

DIVERSIFICATION OF THE ENERGY MATRIX AND ENERGY SECURITY (GY-L1066)

Environmental and Social Analysis Report

Solar Photovoltaic (PV) Farms in Mahdia, Lethem and Bartica



Environmental Engineering Solutions

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1 INTRODUCTION

1.1 Overview

In Guyana, a country that is blessed with an abundance of natural resources, the current projected availability of indigenous renewable energy creates a number of challenges and opportunities for its use in power generation. Currently, the country is highly dependent on imported fossil fuels; Guyana imports around 4.7 million barrels of fuel and the Guyana Power and Light (GPL), a state-owned electric utility company, spent an estimated US\$ 80 million per annum on imported fuel (Sologuren 2017). The high reliance on imported fossil fuels has contributed to the volatility of the Company, dampened private sector growth and competitiveness, and has constrained the development of high value-added sectors such as tourism and manufacturing due to the high cost of electricity (Caricom 2013). Guyana has one of the lowest electrification rates in Latin America, and in rural areas electricity is only available to twenty six percent (26%) of the population. Electricity supply in these areas is therefore unreliable, expensive, and uses mostly fossil fuels such as gasoline and diesel. Moreover, It is known that electricity power systems must have sufficient amounts of generating units available to meet the demand and the changes, from base peak to load. However, the challenge in every country is to define the ideal combination of energy sources to satisfy those needs in an efficient and economic manner.

The Inter-American Development Bank (IDB) has over the years approved over US\$37.6 million in loans and has also secured approximately US\$26.9 million in non reimbursable investment financing from the European Union (EU) in an effort to boost the reliability and efficiency of Guyana's electricity sector through improvements in operational capabilities, electricity loss reduction measures, as well as strengthening corporate performance and management of the country's utility i.e. GPL Inc (IDB 2014). Reducing electricity losses can improve GPL's financial performance, while at the same time alleviating fiscal commitments of the Government of Guyana in relation to the electricity sector (IDB 2014). During the next decade a significant increase in electricity consumption is expected in Guyana as a result of growth of the residential and commercial sectors as well as the expected return of large customers to the national power grid (IDB 2014).

Commonly, there is a false dichotomy when referring to renewable energy, presenting them as opposites, when in reality they perfectly complement each other and represent a realistic option for countries aiming to move from fossil fuels towards a more renewable power generation in the long term. On October 11, 2017, the Private Sector Commission hosted a two (2) day Business Summit at the Marriott Hotel, Georgetown. At the Summit the Director of the Guyana Energy Agency, Mr. Mahender Sharma, indicated that, "With projected energy demand expected to double in ten (10) years' time, diversifying Guyana's energy matrix is important for supply to meet demand." (DPI 2017). Sharma further stated that, "an 'optimal mix' of energy sources comprised of hydro, wind, solar, bio and thermal energy is needed if Guyana is to provide sufficient redundancy and support." (DPI 2017). It is against this background that the Government of Guyana (GoG) through support from the Inter-American Development Bank is investing in solutions along the path to a cleaner and

diversified energy matrix, beginning with innovative solutions for energy security and reliability for hinterland townships.

In the current policy, the Government describes its goal to improve power supply reliability, reduce electricity costs, increase energy security, and utilize local renewable resources for the generation of electricity. This component will address the policy goals by investing in solar technology in the townships of Bartica, Mahdia and Lethem. While the characteristics and needs of each community is different, and the new generation systems will have tailored generation systems to meet the current and future demand, the effect will not only partially displace the utilization of costly fossil fuel generation, but also will extend the availability of power supply for longer periods of the day.

1.2 Background for the Project

Guyana's natural environmental heritage evidenced through its forestry and agricultural resources supports the vast potential for the exploitation of renewable energy, much of which remains untapped but is in the process of realization. Notwithstanding the abundance of such natural resources, Guyana has remained 99% dependent on imports of fossil fuel for its energy needs. High fuel costs have historically constrained the pace of the country's development while creating balance of payments challenges. It has also affected the country's competitiveness on the local and international markets, limiting the opportunities for expansion of the productive sectors. Particularly in the hinterland regions, though there exists an abundance of fertile land, minerals, water and sunlight, many opportunities for large-scale agricultural and industrial development have been lost due to the extremely high cost of electricity supply. While this factor may be underscored by the geographical location of such communities impacting on access to reliable supply and sustainability of energy sources, Guyana's approximate GDP of US\$3.05 billion and a per capita income of US\$4,097 (2016) translates to its inability to macro-economically sustain high electricity costs. In this regard, Guyana can ill afford such high costs of supply which have hamstrung the social and economic development of all Guyanese, specifically the hinterland communities.

Guyana's hinterland located in Regions one, seven, eight and nine holds a myriad of mineral wealth to be exploited, a young trainable population as well as vast expanses of savannah lands, and since assumption to office in 2015, the Government of Guyana has focused on the development of these regions (DPI 2018). Furthermore, efforts are continually being made to provide basic amenities, such as safe water and reliable electricity. The Government of Guyana is also focused on establishing a "Green Economy" as such; the road to a 'Green' Guyana would entail a model that allows the sustainable use of its resources (DPI 2018). Work has already commenced in this regard under the Hinterland Electrification Programme, where numerous indigenous communities have benefitted from solar powered energy to their homes, schools and healthcare centres (DPI 2018). Since the introduction of the programme, the beneficiaries have been receiving at least nine (9) hours of reliable energy supply (DPI 2018).

The need for an adequate supply of electricity is paramount as the hinterland communities continue to economically expand. As such, the government plans to provide hinterland communities with longer

energy supply and has begun pursuing the construction of solar farms. Work of the first solar farm has already commenced in Mabaruma, this GY\$264 million intervention is expected to result in over 700 residents and commercial consumers across the sub-district benefitting from increased hours of electricity service. Residents are expected to receive approximately 16 hours and eventually a full 24 hours. The 400 kilowatt mega solar farm will reduce the dependency of fossil fuels for the generation of electricity as it powers three-quarters of the community while the remaining portion is being powered by fossil fuel or diesel (DPI 2018). Diesel based electricity supply is provided by the Government owned utilities at costs significantly higher compared to the provision of supply on the coastal areas. Additionally, fuel use accounts for between 60 – 80% of the total operational cost of the power utilities.

The other solar farms are slated for Lethem in Region 9 (Upper Takutu – Upper Essequibo); Mahdia in Region 8 (Potaro – Siparuni) and Bartica in Region 7 (Cuyuni – Mazaruni). These solar farms are anticipated to generate 800 kilowatts, 400 kilowatts and 1.5 kilowatts of electricity respectively (DPI 2018). The diversification of the Energy Matrix and Energy Security in these three (3) communities aims to promote socioeconomic development through the supply of reliable and affordable electricity to the three (3) communities as well as reduce carbon dioxide (CO₂) emissions from the power sector by utilizing a renewable energy source.

