharan M. Ag., Environmental-Agriculture and Health and Safety

CURRICULUM VITAE

ISMAEL ELIGIO FABRO

#2216 Juliet Soberanis St. Belama Phase I, Belize City, Belize

Tel/Fax: 501-223-1819 Cell: 501-6071947

iefabro@gmail.com

NATIONALITY: Belizean

LANGUAGES: English, Spanish

DATE OF BIRTH: February 13, 1958

AREAS OF EXPERTISE:

Environmental Impact Assessment

Environmental, Health and Safety Audits

Environmental Legislation

- Environmental Management
- Environmental Emergency Response Planning
- Water Quality Monitoring
- Natural Resources Assessment
- Ecology
- Pollution Control
- Solid Waste Management
- Ecological Effects of Pollution
- Training in Environment and Conservation
- Project Management
- Project Evaluation

PROFESSIONAL BACKGROUND:

Ismael Eligio Fabro is an environmental scientist with 18 years experience in Environmental Management as Belize's Chief Environmental Officer from 1990- 2008.

Under his term as Chief Environmental, Mr. Fabro was responsible for the institutional development of the Department of the Environment and the development of Belize's National Environmental Agenda. Two years after it was first opened, with much hard work and planning, the Department of the Environment was legally established under the Environmental Protection Act (EPA) of 1992. Since then the EPA has undergone several amendments aimed at improving Belize's ability to respond to new environmental challenges, reflecting the dynamic nature of environmental management in Belize.

Under Mr. Fabro's term in office, the Department was able to grow into one of Belize's most dynamic and respected Government Departments. During these 18 years, Mr. Fabro played a leadership role in the development of Belize's current national environmental policies, legislations such as the Environmental Protection Act, Pollution Regulations, Effluent Limitation Regulations, and Environmental Impact Assessment Regulation. During his tenure, the National Environmental Action Plan was developed and implemented among several other sectoral plans and programs. He was also responsible for the preparation of cabinet papers that led to Belize becoming a signatory to several Multilateral Environmental Conventions.

As Chief Environmental Officer, Mr. Fabro was responsible for preparing the proposal and acquiring grant funding for the preparation of Belize's National Solid Waste Management Plan. To ensure proper guidance of the project, he spearheaded the activation of the Solid Waste Management Authority and served as its first Chairman.

In October of 2005, Mr. Fabro was seconded to the position of acting Chief Executive Officer of the Ministry of Natural Resources and the Environment and served in this capacity until June 2007. As Chief Executive Officer of the Ministry, he was able to positively influence the development of the new petroleum industry and to accelerate the implementation of the strategic plans of the Forest Department, Lands and Survey Department and other departments within the Ministry.

In both capacities, Mr. Fabro had the opportunity to represent the Government of Belize in numerous high-level National, Regional and International meetings, negotiations and other forums. He sat as chair of the Pesticide Registration Subcommittee of the Pesticide Control Board, National Environmental Appraisal Committee and the Environmental Subcommittee of the National Emergency Management Organization and as member of the Solid Waste Management Authority, Protected Areas Conservation Trust and several other committees.

Educated primarily in Belize and the USA, Mr. Ismael Fabro was the recipient of a USAID/ Campus Scholarship under which he obtained a Bachelor of Science Degree graduating, summa cum laude, at the top of his class in Mankato State University, a current branch of

Minnesota State University. During this period, Mr. Fabro also managed to complete his postgraduate courses obtaining a Master of Science Degree shortly thereafter.

Prior to heading the Department of the Environment in 1990, Mr. Fabro had served as the head of the science division of Edward P. Yorke High School where he served as a Biology and Chemistry Teacher from 1981-1989.

In addition to these 27 years of Public Service, Mr. Fabro had worked at the Belize Sugar Industries Ltd. as Assistant Chemist (1978-1979) and at Pallotti High School (1979-1981) as the Chemistry Teacher.

Mr. Fabro currently works as an Environmental Consultant and is the Managing Director of Belize Environmental Technologies, a newly registered environmental consulting company.

EDUCATION AND TRAINING:

Master of Science, Ecology
MANKATO STATE UNIVERSITY, USA (1993)

Bachelor of Science (SUMMA CUM LAUDE), Biology with Emphasis in the Environmental Sciences and a Minor in Chemistry
MANKATO STATE UNIVERSITY, USA (1987)

Associates of Science Degree (Dean's List), Majors in Chemistry and Biology
ST. JOHN'S JUNIOR COLLEGE, BELIZE (1978)

Secondary School Honour Graduation Diploma,
ST. JOHN'S COLLEGE, BELIZE (1976)

Certificate in Environmental Protection
NATIONAL INSTITUTE OF ENVIRONMENTAL TRAINING, TAIWAN (1998)

Certificate in Human Resources Management
THE WORLD TRADE INSTITUTE, USA (1995)

Certificate in Management Skills Development
THE WORLD TRADE INSTITUTE, USA (1995)

Certificate in Environmental Assessment and Monitoring

(Langkawi Awards for Environmental Studies-Commonwealth Secretariat)
COUNCIL OF SCIENTIFIC & INDUSTRIAL RESEARCH, INDIA (1991)

PUBLICATIONS AND CONSULTANCIES (Recent 2008 - 2015)

Environmental Site Assessment of Beach Erosion at Laru Beya Resorts, Placencia, Stann Creek. Belize Off Shore Services Limited, Belmopan. November 2015

Environmental Site Assessment for Marion Jones Sporting Complex, Belize. United Nations Office for Project Services (UNOPS) and Ministry of Sport, Belize City, November 2015

As Legal Specialist/Team Member, completed a short-term consultancy for the Institutional Strengthening and Capacity Enhancement of the Department of the Environment of the Ministry of Forestry, Fisheries and Sustainable Development. 2014.

As an Environmental Specialist/Team Leader along with a Social Specialist and a Disaster Risk Management Specialist conducted an "Environmental and Social Impact Assessment for the Rehabilitation of the George Price Highway between miles 47.9 and 79.4." 2014.

As a Natural Resource Management Expert formed part of a consultancy team to Develop Legislation and Regulations for Protected Areas Management in Belize. 2014
As Environmental and Institutional Development Specialist headed a consultancy to draft a National Environmental Strategy and Action Plan for the Government of Belize.

Team Leader in the carrying out an Environmental Impact Assessment for Blue Waters International to farm Red Drum Fish of the coast of Belize City. 2014

As an Environmental Professional, completed a consultancy for a Phase 1 Environmental Site Assessment (ESA) of a property consisting of a total of 640 acres of land containing a foreclosed tilapia fish farm. The fish farm known as Fresh Catch Belize Limited is located in the village of La Democracia, off the Coastal Road in the Belize District. 2014

As an Environmental Legal Specialist/Team leader, completed a consultancy funded by the Caribbean Community (CARICOM) Secretariat, to undertake a Diagnostic and Analytical Review of the Environmental Governance System in Belize. -2013

Environmental Impact Assessment for Boiton Minerals Limited to Prospect and Mine Gold in the Chiquibul Forest Area. July 2012

Sunny City Development-Township Project Environmental Impact Assessment Report, April 2012

Sewage Needs Assessment Pilot Project for Caye Caulker 2009-2011- Final Report.

Department of the Environment. September 2011.

Neuland Reinlaender Homestead-Agriculture Project- Project Documentation and Environmental Checklist- October 2011.

Belize's National Pollutant Release and Transfer Registers (PRTR) Assessment Report. Belize SAICM Initiative Mainstreaming into Development Plans the Sound Management of Chemicals (SMC) Priorities for Key Development Sectors in Belize and Associated SMC Governance Project. Department of the Environment and SG – CCAD. July 2011

Mainstreaming and Capacity Building for Sustainable Land Management in Belize - Mid Term Evaluation Report, prepared for UNDP, January 2011

Belize's National Pollutant Release and Transfer Registers (PRTR) Assessment Report. Belize SAICM Initiative Mainstreaming into Development Plans the Sound Management of Chemicals (SMC) Priorities for Key Development Sectors in Belize and Associated SMC Governance Project. Department of the Environment and SG – CCAD. July 2011

Mainstreaming and Capacity Building for Sustainable Land Management in Belize - Mid Term Evaluation Report, prepared for UNDP, January 2011

The Institutional Strengthening of the Solid Waste Management Authority and the Department of the Environment in Institutional/Legal and Environmental/Technical areas in Solid Waste Management, Local Consultant, GENIVAR Ltd., Trinidad and Tobago, July 2010

Current Environmental Situation in Belize and Environmental Considerations for Tourism Development (Reports) – Local Environmental Consultant -Belize Tourism Master Plan, Tourism & Leisure Advisory Services SL, Spain, July 2010.

Fourth National Report to the United Nations Convention on Biological Diversity, Lead Consultant, Government of Belize, May 2010.

Placencia Marina Limited Supplementary Environmental Impact Assessment, Placencia, Stann Creek, December 2009

PERENCO's Block A, Belize 2D Seismic Exploration Project Proposal and Environmental Report for Environmental Clearance Application, November 2009.

Placencia Estate Limited Golf Course Limited Level Environmental Study, Placencia, Stann Creek, October 2009

Yum Balisi's Environmental Impact Assessment, Stann Creek, August 2009.

National Environmental Guidelines for Marinas and Berthing Facilities– Department of Environment, Ministry of Natural Resources and the Environment, April 2009.

National Environmental Guidelines on Overwater Structures – Department of Environment, Ministry of Natural Resources and the Environment, March 2009.

Revised Environmental Impact Assessment for Mile 22 Sanitary Landfill and Transfer Station, February 2009.

Integrating Protected Areas and Landscape Management in the Golden Stream Watershed (PIMS 1740) – Mid Term Evaluation Report, December 2008.

Environmental Audit and Review – Old Belize Adventure Cucumber Beach Marina, December 2008.

Feasibility and Environmental Studies for the Renewable Technology (Hydroelectric) for Douglas D'Silva Forest Station in the Mountain Pine Ridge Forest Reserve, Cayo, Belize, October 2008.

CONFERENCES AND WORKSHOPS ATTENDED:

As head of the Department of the environment for 18 years, Mr. Fabro had the opportunity to represent Belize in numerous international high level meetings and conferences and served as head of delegation on many occasions.

Conferences and Meetings (Selected):

XXVIII Extraordinary Meeting of The Central American Commission on Environment and Development (CCAD) on the Regional Strategy For Climate Change, Regional Strategy on Agriculture and the Environment and The Regional Integrated Water Resources Strategy, Dominican Republic, (March 2008)

As Belize's CCAD Liaison Officer, Mr Fabro attended most of the technical preparatory and ministerial meetings of the CCAD.

Conference on the Use of Dispersants in Sensitive Coastal Areas (Oil Spills Preparedness Plan), Panama, (Dec 2007)

X Regional Forum: Renewable Energy Initiatives in Central America's Sugar Industry, Belize, 2007

Eight Meeting of the Conference of the Parties on Biological Diversity, Brazil, (March 2006). Head of Delegation.

II Central American Conference on Renewable Energy, Honduras, (Feb.2005)

Regional Meeting on the Stockholm Convention to review draft Guidelines on Best Available Techniques and Best Environmental Practices relevant to Article5 and Annex C of the Convention, Argentina, (March 2005)

Eight Special Session of the Governing Council/ Global Ministerial Environment Forum, Korea (March 2004). Head of Delegation

Regional GRULAC Consultations on SAICM and meeting of the Preparatory Committee for the development of a strategic approach to International Chemicals Management, Kenya (Oct. 2004)

Cleaner Production and Environmental Management Systems Workshop, Belize 2004

Conference on Environmental Risk Assessment on Pesticide Use, El Salvador, (Nov. 2004)

Regional Workshop on the Management of Solid Waste in Central America, El Salvador, (Mar. 2004)

USEPA-Pesticide Registration Training Workshop, USA, (Oct. 2003)

Regional Forum on Renewable Energy and Meeting of the Steering Committee of CCAD's Alliance on Energy and the Environment, Panama, (June 2003)

Seminar on Cooperation on responses to Oil Spill at Sea, organized by the Regional Activity Center/ Regional Marine Pollution Education, Information and Training Center-Caribbean, Panama (April 2003)

Training Workshop on FAO Specifications Applicable to Pesticide Registration of Agricultural Pesticides, Belize, (July 2003)

First Intergovernmental Review Meeting of the Global Program of Action (GPA), Canada, (Nov 2001)

Conference on Enhancing Defence- Environmental Cooperation in Central America and the Caribbean, Costa Rica, (May 2001)

First Meeting of the Regional Task Force on the Environment, Guyana (2001)

The Twenty- First Session of the Governing Council of UNEP, Kenya (Feb. 2001)

Regional Seminar on Phyto-sanitary Registration and Intellectual Property Rights, Guatemala, (July 2001)

5th Meeting of the Conference of the Parties of the Convention on Biological Diversity, Canada, (Feb. 2000). Attended Meeting as head of delegation.

III Regional Meeting on the Institutional Development of the Environmental Health Divisions within the Ministries of Health, Chile (2000)

Conference of Plenipotentiaries to Adopt the Protocol Concerning Pollution from Land-Based Sources and Activities of the Wider Caribbean Region, Aruba, (Oct 1999). Head of Delegation

Seminar for High Level Government Officials on Economic Globalization, Sustainable Development and the Environment in Central America, Costa Rica, (Feb. 1997)
Management Development Seminar on Internal Relations, Economics and Negotiations, Belize, (Nov 1995)

Second National Symposium on the State of the Belize Environment, Belize, (Oct. 1995) Organized and chaired several sessions.

3rd International Meeting of the INTERNATIONAL Society for Ecological Economics, Costa Rica, (Oct, 1994). Organized and chaired several sessions.

Workshop on Environmental Management and Sustainable Development, Belize, (Dec. 1993)

Seminar on Environmental Management, Costa Rica, (Mar. 1992)

First National Symposium on State of the Belize Environment, (Jun. 1992)
Regional Workshop on Data Management using SPSS+PC, Costa Rica, (Nov. 1990)

AWARDS (Selected):

Commonwealth Scholarship (Langkawi Awards for Environmental Studies in Environmental Assessment and Monitoring (1991)

USAID/ Campus Scholarship (1985-1987)

Honour Student Award, Mankato State University (1986)

SUMMA CUM LAUDE Graduate (1987)

Belize Government Associate Degree Achievement Scholarship (1976)

Holy Redeemer Credit Union High School Achievement Scholarship (1972)

COMPUTER SKILLS:

Microsoft Office Suite

Statistics: Inferential and Descriptive Statistic using SPSS-X and Excel

World-Wide-Web, E-mail and Search Engines

CAREER HISTORY:

July 2008 - Present Environmental Consultant and Managing Director Belize Environmental Technologies, Belize City, Belize

July 2007 – June 2008 Chief Environmental Officer, Department of the Environment, Ministry of Natural Resources and the Environment, Belmopan, Belize

Oct 2005 – June 2007 Chief Executive Officer (Acting), Ministry of Natural Resources and the Environment (Seconded), Belmopan, Belize

Jan 1990 – Sep 2005 Chief Environmental Officer, Department of the Environment, Ministry of Natural Resources and the Environment, Belmopan, Belize

Nov 1989 – Dec 1990 Environmental Officer in the Department of the Environment, Ministry of Tourism and the Environment, Belmopan, Belize

Sep 1981- Nov. 1989 Biology and Chemistry Teacher (Head of Science Division) Edward P. Yorke High School, Belize City, Belize

Sep 1979 – May 1981 Chemistry and General Science Teacher Pallotti High School, Belize City, Belize

Sep 1978- May 1979 Assistant Chemist, Belize Sugar Industries Tower Hill, Orange Walk, Belize

OTHER INFORMATION:

Fluent in both spoken and written English and Spanish
Excellent writing abilities
Excellent interpersonal skills
Avid reader and sport enthusiast

Juan R. Rancharan

OBJECTIVE

To maximize on my expertise and working experience in sustainable development operations, while taking into consideration the health and safety of others.