1.2.1 Locations of Load Centres

The Government of Guyana has technical studies of the sites, as well as social, economic and environmental information indicating that more than 24,000 residents, largely comprised of indigenous Amerindians, will have increased access to reliable and affordable energy in the targeted communities.

- In Mahdia, the solar technology project will provide existing businesses with opportunities to expand and promote new productive activities.
- Smart off-grid solutions using solar technologies will contribute to the sustainable economic development of the townships as in Lethem, the component will provide a reliable electricity source to the expanding needs of power supply in the community, as well as to attend the large population of indigenous people.
- Finally, in Bartica, the new power supply will contribute to the “Green Bartica Plan” that involves a holistic approach to sustainable economic growth in the township, and climate resilience.

1) Mahdia

Mahdia is a community located in Region 8 (Potaro-Siparuni) and this hinterland community consists of a vast majority of the migrant residents from other regions of Guyana, ‘Coast Landers’ or international locations ‘Islanders’. The area is dominated by commercial activities in the areas of gold and diamond mining which contributed to a population boom in the community. Mahdia has a

population of 4,200 residents and is supplied with electricity by Mahdia Power and Light Inc. (MPL) for 18 hours on a daily basis. Fuel, which accounts for about 65 - 69% of the company's total operational costs, is also transported overland to Mahdia, some 200 km away from the capital, on unpaved roads which becomes very difficult during the rainy seasons, resulting in delays in deliveries, lack of continuous supply of fuel and interruption of electricity service to the overall community. MPL's installed capacity is 1.2 MW, with a peak demand of 0.25 MW. Electricity is generated at a cost of US\$0.55 per kWh but sold to residents at a subsidised price of US\$0.50 per kWh, requiring subventions from the Government of about US\$125,000 annually.

2) Lethem

Lethem, a small town on the Guyana-Brazil border and contiguous to Bom Fim, and its neighbouring villages of St. Ignatius, Culvert City, Tabatinga and Moco Moco (Lethem Area), have an estimated population of 5,000 residents, largely comprising the indigenous Amerindians. The community, which is located in administrative Region 9 (Upper Takutu-Upper Essequibo), is rapidly developing with its economic activity based largely on commerce between Brazil and Guyana. A large number of warehouses and retail businesses have recently been constructed and large areas for expansion are already earmarked which will buttress the income earning capacity of residents.

Electricity supply in the Lethem Area is provided by the Lethem Power Company Inc. (LMPC) on a 24-hour basis, generated from the company's six diesel units with a total installed capacity of 3.825 MVA. Fuel which accounts for 60 - 65% of operational costs, is transported by bulk transportation carriers from the 450 km distant capitol Georgetown to Lethem, on unpaved roads which becomes very challenging during the rainy seasons resulting in delays in delivery. Though generation cost is about US\$ 0.49 per kWh, consumers currently pay an average rate of US\$0.33 - 0.40 per kWh, thus requiring Government subsidies in the range of US\$500,000 per annum. With income at subsistence level, the high cost of electricity supply continues to remain a major burden on the households and businesses, which can only be expected to intensify considering the expansion of businesses and Government's housing programme in the area. Thus, while the area's peak demand is 800 kW, this is expected to increase in the short to medium term, particularly since Government of Guyana has recently completed infrastructure works for an industrial estate in the community which will add to the demand for more affordable electricity supply.

3) Bartica

Bartica, located in administrative Region 7 (Cuyuni-Mazaruni), is considered the gateway to the interior locations and has been designated to be Guyana's first Green Town. The 'Green Bartica Plan' is a Government of Guyana initiative that involves a holistic approach to sustainable economic growth in the township (Best 2017). The main objectives of the plan are to create a climate resilient economy and to establish a green pathway for the foundation of a new Guyana, which will result in reducing the overall carbon footprint in electricity, agriculture, fisheries, water, forestry, waste, manufacturing, transport, construction, tourism and other sectors. The town has a population of about 15,000 whose main economic activities stem from the extractive industries such as logging and mining as well as

commerce. The town has 4 nursery schools, 5 primary schools and 2 secondary schools. Several government entities including the Town Council and the Regional Democratic Council are located in Bartica. The town also has a regional hospital, a community centre, police and fire stations, and several commercial banks and hotels.

Electricity is provided on a 24-hour basis from an island grid with an installed capacity of 4.4 MW that is operated by the Guyana Power and Light Inc. (GPL). Consumers currently pay an average rate of US\$ 0.19 - 0.28 per kWh. Fuel accounts for about 70% of operational costs and the current peak load is 2 MW. However, the peak demand grew up to over 3 MW during the period of high gold price in 2009-2010. The population in Bartica is expected to grow in the future and the energy demand will therefore increase constantly. Bartica has been designated to be Guyana's first Green Town. The 'Green Bartica Plan' is a Government of Guyana initiative that involves a holistic approach to sustainable economic growth in the township. The main objectives of the plan are to create a climate resilient economy and to establish a green pathway for the foundation of a new Guyana, which will result in reducing the overall carbon footprint in electricity, agriculture, fisheries, water, forestry, waste, manufacturing, transport, construction, tourism and other sectors.

1.3 Objective of the Project

The Government of Guyana, Ministry of Public Infrastructure is facilitating the development of grid-connected Solar Photovoltaic (PV) Systems with a total installed capacity of 5.2 MW to supply the grids of the communities of Mahdia, Lethem and Bartica:

Table 1: Installed Capacity, Annual generation and Investment Cost

Site	Installed Capacity (MW)	Annual Generation (MWh)	Investment Cost (US\$)
Mahdia	0.65	1,000	1,767,299.80
Lethem	1.00	1,554	2,591,614.00
Bartica	1.50	2,331	3,876,047.20
Total	3.15	4,885	8,234,961.00

The main objectives of the project are to:

- Reduce fossil fuel consumption and CO2 emissions for electricity generation,
- Increase energy security and access for hinterland utilities, and
- Support of Government's renewable energy drive for a greener economy.

With a total investment cost of US\$8,234,961.00, the project is expected to generate approximately 4,885 MWh of electricity annually at an average cost (weighted average LCOE) of US\$0.14 per kWh. Though this intervention is not expected to entirely replace diesel generation, it will contribute to an

estimated 69% reduction in electricity generation cost and an estimated annual cost savings of US\$1,932,992 for the hinterland utilities. Further, this will remove the need for annual subventions of about US\$1 million from the Government, thereby allowing the allocation of these resources to other critical needs of the communities. Accordingly, the addition of renewables to the energy mix will reduce approximately 1,815,015 litres of diesel consumption and 4,759,536 kilogrammes of CO₂ emissions into the environment per year while concurrently improving energy security in the communities. It is further envisioned that consumers within the communities will also benefit from reliable, stable and longterm sustainability of supply.