PROFESSIONAL EXPERIENCE

2008 – Present **Agricultural, Environmental, Health and Safety Consultant, Itzamná Limited and Belize Environmental Technologies Belize City**

Consultant

- Provide consultancy expertise in the following areas:

  Agricultural and Extension Education
  Environmental and Natural Resources Management
  Environmental Policy
  Health and Safety

2005 - 2008 **Ministry of Natural Resources and the Environment, Belmopan, Belize**

Policy Coordinator/Sustainable Development Officer

- Provided support to the Ministry in the implementation and coordination of Natural Resources and Sustainable Development policies, strategies and activities, in particular the implementation of Multi-lateral Environmental Agreements (MEA's) to which Belize is a party.
- Monitored the implementation of existing projects and coordinated the review and monitory of project proposals requiring Ministry's endorsement with a view to ensuring that its objectives and activities are consistent with national priorities and with Ministry's policies, goals and objectives.
- Supported the coordination of activities arising from the Central American Commission on Environment and Development (CCAD) and CARICOM on matters pertaining to Natural Resources, Environment and Sustainable Development.
- Represented the Ministry as its designated representative on select Project Steering Committees/Project Execution Groups in particular the National Implementation Plan on Persistent Organic Pollutants (*POPs*) Project.
- Provided oversight for the organization of Ministry's events including forums, conferences and meetings.

2003 - 2005 **High Commission of Belize, Ottawa, Canada**

Counsellor/Head of Chancery

- Assisted in the establishment of the Belize High Commission to Canada including diplomatic, administrative and logistical arrangements.
- Responsible for Belize-Canada Bilateral Programmes and general implementation of government foreign policy as well as trade, tourism and Consular matters.
- Administered, coordinated, supervised and monitored the activities and performance of local recruited personnel.
- Acted as the Head of Chancery and Finance and Budget Officer of the High Commission.

1997 - 2003 **Embassy of Belize, Havana, Cuba**

First Secretary/Head of Chancery

- Assisted in the establishment of the Belize Embassy to Cuba including diplomatic, administrative and logistical arrangements.
- Responsible for Belize-Cuba Bilateral Programmes and general implementation of government foreign policy, trade matters and Consular matters. This included the implementation, monitoring and evaluation of the Cuba-Belize Education Programme, Health Cooperation Programme, Agricultural and Environmental Projects and all other cooperation programmes between Belize and Cuba.
- Administered, supervised and monitored the activities and performance of locally recruited staff.
- Acted as the Head of Chancery and Finance and Budget Officer of the Embassy.

1995 – 1997 **Belize Sugar Industries Limited, Tower Hill, Orange Walk, Belize**

Company Health and Safety Officer

- Responsible for developing, implementing, monitoring and evaluating the company's Health and Safety Programme.
- Investigated accidents to identify causes, prepared detailed reports of same and provided recommendations on improvement in safety standards to be adopted**.**
- Trained staff and employees on all aspects of the company's Health and Safety Procedures.
- Liaised with other agencies, managers and staff on purchasing requirements of equipment and other items relating to health and safety.
- Conducted Company Health and Safety Audits; a critical, in-depth examination of an organisation's health and safety management

system. The audit covered the whole system including risk assessment procedures, issue and control of personal protective equipment etc.

1987 -- 1995 **Belize Sugar Industries Limited, Tower Hill, Orange Walk, Belize.**

Senior Technical Officer

- Responsible for developing, implementing, monitoring and evaluating the Sugarcane Technical Support Service (SETSS).
- Developed, organized and carried out in-house training of the company's Field Technical Officers.
- Coordinated and supervised the allocation of farm land preparation equipment, inputs and credit facilities in the implementation of the land preparation programme for sugarcane farmers with the objective of promoting the newly released sugarcane varieties.
- Developed and conducted seminars, workshops and demonstrations on the recommended sugarcane farming operations.
- Liaised with the Belize Cane Farmers' Association and other agencies to communicate and promote SETSS.
- Responsible for organizing exhibits for various Agricultural/Trade Shows.
- Prepared monthly reports on SETSS development and advances to document the programme's innovative approach.

1980 – 1982 **Atlantic Bank Limited, Belize City, Belize**

Banking Clerk

- Responsible for conducting various financial and banking transactions while assigned on rotation as bank teller, teller supervisor, proof teller and Letter of Credit Officer.

EDUCATION

1986 – 1987 **Masters in Agricultural and Extension Education**
University of Florida, Gainesville, Florida, USA

Courses (Selected)

- Programme Development in Extension Education
- Methods of Plan Change
- Extension Administration and Supervision
- Developing Instructional Materials and Advance Instructional Techniques
- Fundamental Plant Pest Management
- Principles of Post-harvest Horticulture

- Marketing (Agriculture)

1983 - 1985 **Bachelors in Agricultural and Extension Education (Honours)**
University of Florida, Gainesville, Florida, USA

Courses (Selected)

- Development and Role of Extension Education
- Development and Philosophy of Agricultural Education
- Evaluation of Extension Education Programme
- Agricultural Youth Programmes
- Farm Firm Management
- Horticultural Vegetable Gardening and Worlds Vegetables
- Farm Machinery
- Agricultural Construction and Maintenance
- Extension Internship – Vegetable Crop Production, Homestead, Florida, USA

1978-1980 **Associate's Degree in Maths, Biology, and Chemistry**
St. John's Junior College, Belize City, Belize

CERTIFICATES (Selected)

2007 Capacity Building on "Sustainable Development, Trade, Investment and Intellectual Property Rights, CEPAL - ECLAC, Costa Rica.

1997 Certificate in Health and Safety, London, England.

1993 Travelling Seminar – Sugarcane Industries – Tate and Lyle, Kenya, Zambia and Swaziland.

1991Introduction to Management Programme, Tate and Lyle PLC, London, England.

CONFERENCES/WORKSHOPS (Selected)

November 2007 X Regional Forum – Renewable Energies in the Sugar Industry in Central America, and XIII Meeting of the Technical Advisory Committee of the Energy and Environment Partnership with Central America (EEP), – Lead Organizer and Participant, Belize.

November 2007 National Programme of Action for the Protection of the Marine Environment from Land-Based Sources of Pollution in Belize.

October 2007	Areas of Cooperation in Mesoamerica in Climate Change - Regional Technical Workshop, Belize.
September 2007	BIOENERGY 2007 International Conference and the XII Meeting of the Technical Advisory Committee of the Energy and Environment Partnership with Central America (EEP), Finland (Head of Delegation).
February 2007	IX Regional Forum – Financial Opportunities for Renewable Energy and Environmental Projects in Central America**,** and the XI Meeting of the Technical Advisory Committee of the Energy and Environment Partnership with Central America (EEP), Guatemala (Head of Delegation).
June 2006	Environmental Ethics Protocol for Central America – Central American Commission on Environment and Development (CCAD), Workshop, Costa Rica.
April and June 2006	Belize National Security Policy and Strategy Workshop, Belize.

COMMITTEES

2007	Belize Representative, Technical Advisory Committee of the Energy and Environment Partnership with Central America (EEP), Salvador.
2007	GEF Operational Focal Point Representative on Project Executing Groups for the following projects: 1. United Nations Framework Convention on Climate Change (UNFCCC) – Second National Communications of Belize. 2. Integrating Protected Areas and Landscape Management in the Golden Stream Watershed Project. 3. National Implementation Plan on Persistent Organic Pollutants (POPs).
2006 – 2007	Ministry of Natural Resources and the Environment (MNRE) Representative to the National Human Development Advisory Committee (NHDAC).
2006 – 2007	Belize's Representative to the Regional Steering Committees to the "Environmental Protection and Maritime Transport Pollution Control Project in the Gulf of Honduras" (Belize, Guatemala and Honduras), Honduras.

2006 – 2008	Member – Policy and Agriculture - National Steering Committee – GEF Small Grants Programme (Requested leave due to conflict with Consultancy Work).
2003 – 2005	Founding Member of the Latin American Consular Group, Ottawa Chapter, Canada.
2003 – 2005	Alternate Member to the diplomatic group: Grupo Latino Americano (GRULA), Ottawa, Canada.
2003 – 2005	Alternate Member to the diplomatic group: CARICOM, Ottawa, Canada.
1998 – 2003	Alternate Member to the diplomatic group: Grupo Latino Americano y del Caribe (GRULAC), Havana, Cuba.
1998 – 2003	**Health and Safety Advisor to the International School of Havana, Havana, Cuba.**

SELECTED CONSULTANCY WORK:
BELIZE ENVIRONMENTAL TECHNOLOGIES - CONSULTANCY TEAM MEMBER
(Some of which are posted in the Department of Environment website.)

Enivornmental Site Assessment of Beach Erosion at Laru Beya Resorts, Placencia, Stann Creek. Belize Off Shore Services Limited, Belmopan. November 2015

Environmental Site Assessment for Marion Jones Sporting Complex, Belize. United Nations Office for Project Services (UNOPS) and Ministry of Sport, Belize City, November 2015

Limited Level Environmental Studies for Belize Wellness Resort Project, Northern Caye Caulker, Belize. Mayan Sunset Holdings Limited, Caye Caulker. August 2015

Developing an Environmental Programme for the Rehabilitation and Re-Opening of the Lighthouse Reef Resort. Northern Two Cayes Company. Belize, January 2015

Environmental Checklist for PERENCO's Block Cayo, Belize – Saturday Creek Petroleum Exploration Well and process Environmental Clearance. PERENCO Belize Limited. November 2014.

Environmental Checklist for PERENCO's Block Cayo, Belize – San Ignacio Petroleum Exploration Well and process Environmental Clearance. PERENCO Belize Limited. November 2014.

Environmental and Social Impact Assessments for the Rehabilitation of the George Price Highway between Miles 47.9-79.4. Ministry of Works and Transport and Inter American Development Bank, Belmopan July, 2014.

Developing a 10 year National Environmental Policy and Strategy Statement, Strategy Plan and Action Plan." Department of Environment and World Bank. Belize, June 30, 2014

Blue Waters International -Belize- Environmental Impact Assessment for Marine Cage Farming of Red Drum (*Sciaenops ocellatus*), Adjacent To Drowned Cayes, Belize District. December 2013.

Source Vulnerability Assessment (SVA) and a Source Water Protection Plan (SWPP) for Bowen and Bowen bottling facility- Crystal Bottling Co., Ladyville, Belize, January 2013

Environmental Impact Assessment (inclusive of an Environmental, Health and Safety Audit) for Boiton Minerals Limited to Prospect and Mine Gold in the Chiquibul Forest Area. July 2012

Sunny City Development-Township Project Environmental Impact Assessment Report, April 2012

Environmental Checklist for PERENO's Block A –West - Petroleum Exploration Well and process Environmental Clearance. PERENCO Belize Limited. November 2011.

Consultancy 17 Belize - To prepare National Environmental Summary for Belize, Indicators of Sustainable Development of Belize, and Economy Scoping Study, UNDAF/CCA Process- UNEP. October 2011

Neuland Reinlaender Homestead-Agriculture Project- Project Documentation and Environmental Checklist- October 2011.

Sewage Needs Assessment Pilot Project for Caye Caulker 2009-2011- Final Report. Department of the Environment. September 2011.

Belize's National Pollutant Release and Transfer Registers (PRTR) Assessment Report. Belize SAICM Initiative Mainstreaming into Development Plans the Sound Management of Chemicals (SMC) Priorities for Key Development Sectors in Belize and Associated SMC Governance Project. Department of the Environment and SG – CCAD. July 2011.

Mainstreaming and Capacity Building for Sustainable Land Management in Belize - Mid Term Evaluation Report, prepared for UNDP, January 2011.

Belize's National Profile for the Management of Chemicals and Wastes, prepared for the Central American Commission on Environment and Development and the Department of the Environment, November 2010.

Yum Balisi Sustainable Luxury Resort Environmental Impact Assessment, Yum Balisi Limited, Dangriga, Belize. November 2010.

The Institutional Strengthening of the Solid Waste Management Authority and the Department of the Environment in Institutional/Legal and Environmental/Technical areas in Solid Waste Management, Local Consultant, GENIVAR Ltd., Trinidad and Tobago, July 2010.

Current Environmental Situation in Belize and Environmental Considerations for Tourism Development (Reports) – Local Environmental Consultant -Belize Tourism Master Plan, Tourism & Leisure Advisory Services SL, Spain, July 2010.

Preparation of Fourth National Reports To the Convention on Biological Diversity (CBD), Forest Department, Government of Belize- UNDP – May 2010.

Placencia Marina Limited Project Environmental Impact Assessment Placencia Estate Limited, January 2010.

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Placencia Estate Limited Golf Course Project Limited Level Environmental Study, Placencia Estate Limited, October 2009.

National Environmental Guidelines for Marinas and Berthing Facilities– Department of Environment, Ministry of Natural Resources and the Environment, April 2009.

National Guideline for Over Water Structures, Department of Environment, Ministry of Natural Resources, Belize, March 2009, Belize Environmental Technologies -Consultancy Team Member.

Mid Term Evaluation: Integrating Protected Areas And Landscape Management in the Golden Stream Watershed Project. UNDP, December 2008.

Environmental Audit and Review, Old Belize Adventure Cucumber Beach Marina, December 2008.

Feasibility and Environmental Studies for the Renewable Technology (Hydroelectric) for the Douglas D'Silva Forest Station in the Mountain Pine Ridge Forest Reserve, October 2008.

AWARDS

1986 - 1987	Dean's and Presidents List, University of Florida, Gainesville, Florida, USA

1986	Recipient of the First Agricultural Extension Education Department's Foreign Student Assistantship Award to pursue graduate studies, University of Florida, Gainesville, Florida, USA.
1987	Elected to Phi Kappa Phi and Alpha Zeta, National Honour Societies in recognition and encouragement to superior scholarship in All Academic Disciplines and Agriculture Disciplines respectively, University of Florida, Gainesville, Florida, USA.
1985	Bachelors Diploma with Honours.
1983 - 1985	Dean's and Presidents List, University of Florida, Gainesville, Florida, USA.
1983	Recipient of the Belize Sugar Industries Ltd. Belize's Independence Undergraduate Scholarship.
1980	Dean's List, St. John's Junior College, Belize City, Belize.
1978	Government of Belize Sixth Form Scholarship.
1978	St. Francis Xavier College Graduating Class Valedictorian.