1.4 Purpose and Scope of Work

In compliance with the National Environmental Legislation as well as the Environmental and Social Safeguards Policies of the Inter-American Development Bank (IDB), the Environmental Engineering Solutions (EES) is required to address the environmental and social issues related to the Project.

1.4.1 Purpose

A Terms of Reference (ToR) for conducting an Environmental and Social Analysis (ESA) was published by the IDB. An application was made by the Environmental Engineering Solutions to pursue the Consultancy. EES was then selected to undertake the ESA study for the proposed project i.e. three solar systems (solar plant, substation, control room, etc.) of Component 2 of the Operation “Diversification of the Energy Matrix and Energy Security (GY-L1066) and a management instrument called an Environmental and Social Management Plan (ESMP) for each of the Solar plants that ensures the environmental and social sustainability of the infrastructures to be financed and the activities to be financed by the Operation. Moreover, the document must comply with the requirements of the Inter-American Development Bank (IDB) Environmental and Social Safeguards Policies and the National Environmental Legislation of Guyana.

The Environmental and Social Analysis has been carried out against the following reference framework:

- Local, National and International regulatory requirements that are applicable to the Project;
- Applicable Inter-American Development Bank (IDB) Operational Policies
 - IDB’s policy on involuntary resettlement.

1.4.2 Scope of Work

The scope of the project comprises of:

- Field surveys to access the existing environmental and socio-economic conditions in the three project areas, including the identification of the environment and social receptors;
- Consultations with key stakeholders and members of the three (3) communities to discuss the project and to understand public perception and expectations from the project;

- Collection of additional secondary demographic, environmental and social information;
- Collection of Biological information on flora, fauna, natural habitats and species of special conservation or scientific interest through ecological survey of the three (3) study areas;
- Identification and review of the applicable standards and identification of key issues;
- Review of negotiated land acquisition, if any;
- Evaluation of potential social impacts of the Project and its components; and
- Preparation of Environmental and Social Management Plan (ESMP) based on the findings of the ESA and develop procedures for mitigation and monitoring of environment and social impacts on an on-going basis and to identify any impacts/mitigation requirements that may occur subsequent to the completion of the ESA.

1.5 Approach and Methodology

The Environmental and Social Analysis (ESA) for the project has been carried out as per the requirements of the Inter-American Development Bank Operational Policies related to Environmental and Social aspects. The Environmental Analysis of Mahdia, Lethem and Bartica consider an estimated combined project area of 6.37 hectares (15.75 acres). For assessment of the impacts of the project, the three (3) project locations and communities have been considered. Moreover, the ESA is based on scientific, engineering, environmental and economic parameters, professional judgement, and consultation with the public, applicable government agencies, communities, interest groups and other stakeholders directly affected by the Project. The approach includes the following steps:

- Developing the Project description, including construction, and operation activities;
- Preparing a description of existing environmental conditions to assess the potential effects of the various Project activities on the environment and the potential effects of the environment on the Project.
- Concerns of the regulatory agencies involved in the Project review are identified;
- Public concerns;
- Elements of the environment that could be affected by the Project and are protected by legislation or regulation;
- Details of environmental protection measures that would be applied to the project for construction and operations of the facilities.

1.5.1 Baseline Data Collection

To provide accurate and scientific analysis of the potential environmental effects of the proposed Project on the environment, it is critical to have data that represents the state of the environment prior

to developing the Project. This baseline data can be used, in conjunction with the predicted Project outputs, to complete the environmental analysis for the Project.

In order to achieve the objectives of the project and assess the impact of the project on the communities of Mahdia, Lethem and Bartica, the following data collection tasks were carried out:

a. Questionnaires

The questionnaire was one of the main methods used to obtain information from residents of Mahdia, Lethem and Bartica on the establishment of the Solar PV Farms. The aim of the questionnaire survey was to supplement the secondary data collected, with vital socio-economic information in order to provide a more comprehensive representation of the challenges posed by the Project. The questionnaires were all self-administered by the researcher, with the residents being the main target groups.

Self-administered questionnaires were chosen for four (4) basic reasons.

1. Questionnaires are used as an ideal way to obtain the opinions as well as views of a desired sample population and many persons are familiar with them.
2. Data obtained from questionnaires can be used in a format that is easy to analyze and graphically represent.
3. Self-administered questionnaires minimize the frequent issue of respondents not completing them.
4. Self-administered questionnaires ensured that if there were questions not easily understood by the respondent, they could be explained on the spot by the researcher.

b. Discussions with relevant personnel and agencies

Open-ended interviews were conducted with relevant personnel from various agencies. These discussions were undertaken because they enabled wider and more detailed responses and explanations. Additionally they allowed for clarification and flexibility, were more relaxed and conversation-like, and aided in gathering significant additional information.

The following sections outline the specific baseline programs that were conducted for this ESA:

1. Ambient Air Quality

Ambient air quality monitoring was completed in the immediate vicinity of the proposed site to confirm baseline conditions. This consisted of monitoring instruments for suspended particulate matter less than 10 microns (PM₁₀) and 2.5 microns (PM_{2.5}) in size over a one week period. Additional sampling of total suspended particulates matter (TSP) was also included to supplement the ambient air quality information.

2. Ambient Noise Levels

Baseline ambient noise levels were established by conducting attended daily measurements in the vicinity of the site. These locations were determined in the context of the nearest sensitive receptors such as a School, Residence, and Business etc.

3. Spatial and Temporal Boundaries

The effect of a specific project activity on an environment may differ in both space and time from the effect of any other activity. Certain project activities may have long-term consequences; others will be of short duration. Temporal and spatial study boundaries have been considered for the construction and operation phases of the Project.

1.5.2 Methodology to Predict Environmental Effects

Methodologies used in the identification and assessment of effects may be specific to each discipline. They can be grouped in the following categories:

- Review of public literature;
- Acquisition and review of unpublished reports and data from government agencies and departments, universities and research institutions, and other relevant projects;
- Interviews with resource persons and knowledgeable individuals; and
- Site visits and evaluations.

1.5.3 Cumulative Effects

The environmental effects of the Project in conjunction with other activities and other projects that have or will be carried out in the Project Area are examined. The temporal boundaries, however, are extended to include activities in the past, those that are under way in the area, and known projects planned outside of the time boundaries established for the Project. A review of other similar projects that have been operational for long durations also provides insight into the potential cumulative effect of this Project.

1.5.4 Consultation Process

As part of the ESA process and the social impact assessment, consultations are completed with the public and government agencies to ensure that all the relevant issues are addressed within the report.

1.6 Limitation and Technical Difficulties

Limitations and technical difficulties encountered while conducting the Environmental and Social Analysis are as follows:

Availability of Data

Secondary data that may be relevant to the project area is extremely limited due to the fact of very little research work has been done within this area. Therefore, the Environmental and Social Analysis Team relied on communication with relevant stakeholders and communities to gather data.