COMPUTER LITERACY

Computer Literate with Microsoft Office Suite and Adobe (Photoshop and Acrobat) knowledge

PERSONAL DATA

Nationality: Belizean

Country of Residence: Belize

Languages: English and Spanish (Spoken and Written - Fluent)

REFERENCES

1. Diane Wade-Moore - Environmental Programme Analyst
   United Nations Development Programme-Belize
   Nicholas Building, Belmopan
   Phone #: 501- 822-2635
   e-Mail: diane.wade@undp.org

2. Wilber Sabido – Chief Forest Officer
   Forest Department

Ministry of Forestry, Fisheries and Sustainable Development
Phone #: 501- 822-1524
e-Mail: wilbersabido@gmail.com

3. Ismael E. Fabro – Managing Director
(Retired Chief Environmental Officer- Government of Belize)
Belize Environmental Technologies
#2216 Juliet Soberanis St. Belama Phase I,
Belize City, Belize
Phone #: 501- 615-1957 or 607-1947
e-Mail: iefabro@gmail.com

Appendix II: The Terms of Reference – IADB

IDBDocs#39825863

ANNEX A

Country Office Belize
WSA/(INE)

Environmental Assessment (EA) and Environmental Management Plan (ESMP) for the CLOSING OF THE BELMOPAN DUMPSITE & CONSTRUCTION OF A TRANSFER STATION TERMS OF REFERENCE

Background

At the request of the Government of Belize, the Inter-American Development Bank (IADB) is currently preparing a loan proposal for the "Solid Waste Management Project II" (BL-L1021), to continue the implementation of improvements associated to solid waste management in Belize, improvements that were initiated as part of the Solid Waste Management Project (BL-L1006). The proposed project would be for an amount of USD 10 to 15 million.

It is currently discussed that the program BL-L1021 will be comprised of four components as outlined below.

- Component 1: Investments related to construction of transfer stations, recycling and composting and closure of open dumpsites. This component may include equipment for managing medical waste, and other waste specific streams.
- Component 2: Institutional strengthening support to ensure cost recovery mechanisms, medical waste and other specific streams characterization study, social communication strategy, and training and capacity building for recyclers
- Component 3: Project Execution Unit: office and administration expenses.
- Component 4: Monitoring and Evaluation, including financial audit and midterm and final evaluation

The Project Executing Agency (PEA) for the program will be the Solid Waste Management Authority (SWaMA), which will be responsible for overall project execution. The Solid Waste Management Authority Act of 2000, the most important legal instrument governing the solid waste sector, establishes the structure and functions of the SWaMA, a corporate body with independent legal personality within the Ministry of Natural Resources and Agriculture (MNRA). SWaMA is currently executing the BL-L1006 Project.

Consultancy objective(s)

The IDB is looking for an Environmental Contractual to prepare an Environmental Assessment (EA) / Environmental Management Plan (EMP for the closing of Belmopan Dumpsite and the Construction of a Transfer Station.

TMR

Main activities

The contractual will prepare the EA / ENSMP as outlined below. The consultancy will involve field visits and the consultation process.

The Environmental Assessment (EA) / Environmental and Social Management Plan (ESMP) will include: (i) an analysis of the potential environmental and social risks and impacts of the Closing of the Belmopan Dumpsite and the Construction of a Transfer Station; (ii) the development of the required environmental mitigation plan; and (iii) the development of an environment monitoring plan.

The EA / EMP will address all phases of the project (construction, operation, closure) and must include, as a minimum, the following:

- A short executive summary highlighting the main recommendations in support of the operations feasibility from the standpoint of environmental and social risks, impacts and mitigation.
- A description of the proposed operation, its objectives, and evaluation of the considered alternative.
- A description of the environmental and social conditions in the area of influence.
- A description of the institutional and legal environmental framework associated with the project, including any project specific legal or other requirements including of the Government of Belize and IDB.
- An analysis of the direct and indirect, environmental and cumulative impacts and risks.
- Options and recommendations for preventing, avoiding, reducing, eliminating or compensating the impacts of the activity.
- The schedule, assignment of responsibility and budget for the environmental quality and impact management measures.
- The monitoring, reporting and evaluation requirements during the execution of the project, including schedule, assignment of responsibility and budge for all phases of the project (construction, operation, closure, post closure).

A proposed outline is attached in the ANNEX to these TORs.

Reports / Deliverables

The contractual will submit two documents as part of this consultancy. A draft EA report to be submitted two weeks after signing of the contract and a final report to include comments received from the IDB and SWaMA. This final report is to be submitted no later than a month after the start of the contract.

Payment Schedule

- 20 % upon signature of contract
- 40 % after submission of draft report and approval by IDB and SWaMA.
- 40 % after submission of final report and approval by IDB and SWaMA

JMR

Qualifications

Professional Qualifications and Experience: Demonstrated professional qualifications of the contractual, including the following:

- A Master's Degree in Ecology, Biology or related field;
- At least 10 years extensive experience in preparing EAs and ESMPs in relevant sectors (solid waste management, infrastructure, water and sanitation);
- At least 10 years in-depth knowledge of solid waste management is a plus;
- 10 years experience in knowledge of the Belize's national legislation and environmental policies and regulations and IDBs environmental and social safeguard policies and or other MDBs (e.g. IFC);
- At least 10 years experience in conducting consulations; and
- Excellent writing and communications skills.

Characteristics of the Consultancy

- Consultancy category and modality: Products and External Services Contractual, Lump Sum
- Contract duration: *20 days*
- Place(s) of work: Country Office Belize
- Division Leader or Coordinator: *Javier Grau-Benaiges, Water and Sanitation Specialist/CPN*

Payment and Conditions: Compensation will be determined in accordance with Bank's policies and procedures. In addition, candidates must be citizens of an IDB member country.

Consanguinity: Pursuant to applicable Bank policy, candidates with relatives (including the fourth degree of consanguinity and the second degree of affinity, including spouse) working for the Bank as staff members or Complementary Workforce contractuals, will not be eligible to provide services for the Bank.

Diversity: The Bank is committed to diversity and inclusion and to providing equal opportunities to all candidates. We embrace diversity on the basis of gender, age, education, national origin, ethnic origin, race, disability, sexual orientation, religion, and HIV/AIDs status. We encourage women, Afro-descendants and persons of indigenous origins to apply.

JMR

Appendix II: Transfer Certificate of Title

FORM 20

(RULE 24)

INSTRUMENT No. TCT-201500085
DATED: 24th May,2015

BELIZE

GENERAL REGISTRY ACT, Chapter 327 of the Substantive Laws of Belize R.E 2000-2003, GENERAL REGISTRY RULES

TRANSFER CERTIFICATE OF TITLE

Know all men to whom these present shall come that by transfer effected by

BELMOPAN CITY COUNCIL	of	Established under the provision of Belmopan City Council Act, Chapter 86 of Law of Belize with office situate at 36/38 Trinity Boulevard,, City of Belmopan, Cayo District, Belize
SOLID WASTE MANAGEMENT AUTHORITY	of	A statutory body established under the provisions of the Solid Mangement Authority Act, Chapter 224 of the Laws of Belize with office at the Ministry of Natural Resources and Agriculture, HM Queen Elizabeth II Boulevard, City of Belmopan, Cayo District

has (or have) become and is (or are) the registered proprietor (or proprietors) of

ALL THAT piece or parcel of land **containing 10.261 acres** situated on the Eastside of the Hummingbird Highway, 3.5 miles South of the City of Belmopan, Cayo District and is more particularly described as follows: On the North for a distance of 313.084 meters by a 39.673 acres of land now or formerly owned by Belmopan City Council: On the East for a distance of 132.664 meters by a 39.673 acres of land now and formerly owned by Belmopan City Council; On the South for a distance of 226.927 meters by Private Land now or formerly owned by Caribbean Investment Limited; and On the West for a distance of 132.674 meters by the buffer area and the Hummingbird Highway as shown on Entry No. 15442 Reg No. 16 **(SEE OVERLEAF)**

subject, nevertheless, to the legal charges and incumbrances which are noted herein, or endorsed hereon.

In faith, and testimony whereof I have hereunto subscribed my signature and affixed the seal of the Registrar of Lands Office, this 29th **day of** July **,** 2015 **at the Office of the Land Titles Unit.**

Registrar of Lands

NOTINGS

A Memorandum of Transfer was presented at on the Land Titles Unit on the 24th day of May,2015 At 9:31 a.m also a Transfer/First Certificate of Title dated the 19th day of March,2015 in respect of the Land described herein in registered in the Land Titles Register NO. TCT-201500013

Registrar of Lands

Appendix III: Sample Testing Instruments

Information on Instruments used during the ESIA

Instrument	Measurement Range/Acurracy	Ambient Standards
YSI Professional Plus	**Various Sensors**	**Depending on Sensor used**
Casella MicroDust Pro-Particulate Monitor	**1µgm-3 to 2500 mgm-3 in single meter**	**EPA – 50 ug/m3 (annual mean) 150 ug/m3 (daily concentration)**
JDC -Flowatch Flow Meter	**+/- 5 % from - 10° to + 50°C.**	**Air and Water Current Meter [kph, m/s, ft/s, Temp (F),]**
Sper Scientific Sound Level Pen 840018	**Range: 32 ~ 130dB Accuracy ±1.5dB (under reference conditions, 94dB @ 1kHZ)**	**PEL for Noise - <80dB / 8hrs >80dB-85dB (require noise reduction equipment, e.g. PPE)**
BW Technologies by Honeywell Gas Alert Multi-Gas (4) Meter	**Hydrogen Sulfide (H_2S) 0-200 ppm Carbon monoxide (CO) 0-1000 ppm Oxygen (O_2) 0-30.0% Combustible Gases (%LEL) 0-100% v/v**	**Personal Exposure Limits (PEL) H2S – 10ppm/8hrs CO – 0-9 ppm (TWA) (WHO) O2 – 19.5% -23.5% (20.9% Average O2 in Ambient Air) LEL - <10% (safe level)**

More Versatile

1 Pro Plus Instrument
2 Single Port Conductivity Only
3 Single Port Cable
4 Single Port Cable with Conductivity
5 Dual Port Cable
6 Quatro Multiparameter Cable

Professional Plus Instrument General Specifications	
Auto Stable	User-defined auto-stable function holds stable readings on display when criteria is met
Barometer	Built-in barometer
Buffer Recognition	Auto buffer recognition for US and NIST buffers
Certifications	RoHS, CE, WEEE, C-Tick, VCCI, FCC, IP-67, 1-meter drop test, Assembled in USA
Connectivity	USB 2.0; ProComm II communications saddle and USB cable included; user-upgradeable software via USB and website
Connector	MS (military spec) waterproof with bayonet lock
Data Management	Data Manager desktop software included; 100 user-defined folders and site names
Data Memory	5,000 data sets (data, date, time, user-defined info); 100 GLP files
Dimensions	8.3 cm width x 21.6 cm length x 5.6 cm depth (3.25 in x 8.5 in x 2.21 in)
Display	Graphic display with detailed Help; backlit display AND keypad
DO Membrane Response Times (T95; 100%-0) and Flow Dependence	1.25 mil PE = 8 seconds and 6 in/sec flow 2.0 mil PE = 17 seconds and 3 in/sec flow 1 mil Teflon® = 18 seconds and 12 in/sec flow
DO Sensors	Polarographic or galvanic field sensors; self-stirring polarographic BOD sensor for the lab
Field Cables	Standard lengths of 1, 4, 10, 20, or 30 meters - up to 100 meters on DO only cables; all 4-meter and longer cables include a cable management kit
Flow Cell	Single, dual and multiparameter Quatro cable all flow cell compatible
GLP Compliance	Yes; detailed GLP information is stored and is available to view, download or print
Lab Cables	BOD sensor includes 2-meter cable; 1 or 4 meters on lab pH, ORP and pH/ORP cables
Languages	English, Spanish, German, French, Italian, Norwegian, Portuguese, Japanese, Chinese (Simplified & Traditional)
Logging Modes	Single or Continuous
Operating Temperature	-10 to 60°C
Power	2 alkaline C-cells provide 80 continuous hours at ambient temperature without backlight; ProComm II saddle provides USB power or optional wall power, cigarette lighter, and universal cell phone charger options
Storage Temperature	-20 to 70°C
User ID	Optional user ID for data security
Warranty	3-year instrument; 2-year field cables
Waterproof	IP-67 (even with the battery cover off); floats
Weight with Batteries	475 grams (1.05 lbs)

System Specifications (Cable and Sensors)

	Sensor Type	Range	Accuracy	Resolution	Units	Calibration
Dissolved Oxygen (%) (temp comp range -5 to 45°C)	Polarographic or Galvanic	0 to 500%	0 to 200% (± 2% of reading or 2% air saturation, whichever is greater) 200% – 500% (± 6% of reading)	1% or 0.1% air saturation (user selectable)	%	1 or 2-points with zero
Dissolved Oxygen (mg/L) (temp comp range -5 to 45°C)	Polarographic or Galvanic	0 to 50 mg/L	0 to 20 mg/L (±2% of the reading or 0.2 mg/L, whichever is greater) 20 to 50 mg/L (±6% of the reading)	0.1 or 0.01 mg/L (user selectable); 0.1% air saturation	mg/L, ppm	1 or 2-points with zero
Temperature (Field rugged cables)		-5 to 70°C	±0.2°C (±0.3°C cables over 45-meters)		0.1°C	°C, °F, K
Temperature (Lab-grade)*		0 to 40°C	±0.35°C	0.1°C	°C, °F, K	
Conductivity**	Four electrode cell	0 to 200 mS/cm (auto range)	±0.5% of reading or 0.001 mS/cm, whichever is greater (1-, 4-m cable) ±1% of reading or 0.001 mS/cm, whichever is greater (20-m cable)	0.001 mS (0 to 500 mS); 0.01 mS (0.501 to 50.00 mS); 0.1 mS (50.01 to 200 mS)	µS, mS	1 point
Salinity	Calculated from conductivity and temperature	0 to 70 ppt	±1.0% of reading or 0.1 ppt, whichever is greater	0.01 ppt	ppt, PSU	1 point
pH	Glass Combination Electrode	0 to 14 units	±0.2 units	0.01 units	mV, pH units	1, 2, 3, 4, 5, or 6 point (user selectable); US, NIST or Custom Buffers
ORP	Platinum button	–1999 to +1999 mV	±20 mV in redox standards	0.1 mV	mV	1 point
Ammonium*** (ammonia with pH sensor)	Ion Selective Electrode	0 to 200 mg/L-N, 0 to 30°C	±10% of reading or 2 mg/L-N, whichever is greater	0.01 mg/L	mg/L-N, mV	1, 2, or 3 point (user selectable)
Nitrate***	Ion Selective Electrode	0 to 200 mg/L-N, 0 to 30°C	±10% of reading or 2 mg/L-N, whichever is greater	0.01 mg/L	mg/L-N, mV	1, 2, or 3 point (user selectable)
Chloride***	Ion Selective Electrode	0 to 1000 mg/L, 0 to 40°C	±15% of reading or 5 mg/L, whichever is greater	0.01 mg/L	mg/L-Cl-, mV	1, 2, or 3 point (user selectable)
Total Dissolved Solids (TDS)	Calculated from conductivity and temperature	0 to 100 g/L TDS constant range 0.30 to 1.00 (0.64 default)		0.001, 0.01, 0.1g/L	kg/L, g/L	
Barometer	Piezoresistive	375 to 825 mmHg	±1.5 mmHg from 0 to 50°C	0.1 mmHg	mmHg, inHg, mbar, psi, kPa, ATM	1 point