Lack of cooperation

Some of the residents of Georgetown were reluctant towards answering questionnaires and this had a spin-off effect on data collection.

Time

The time allotted to complete all forms of data collection; surveys and data analysis was limited.

2 PROJECT DESCRIPTION

2.1 Project Location and Existing land Use

This section of the report provides a description of the site settings and project components along with other associated facilities. Project activities and requirements for the construction and operation phase of the Solar Plant are discussed in this section.

2.2 Site Location

As the proposed project envisions supply to three (3) geographical areas within Guyana, issues of land allocation, access to grid connection and terrain of specific locations have been considered. Lethem Power Company Inc. (LMPC) already has allocated lands in Lethem for the purposes of the project and the Ministry of Public Infrastructure is in the process of finalising ownership of already identified land in Bartica. Subject to the finalization and formal procedural acquisition of respective land for the site identified in Mahdia, the Guyana Energy Agency (GEA) will further pursue and finalize site layout plans for the solar PV systems.

Solar PV systems with a total capacity of 3.15 MW will therefore be established to supply power to three (3) electricity utilities across Guyana. Additionally, the systems include backup storage of 30 minutes for Mahdia, Lethem and Bartica. Mahdia has a geographical makeup with slightly hilly and forested areas while, Lethem and Bartica generally consist of flat grasslands. The combined annual expected generation from the project is 4,885 MWh with an estimated 15.75 acres (6.37 hectares) of land required for construction. The breakdown is as follows:

Table 2: Installed Capacity, Battery Storage, Generation and Land Requirement

Site	Size of PV systems (MW)	Size of Battery (MWh)	Annual Expected Generation (MWh)	Estimated Land requirement (acres)
Mahdia	0.65	0.325	1,000	3.25
Lethem	1.00	0.50	1,554	5.00
Bartica	1.50	0.75	2,331	7.50
TOTAL	3.15	1.575	4,885	15.75

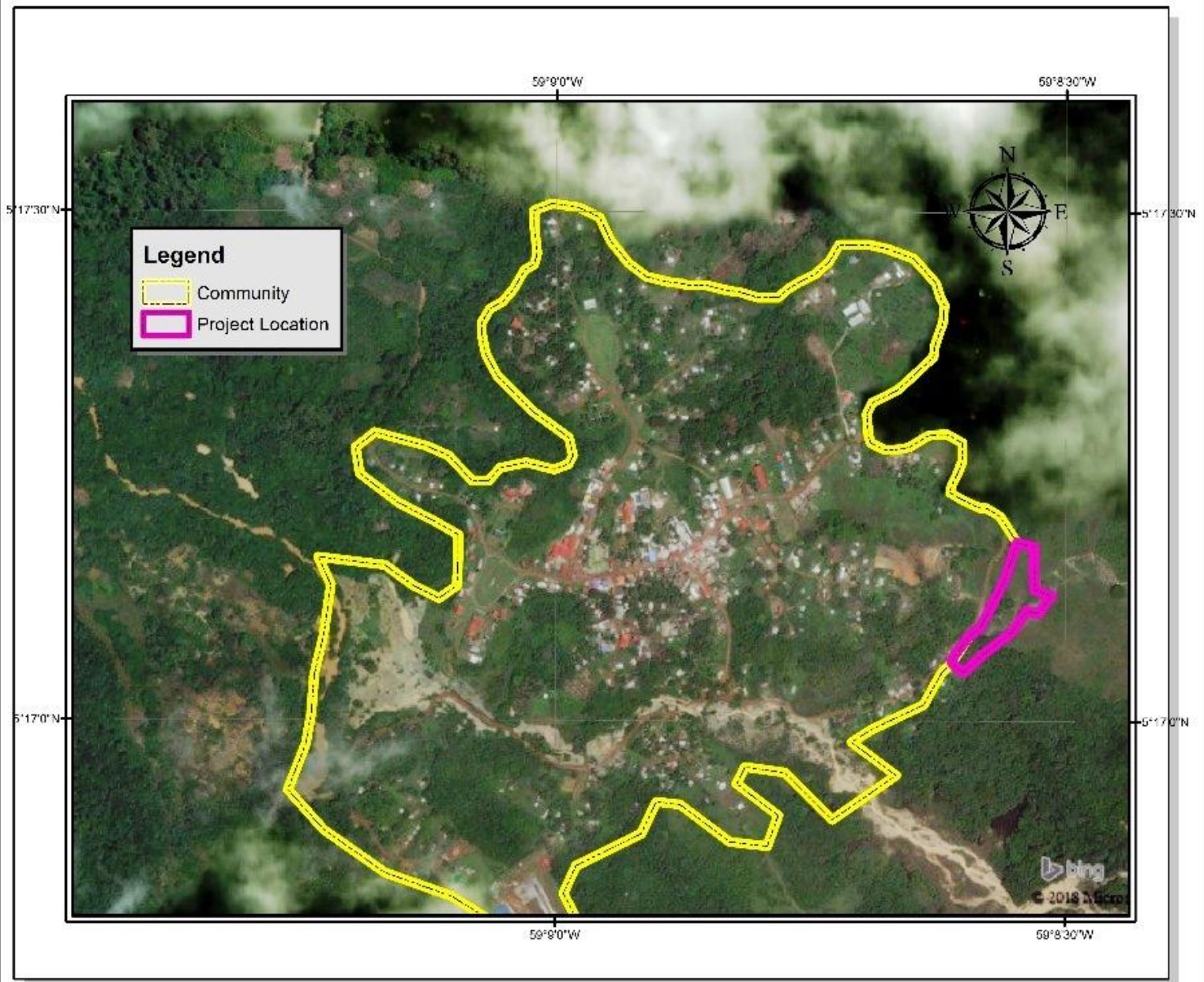
The solar PV systems will be installed within 1.6 km from the utilities. This means that continuous monitoring is possible and the connection to the grids is simplified. Access roads to the main grid and mini-grids in the Hinterland already exist. These grids are well developed and no major work is envisioned to facilitate interconnection to the solar PV systems. The average solar irradiation across the three (3) sites amounts to 4.993 kWh/m² per day. The breakdown is as follows:

Table 3: Average Solar Irradiation

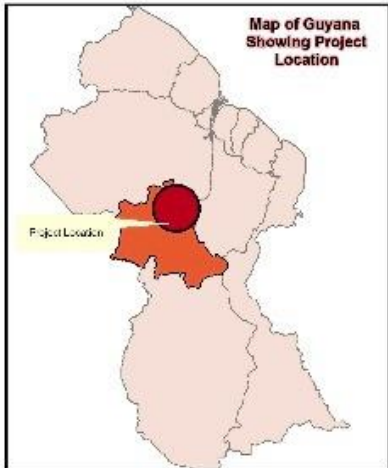
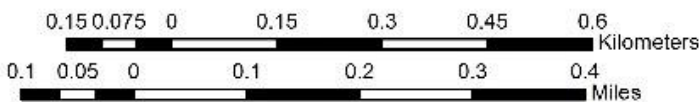
Site	Resource Data (kWh/m² per day)
Mahdia	4.89
Lethem	5.32
Bartica	4.77
Average solar irradiation across the 3 sites	4.993

Figure 1, 2 and 3 below illustrates the locations of the Solar PV Farms in Mahdia, Lethem and Bartica.