Instrument Only Specifications (at Ambient Temperature)

pH		-2.60 to 16.60	±0.1 mV (0.01 pH units)	0.1 mV (0.01 pH units)		
ORP		-1999 to +1999 mV	±0.5 mV	0.1 mV		
Conductivity		0.0 to 200 mS/cm each range	±0.1% FS ±1 digit for uS/cm to 0.1 mS/cm (range dependent)	0.0001 mS/cm or 0.1		
Dissolved Oxygen		0.00 to 90 mg/L; 0 to 550%	±0.2% FS (550% air saturation) ±1 digit (with 1.25 PE membrane at 10°C)	0.01 mg/L; 0.1% air saturation		
Temperature		-10 to 100.00°C	±0.2% FS ±1 digit	0.1°C	°C, °F, K	

*Lab-grade cables include 605107, -108, -109, 605177, -178, -179 ** Derived parameters can include resistivity, salinity, specific conductance, and total dissolved solids

***ISE sensors for freshwater only; 17-meter maximum depth

Casella Microdust pro Particulate Monitor

Introduction

The Microdust Pro from Casella USA is a portable, real time monitor for assessing the concentration of suspended particulate matter, and is probably the most versatile instrument available with the ability to measure from 1µgm^{-3} to 2500 mgm^{-3}. It is the only hand-held real-time dust monitor on the market capable of graphically presenting variations in dust concentration on a real time scrolling graph – no longer is it necessary to wait to analyze results on a PC.

Key benefits

- Wide range from 1µgm^{-3} to 2500 mgm^{-3} in single meter
- Data-logger with >15,700 readings
- Detachable probe
- TSP, PM_{10}, $PM_{2.5}$ or respirable measurements
- Firmware calibration and zero in the field
- 4 user defined calibration routines available for differing dust types
- Alkaline or rechargeable batteries or mains power
- 32bit *WinDustPro* PC software as standard

Applications

- Occupational health & safety monitoring
- Walk through surveys
- Site boundary monitoring & environmental measurement
- Industrial process monitoring
- Testing respiratory equipment or air filtration efficiency
- Research activities

Each Microdust Pro is individually **factory calibrated**, using a gravimetric technique. The instrument can be returned to this "factory" calibration setting at any time during its life by the use of a non-degradable **calibration insert** (supplied with every unit). An individual **gravimetric calibration** is also possible. This involves the simultaneous collection of a gravimetric (filtered) sample of the dust. In this way, two averages are collected over the exposure period. One is from the filter, whilst the other is provided by the averaging function within the instrument. It is then possible to derive the difference in these two figures and correct accordingly.

Operation and use

The Microdust Pro measures particulate concentrations using a near forward angle light scattering technique. Infrared light of 880nm wavelength is projected through the sampling volume where contact with particles causes the light to scatter. The amount of scatter is proportional to the mass concentration and is measured by the photo detector. By using a narrow angle of scatter (12-20°) the majority of light scattered is in the diffracted and refracted components, which minimizes the uncertainty associated with particle color, shape and refractive index.

real time scrolling display of concentration levels with user selectable time bases and auto ranging y-axis scale

The Microdust Pro features an internal logger that can store up to 15,700 data points over 32 separate runs. The logging interval can be set from 2 seconds to 10 minutes. At 2 seconds, it is possible to record 8.75 hours of data; at 5 minutes, this equates to a total logging time of 50 days. Recorded values include:

- Average concentration over the logging period (mgm^{-3})
- Maximum concentration over the logging period (mgm^{-3})
- Date and time stamp

Logged results are downloaded to the included MS Windows software package.

Casella USA
(800) 366-2966
info@CasellaUSA.com

Technical Information	
Sensing Technique:	Near forward light scattering - 880nm infra red
Ranges:	All instruments provide 0 to 2500 mgm^{-3} over four ranges as standard:
Resolution:	0.001 mgm^{-3} (1μgm^{-3})
Operating Temp Range:	32 to 122 °F (0 to 50°C) non condensing
Storage Temp Range:	-4 to 131 °F (-20°C to +55°C)
Calibration:	Gravimetric method using 'Arizona Fine' calibration dust (ISO12103-1, A2)
Zero Stability:	±0.002 mgm^{-3}/ °C
Span Stability:	<0.7% FSD / °C
POWER	
Battery:	4 x AA / MN1500 cells - Alkaline or rechargeable NiCad
Operating Duration:	Alkaline (2700mAh) typically >20 hours NiCad cells (950mAh) typically >10 hours
Battery Charging:	Internal NiCad fast charger circuitry (with time-out protection)
Charge Rate:	Fast charge rate 450mA, Standby charge rate 55mA
Power Adapter:	Universal input voltage range 100-240VAC, 47-63Hz
Output:	12VDC @ 800 mA
GENERAL	
Analogue Output:	0 to 2.5 V_{DC} FSD, 500Ω output impedance (3ms update rate)
Keypad:	7 key tactile membrane
Weight:	Instrument only = 34.6 oz (0.97 Kg) (complete kit plus case = 10lb - 4.5Kg)
Dimensions:	Probe = 1.4 Ø x 11.6 in (35mm Ø x 290mm) total length Instrument H x W x D = 9.8 x 3.8 x 2.0 in (245 x 95 x 50mm)
Maintenance:	Factory cleaning required annually depending on measurement conditions
DISPLAY	
Display:	128 x 64 pixel LCD graphics panel with backlight
Displayed Values:	
Instantaneous reading:	Rolling average concentration over a user selectable period (1 to 60 sec)
Other readings:	AVE & MAX concentration since power on or reset
Scrolling Graphs:	100 / 200 seconds, 15 minutes or 60 minutes (Y Axis auto-ranging or fixed)
Battery voltage:	Battery Voltage with 'OK' / 'Low' status message.
CALIBRATION	
Factory Calibration:	Traceable isokinetic technique (wind tunnel) and ISO 12103-1
User Calibration:	Four user defined calibration settings available stored for later use.
Routine Calibration:	Firmware calibration for zero & span setting in the field by user. Optical calibration filter supplied (restores factory calibration)
DATA LOGGING	
Internal Memory:	64K EEPROM providing 15,700 data points
Logging Interval:	Adjustable from 2 to 600 seconds.
Recorded Values:	Average, spot, max & min concentration over logging period
Serial Interface:	RS232 up to 38.4K baud
Ordering Information	
176000A	Microdust pro kit in carrying case with standard accessories
176093A	Environmental enclosure with pump, adaptor and rechargeable battery pack
103214B	Gravimetric dust adaptor
103187B	Aspirated adaptor
103182B	Respirable dust adaptor
151280B	Size selective adaptor
103396B	Iso-kinetic adaptor (for use with stack sampler)

JDC -Flowatch Flow Meter

Th ment designed for simple and accurate measurement of air and water flow. This instrument (flowmeter - thermometer) has been developed for use under challenging circumstances. Because of its different impellers, you can use it to measure almost any liquid or gaseous medium. The standard FLOWATCH kit comes complete with a display, 1.2 meter telescoping rod, carrying case and two flow sensors; one for water and one for air. Additional sensors are available, including a hanging water sensor with 15 meter cable.

Features:	Specifications:
- Instant speed, air or water. - Maximum and average speed. - Temperature - Minimum and maximum temperatures. - Windchill (when used as windmeter). - Replaceable sensors. - User selectable averaging period from 3 seconds to 24 hours. - EL Backlight. - Waterproof. - Floats. - 2 AA Batteries. - Aluminum base for tripod attachment. - Aluminum carrying case for all parts.	- Weight (Display Unit) - 8.3 oz (230 g),br> - Dimensions (Display Unit) - 2.5" × 2.5" × 5.1" (6.4 × 6.4 × 13 cm), - Dimensions (Included Case) - 25" × 13.5" × 3.5" (63.5 × 34 × 9 cm). - Flow Speed Units - km/h, mph, knots, m/s and cm/s. - Flow Speed Accuracy - +/- 5 % from - 10° to + 50°C. - Flow Speed Range - 2 to 150km/h. - Temp Units - °C, °F and windchill. - Temp Accuracy - +/- 1°. - Temp Functions - Current, minimum, average, maximum temperature and windchill factor.

B. The Sper Scientific Sound Level Pen

Type 2 sound meter with one-button operation

The Sper Scientific Sound Level Pen features a type 2 internal calibrator, one-button operation, low cost, auto-ranging and max hold in a mini size.

The Sper Scientific Sound Level Pen is the smallest, lightest, easiest to carry sound meter in the world. Despite its small size, the Sound Level Pen is a full function type 2[1] sound meter perfect for testing OSHA requirements and most other sound meter applications. Auto-ranging with simple one-button operation. Press once to begin reading sound levels. Press the button a second time and the display holds the maximum reading, updating as new maximums are reached. Hold the button for 2 seconds to turn the unit off. Measures the 32 ~ 130 dB range in the "A" scale, with an accuracy of ±1.5 dB. The display provides 0.1 dB resolution, under range, over range and low battery indicators. The Sound Level Pen calibrates electronically to its own internal oscillator[2] or external 2 Pt. Acoustical Calibrator 850016. Comes ready to use with two AAA batteries, instructions, calibration tool, and a wind screen. N.I.S.T. traceable certificate of calibration available.

Dimensions: 8" × 1½" × 1" (203 × 38 × 25 mm)
Weight: 4.3 oz (122 g)

[1] Meets ANSI S1.4 Type 2 and IEC61672-1 Class 2
[2] 94dB at 1kHz

C. Gas Alert Quattro – multi-gas detector

Standard features of BW products:

- Continuous LCD shows real-time gas concentrations
- Compact and lightweight design makes it comfortable to wear
- Simple automatic calibration procedure; compatible with BW MicroDock II automatic test and calibration station
- Full function self-test of sensor(s), battery status, circuit integrity and audible/visual alarms on start up and continuous testing on sensor(s)
- Bright wide-angled visual alarm bars
- Built-in concussion-proof boot

GasAlertQuattro Specifications

Size	5.1 x 3.2 x 1.9 in. / 13.0 x 8.1 x 4.7 cm
Weight	- 11.15 oz. / 316 g (with rechargeable battery pack) - 11.92 oz. / 338 g (with alkaline battery pack)
Temperature	-4 to +122°F / -20 to +50°C
Humidity	10% - 100% RH (non-condensing)
Alarms	- Visual (six, red LEDs), vibrating, audible (95dB) - Low, High, STEL, TWA, OL (over limit)
Tests	Sensor integrity, circuitry, battery and audible/visual alarms on activation, battery (continuous), sensor (continuous)
Pump	Compatible with the Sampler motorized sampling pump
Battery life	AA alkaline: 14 hrs (+68 to 122°F / +20 to 50°C) Rechargeable: 20 hrs (+68 to 122°F / +20 to 50°C) 18 hrs (-4 to +32°F / -20 to 0°C)
User options	Confidence / compliance beep Confidence flash Set STEL interval Sensor on/off Latching alarms Safe display mode Force calibration Auto-zero on start up Flip display Combustible gas measurement (% LEL or % by volume methane) User-definable calibration gas concentration Force bump Language choices (five) Custom start up message Datalog interval
Ratings	EMI/RFI: Complies with EMC Directive 2004/108/EC IP66/IP67
Certifications and approvals	Class I, Div. 1, Gr. A, B, C, D **ATEX:** II 1 G Ga Ex ia IIC T4 **IECEx:** Ga Ex ia IIC T4 BR-Exia IIC T4
Warranty	Full two year warranty including all sensors

Additional GasAlertQuattro features:

- Powered by an interchangeable rechargeable battery pack or alkaline pack with 3 AA batteries
- One-button operation and straightforward user interface minimizes training
- Comprehensive datalogging and event logging capacity
- IntelliFlash verifies operation and compliance to both the user and supervisors from up to 20 ft. / 6.1 m
- Enhanced resistance to common industrial cross sensitive gases such as methanol and ethanol (CO and H_2S sensors)
- Multi-language support in English, French, German, Spanish and Portuguese
- Field-proven Surecell sensors offer an unprecedented performance in even the harshest environments.

Options and Accessories


MicroDock II compatible


Carrying holster


Auxiliary filter


Vehicle attachment

For a complete list of accessories, please contact BW Technologies by Honeywell.

Sensor Specifications

Gas	Measuring Range	Resolution
Hydrogen sulfide (H_2S)	0-200 ppm	0.1 ppm
Carbon monoxide (CO)	0-1000 ppm	1 ppm
Oxygen (O_2)	0-30.0%	0.1%
Combustible gases (%LEL)	0-100% LEL 0-5.0% v/v	1% 0.1%

Alarm setpoints for all sensors are user adjustable. Setpoint(s) are automatically displayed during instrument start up.

Locally available from

Brandt Instruments, Inc.
18568 Oak Grove Pkwy
Prairieville, LA 70769
1-800-337-6291 / 225-673-6776
http://www.brandtinst.com
E-Mail: dbrandt@brandtinst.com

BW Technologies by Honeywell

Appendix V: Persons Consulted

List of Persons Consulted

	Name	Post	Issue
1	Golroy Lewis	Chief Executive Officer-SWAMA	Project Information/baseline information
2	Emmerson Garcia	Solid Waste Officer-SWAMA	Project Information/baseline information
3	Tyron Chimilio	Social Coomunications Officer	Baseline Information
4	Mr. Timmons	Belmopan City Council	Background Information on site management
5	Craig Moore	Deputy Director of Petroleum Department	Background Information on Geology
6	Marcelo Windsor	Deputy Chief Forest Officer, Forest Department	Background Information on Flora and Fauna of Area
7	Jorge Franco	Head of EIA UNIT, Department of Environment	Information of Past EIA and Environmental Clearance Process
8	Francis Martinez	Environmental Technician, Department of Environment	Background Documents and Information
9	Albert Roches	Environmental Officer BNE	Monitoring Equipment
10	Ramon Frutos	Private Consultant	Hydrology of the Area
11	Gonzalo Cartajena	Armenia Farmer	Information on Land Use adjacent to Site
12	Miguel Pop-Efrain Garcia	Dump Site Managers, Belmopan City Council	Dump Site Management Issues
13	Two Family Leaders	Waste Pickers	Dump Site Economic and Social Issues