Project Location (Mahdia) Map



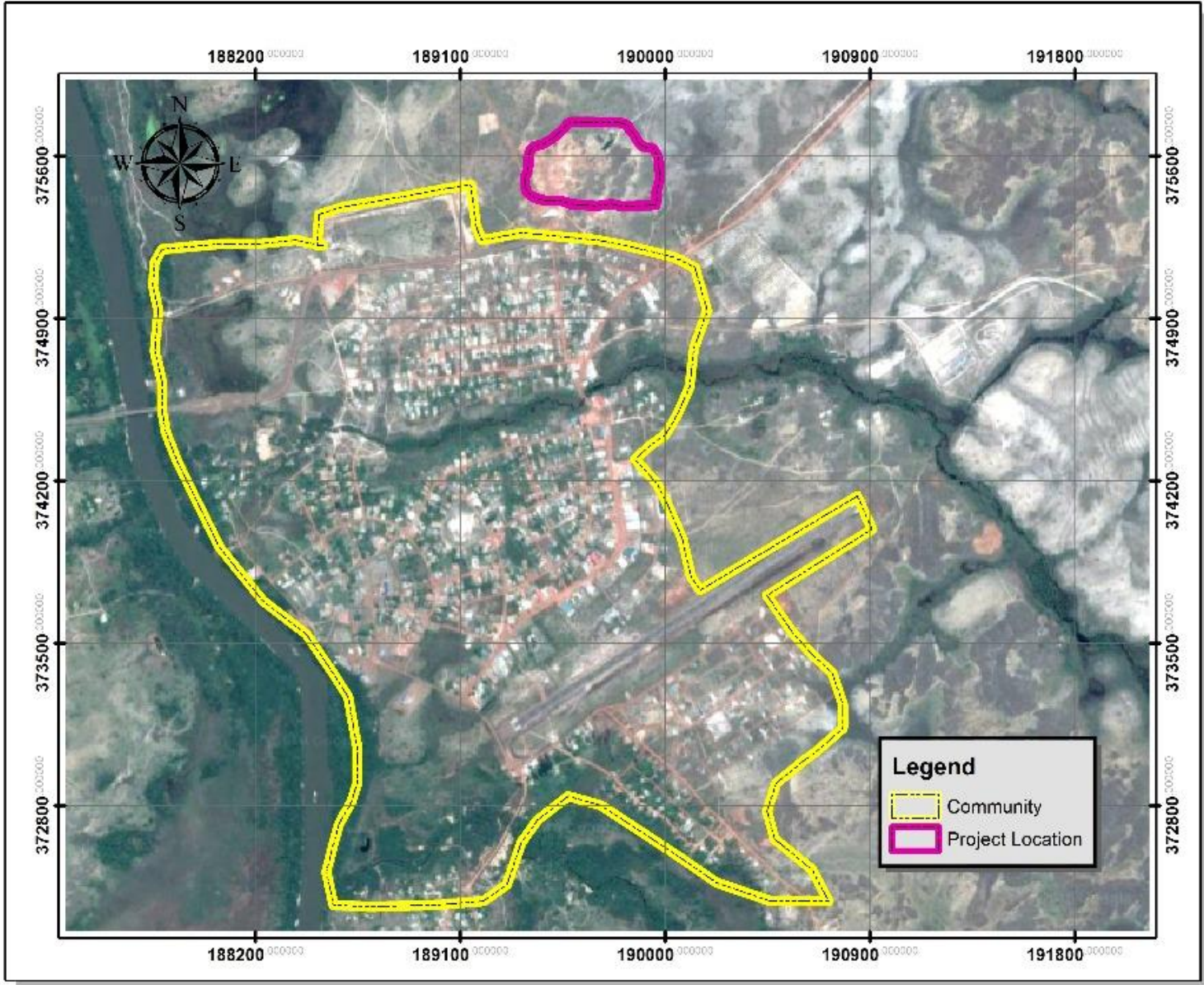
SCALE: 1:10,428



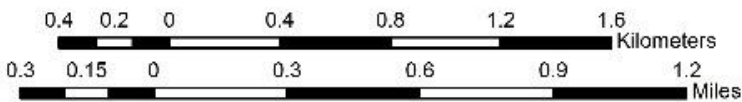
CLIENT: Inter-American Development Bank (IDB)
SITE: Mahdia, Region 8 (Potaro-Siparuni)
DRAWN BY : Samuel A. D. Reid
ENVIRONMENTAL ENGINEERING SOLUTIONS (EES) 06-JUNE-2018
NOTE: DRAWING PROVIDED FOR INFORMATION PURPOSES ONLY

Figure 1: Mahdia Community and Solar PV Farm Location (Source: Reid, 2018)

Project Location Map (Lethem)



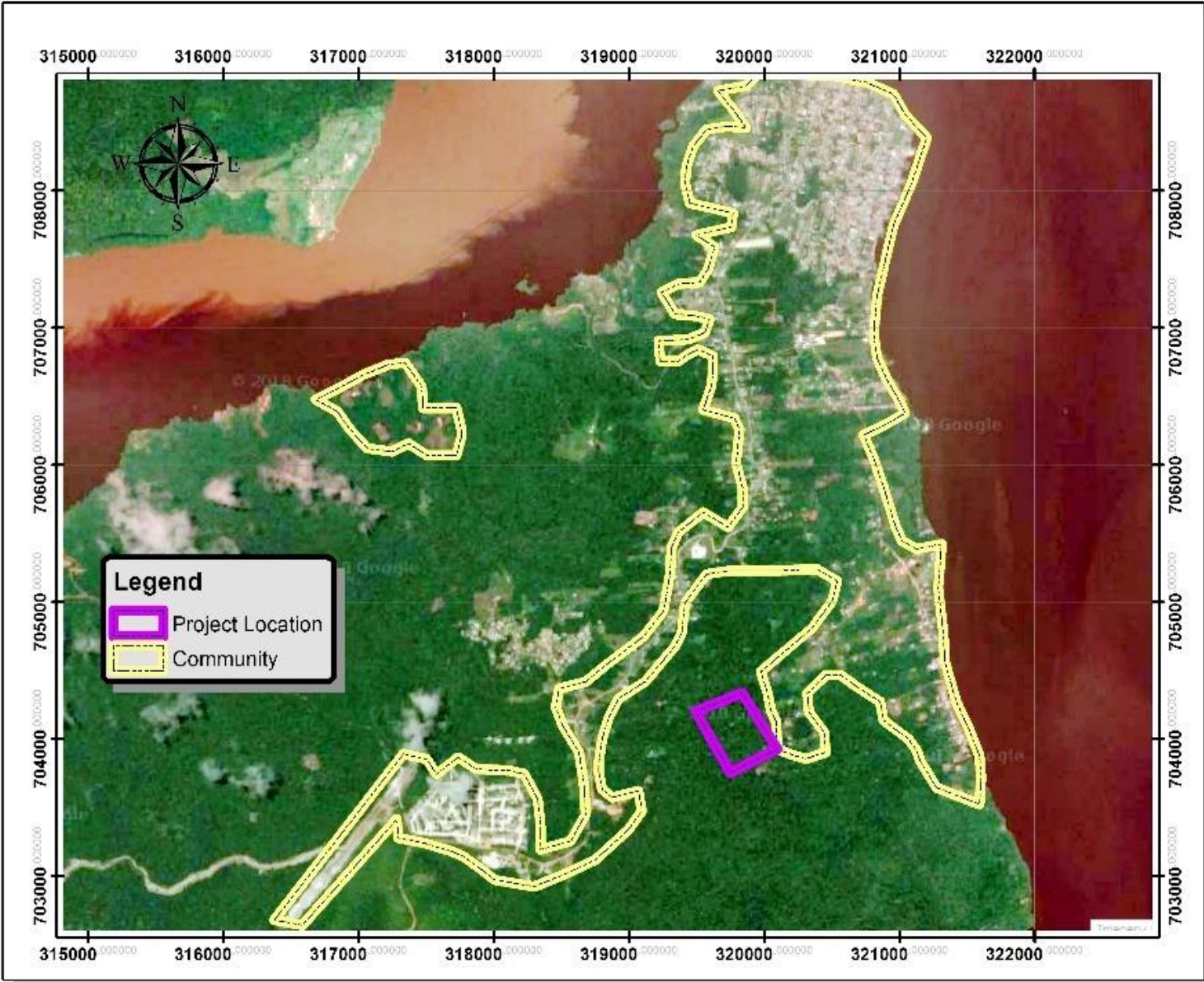
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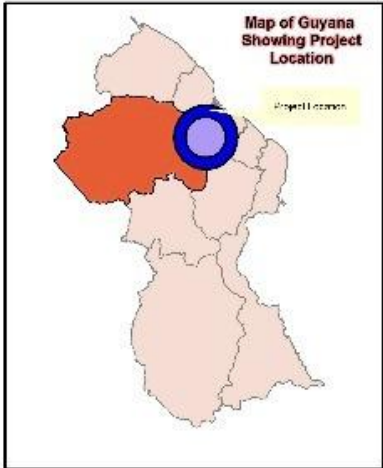
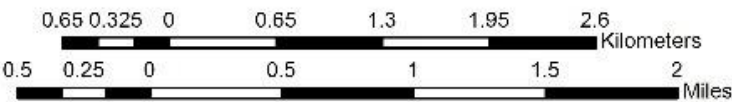
CLIENT: Inter-American Development Bank (IDB)
SITE: Lethem, Region 9 (Upper Takutu - Upper Essequibo)
DRAWN BY : Samuel A. D. Reid
ENVIRONMENTAL ENGINEERING SOLUTIONS (EES) 06-JUNE-2018
NOTE: DRAWING PROVIDED FOR INFORMATION PURPOSES ONLY

Figure 2: Lethem Community and Solar PV Farm Location (Source: Reid, 2018)

Project Locations Map (Bartica)



SCALE: 1:44,000



CLIENT: Inter-American Development Bank (IDB)
SITE: Bartica, Region 8 (Cuyuni-Mazaruni)
DRAWN BY : Samuel A. D. Reid
ENVIRONMENTAL ENGINEERING SOLUTIONS (EES) 06-JUNE-2018
NOTE: DRAWING PROVIDED FOR INFORMATION PURPOSES ONLY

Figure 3: Bartica Community and Solar PV Farm Location (Source: Reid, 2018)

2.3 Project Timeline

The project timeline is expected to be a 15-month period with continued monitoring for another 12 months following commissioning to ensure grid stability and regulation. Following a 3-month tendering process from January to March 2019, construction of the project is estimated to commence in April 2019, with estimated project operations anticipated to commence in March 2020 (IDB 2014).

2.4 Project Design and Technology

The use of grid feed-in solar PV technology is premised on previous studies and pilot projects conducted over the last four (4) years in Guyana. Solar PV technology is a mature technology option and deemed appropriate based on site location and suitability, weather patterns and site requirements. Additionally, Guyana commissioned its first utility-scale Solar PV Farm in Mabaruma, Region 1 with an installed capacity of 400kW in June, 2018. The experience gained from this project will be transferred to the 3 sites.

Within the specified site locations, the use of hydropower, while still a viable technology option, is being considered as a complementary input in the medium term. However, the existing opportunities to integrate the solar PV to the grids for the Mahdia, Lethem and Bartica communities indicates that a faster uptake and implementation in the short term based on distance to grid, layout of communities and resources to complete this renewable energy project. Also, the use of solar PV envisions lesser costs and low maintenance and is a prime use of technology within hinterland communities that have previously witnessed the use of solar technologies. Wind data collection is on-going in some areas and will be assessed to accommodate future demand.

2.5 Main Infrastructure Components

Solar Panels: Polycrystalline (or multi-crystal) silicon panels are made by using polycrystalline wafers which is the most preferred technology with a module efficiency of 19-23 %. Average land requirement using this panels technology is about 1.72 hectares/MW (4.25 acres/MW). Crystalline technology has got a proven track record of over 30 years in commercial operation as compared to approximately 7 years for thin film technologies.

As a part of the construction:

- Excavate and form footings (concrete) or install post (pile driven).
- Attached support structure to footings or post.
- Mount panel on support structure.

Module Mounting System: For the installation, Footings or posts as foundations. Solar array locations shown in indicative layout, Support structures for mounting solar panels (992mm by 1956mm) standing approximately 3m high. Panels tilted at a fixed angle between 20-30 degrees.

The PV panels will be mounted on aluminium fixed frame structures. The prime consideration in the design of mounting structures is the nature of wind loads in the proposed location, taking into cognizance any seasonal/local winds that may exert additional load. Typically the mounting structure is designed to have a capability of withstanding wind load up-to 150 to 200 kmph. Accordingly, the concrete blocks are to be designed to counter balance the load. In addition, the material of the structure is to be selected in such a way that it serves at least for 20 years. In general “galvanized steel” or “anodized aluminium” are used to make the structures. Since the proposed site is prone to corrosion due to brackish water and salt, galvanized steel or anodized aluminium structures will be utilized.

Inverters: Inverters will convert incoming DC received from PV modules into AC with suitable power quality. Wiring between panels and inverter systems, regularly 5 or 6 inverter station (about 6m long each) consisting of 1.8 MW to 2MW inverter and sep up transformers to convert direct current (DC) to alternating current (AC). 1000-1500 Volt DC junction boxes (combiner boxes)

The features of proposed inverter system comprises of:

- Unique Maximum Power Point Tracking (MPPT) algorithm adjusts the DC Link operating voltage to ensure that maximum power is extracted from the solar array in an efficient manner.
- Automatic “sleep” mode at night reduces standby losses.
- Local LCD (liquid crystal display) monitor and key pad for system control and monitoring instantaneous system data.
- Remote control and monitoring option using standard GSM modem available.
- Communication based on LAN / WAN protocol is also available.
- During the construction these are the activities:
- Install/connect electrical wiring.
- Footing installed for inverters and transformers mount inverters and transformers on footings.
- Connect inverters.

Transformers: The output of the inverters will be connected to 2MVA 440V/33kV transformers and associated controls on Low Tension & High Tension side all housed in a single enclosure.

Pooling Sub-station: Pooling station will compromise of three 33/220 kV, 3X100 MVA set up transformers and a switchyard.

Earthing system: there will be dedicated earthing stations for the transformer, MV switch boards, PLC panel and high voltage panel. Maintenance free earthing stations have been considered for the designs.

All the module will be appropriately earthed. Grounding of the modules may be done as recommended by manufacture.

2.6 Auxiliary Electrical Equipment

The following additional electrical equipment will be required for the project:

- ✓ Security system, electrical fence and 24 hour on site security access control;
- ✓ Fire detection system;
- ✓ Weather monitoring equipment (rainfall, wind speed/direction, solar irradiation, air moisture) will be
- ✓ located inside or in close proximity to the guard house; and
- ✓ PV power facility monitoring equipment and associated telecommunication links will be located
- ✓ Inside the guard house.

2.7 Construction

The sequence of the construction program would be as follows:

- ✓ Pre- construction site investigations, such as a geotechnical assessment³ to inform how the panels are mounted and secured.
- ✓ Detailed design and procurement of materials.
- ✓ Site establishment and preparation for construction, including fencing, earthworks, set out and construction of access roads and sediment and erosion controls. While extensive earthworks are not proposed, some land forming (including localised cut and fill areas) may be undertaken to achieve more consistent gradients beneath the array.
- ✓ Delivery of materials and equipment.
- ✓ Installation of the foundations (excavation and concrete footings) or driven piles.
- ✓ Installation of underground cabling (with an option for a short section of overhead cabling.
- ✓ Assembly of the panel frames and mounts.
- ✓ Installation of the PV panels.
- ✓ Installation of the converter / transformer units, including pouring of concrete pads for converter/transformer units.
- ✓ Installation of low voltage cabling and combiner boxes.
- ✓ Construction of a spare parts storage shed.

- ✓ Substation works to connect the Solar Farm to the existing Power Company.
- ✓ Substation (these occur within the switch room of the existing substation with no additional visible external substation infrastructure required).
- ✓ Testing and commissioning of the Solar Farms at Bartica, Lethem and Mahdia.
- ✓ Removal of temporary construction facilities and completion of restoration works.

During construction, it is expected an average of 20 workers will be required onsite with a construction peak of approximately 56 workers. Including offsite requirements, 39 jobs with a construction peak of approximately 72 jobs are anticipated. Peak construction periods would have the greatest potential to employ local contractors and labourers.

2.8 Project Costs

The total estimated cost of the overall project amounts to approximately US\$8.2 million. An outline of the total cost by site is as follows:

Table 4: Financing Structure

Size	Size of System (MW)	Cost (US\$)	% of Project Cost
Mahdia Power & Light Inc. (MPL)	0.65	1,767,299.80	21.5%
Lethem Power Company Inc. (LMPC)	1.00	2,591,614.00	31.5%
Bartica (GPL)	1.50	3,876,047.20	47%
Total	3.15	8,234,961.00	100%

3 DIAGNOSTIC OF AREA OF INFLUENCE (DIRECT AND INDIRECT) AND STAKEHOLDERS OF THE OPERATION

3.1 Natural Environment

This section provides a detailed overview of the project's natural environment. It includes a description in relation to the project locations, that is, the towns of Lethem, Bartica, Mahdia. As the locations are influenced by natural features beyond its boundaries, this chapter also considered those applicable characteristics of the natural environment to provide additional context as well as to strengthen a holistic understanding of the project areas. Each of the three towns are found in interior locations in central and southern Guyana. Lethem is situated within the Rupununi savannah, Region 9, and bounded to the west by the Takatu River which separates Guyana and Brazil. At the confluence of the Cuyuni, Mazaruni and Essequibo Rivers, Region 7, sits the town Bartica, known for its linkage to

the gold mining industry. Mahdia, similarly known for its connection with gold mining activities, is located in the Potaro - Siparuni region within central Guyana.

The methodology used in the development and elaboration of this section was based on a review of existing information from various sources including national plans, reports and strategies, scientific research and discussions with resource persons.

3.2 Topography and Soils

Lethem is located in the Rupununi savannah, an area divided into the northern and southern savannahs by the Kanuku Mountains protected area. The FAO maps the northern Rupununi savannahs as Interior Alluvial Plains and the southern savannahs as part of the White Sand Plateau and Older Pediplains and, both are associated with Lethem (GoG, 2013). The savannah itself is generally flat but in places is more dissected with an undulating topography, particularly to the north and east of the Kanuku range. The northern savannahs are characterised by large areas of wetlands which result from the backflow of the Takutu and Ireng Rivers during the Amazonian wet season while, the southern savannahs are composed of precambrian aged rocks (ter Steege et. al. 2000). The precambrian rocks are exposed in the Kanuku Mountains and over a wide area in the south Rupununi savannah. In the north Rupununi savannah the Precambrian rocks are covered by the sedimentary rocks of the Takutu Formation (ter Steege et. al. 2000). The gently undulating landscape of the north Rupununi savannah sits at an altitude of about 100-110m. Domes and ridges with porous laterite on top are mostly forested, in - between seasonally waterlogged flats with sandy clay are found (ter Steege et. al., 2000). The Kanuku Mountains, which rise to 760-840m, are a large outcrop of granite. The slopes have a thin layer of sandy-clayey lithosol and are covered with forest. In the south Rupununi Savannah the granitic bedrock is close to the surface and are characterised by a relatively flat plain at a height of 100-120m with granitic inselbergs rising abruptly from the plain to heights of 760m (ter Steege et. al. 2000; GoG 2013). The slopes of the higher inselbergs are steep and strewn with boulders. The thin sandy soil that develops on the slopes supports a moderately thick forest. The pediments have thin soil with lateritic tendencies (Jansen-Jacobs and Steege 2000). In the depressions, “groundwater laterites” are formed which act as a partially impermeable layer (ter Steege et. al. 2000). In general the soils of the Rupununi Savannah are highly acidic and poor in nutrients (GoG, 2013). According the National Land Use Plan (LUP), 2013, alluvial plains and other low-lying lands dominate extensive parts of the interior and are most extensive in the Rupununi savannahs both south and north of the Kanuku Mountains. A variety of soils is represented, all derived from alluvium, generally hydromorphic with poor drainage and are generally of low fertility. The soils have been mapped and described as follows in the national LUP:

- **1b** Low humic gleys to groundwater laterites including alluvial soils (Endoaquepts with Endoaquods, Udorthents)

This mapping unit is centred on the Northern Rupununi savannahs and extends as far east as the Corentyne river south and east of Apoteri. The soils are very poorly to poorly drained silty loams to clays (occasionally sands) and are mainly low humic gleys (Endoaquepts) except in the Marakanata

Basin in the Rupununi savannahs where groundwater laterites (Endaquods) predominate. The soils have low fertility and can be flooded for appreciable amounts of time, often 3-4 months but rising to 6-8 months in the Marakanata depression. Drainage and low fertility is a limitation for the whole unit with flooding an additional limitation in parts of the savannas. The land cover is a mixture of forest and savannah.

- **3b** Red yellow latosols and hydromorphic soils, low humic gleys and ground water laterites (Endoaquepts with Psammaquents, Endoaquults)

This small unit occurs in undulating terrain in the southern Rupununi savannas to the south and west of the Kanuku Mountains and is characterised by moderately well to well drained latosols in upland positions with poorly drained gleys in 'baixas, low lying areas. The upland soils are clay to clay loams with sandy loams in depressions. The soils have limitations of fertility with flooding and waterlogging an additional constraint in low lying areas. The land cover is mainly savannah grassland used for grazing.

- **4c** Regosols, laterite gravel phase, including red yellow latosols, forest and savannah phases (Kanhaplustults with Kandiudults, Eutrochrepts)

This unit describes soils containing large amounts of laterite gravels. They are extensive in the northern Rupununi savannas forming the higher ground between the alluvial plain and the Kanuku Mountains. The soils are generally very shallow (though occasionally deep), very gravelly (>70% gravels) and vary from darker coloured gravelly sandy clay loam under forest to lighter coloured gravelly clay loams on the savannas, both of very low fertility. The main limitations are the high gravel content resulting in low water holding capacity and low fertility.

- **2e** Reddish brown lateritic soils of high base status, pedimentary phase (Kanhapludults with Rhodudults, Kandiudox)

This mapping unit describes some of the most fertile soils in Guyana but unfortunately it is of very limited extent. It occurs on the northern flanks of the Kanuku Mountains between Moco Moco and Nappi. The soils are deep, well drained loams to clays with high fertility and no limitations to development except for the forest cover (if present) and the need for appropriate land management.

Mahdia is a small, developing town in the Potaro-Siparuni region of Guyana, located near the central part of the country at an altitude of 415 metres (1,362 ft). It can be considered the administrative and business hub of Region 8 and is widely known for its connection with the gold mining industry. Mining and its impact on the landscape can be seen in lower portion of the Potaro River, which is associated with the area; smaller creeks and streams flowing through the area; and the Konawaruk River. Mining has changed the topography of the landscape in many ways in these areas: deep pits and depressions remain post-mining, and there is alteration of river channels and flood plains. Like the Rupununi savannahs, the soil in Mahdia is classified as:

- **4c** Regosols, laterite gravel phase, including red yellow latosols, forest and savannah phases (Kanhaplustults with Kandiudults, Eutrochrepts; GoG 2013)

This unit describes soils containing large amounts of laterite gravels. In general these soils are very shallow, although occasionally deep, are primarily gravelly and are darker coloured gravelly sandy clay loam under forests. It is characterised by low fertility and its high gravel content results in low water holding capacity.

Bartica has traditionally been a focal entry point for forestry and mining in the interior of Guyana, with its central position being at the confluence of the Essequibo, Cuyuni and Mazaruni Rivers (ter steege. et al. 2003). It has a topography that is undulating to hilly. Its soils have been mapped in the national LUP as:

- **3c.** Red yellow latosols, steep phase including red yellow podzolic intergrades to red yellow latosols (Kanhaplustults with Dystrochrepts, Kandiudults)

This association occurs in north-central Guyana around the lower Cuyuni, Mazaruni and Essequibo rivers and is characterised by the hilly terrain and steep slopes with deep, well drained sandy loams to sandy clays of low fertility. The main limitation is the terrain with a high erosion potential if the forest cover were to be removed.

3.3 Hydrological Situation

The Lethem project site is broadly situated in the Rupununi savannah. The Rupununi River, a tributary of the Guyana's largest river - the Essequibo, is a major river which dissects the region. The Essequibo is a large tannin-rich, black-water river that is over forty meters deep and 250-500 m. wide, while the Rupununi River is a white water river containing heavy sediment loads, one hundred meters wide, with high riverbanks. (Elliot et. al., undated). The Ireng River and Takutu River form the western border of Guyana and is shared with neighbouring Brazil. The Ireng and Takutu Rivers drain into the Rio Branco and thence into the Amazon (Elliot et.al., undated). Lethem is located just east of the Takutu. These rivers store enormous quantities of water. However, large quantities of fresh water are available only during April to August of the year, a period which represents the annual rainy season in the in the Rupununi. Heavy rainfall during this time results in the Takutu, Ireng and Rupununi over topping their banks, leading to extensive flooding of the savannah and the creation of vast wetland areas. The flooding also creates a complex hydrological connection between the Amazon and Essequibo river systems which supports rich floral and faunal diversity and recharge of ground water aquifers (GoG 2016; Alonso et. al. 2016). This modern hydrology system is suggested to have its roots in an ancient river that may have once drained the central Guiana Shield, i.e. the Proto-Berbice River. This river would have flowed through the northern Rupununi savannahs to drain portions of the Roraima State in Brazil, most of Guyana and parts of southern and eastern Venezuela and western Suriname into the Atlantic Ocean near the mouth of the Berbice River (Alonso et. al.

2016). The transboundary Boa Vista-Serra do Tucano-North Savannah aquifer is associated with the project site (GoG 2016; see Figure 4, below). It is primarily utilised by residents within Region Nine and is a multilayered hydraulically connected unconfined aquifer (GoG 2016). The aquifer is a composition of Arkosic sandstones, conglomerates, and siltstones. It has an approximate area of 6,784 km² shared between Guyana and Brazil with the greater portion within Brazilian territory (GoG, 2016; see Figure 4 below). The main source of recharge for the aquifer is via precipitation. This aquifer is within a tropical dry climate with a single major rainfall period and receiving approximately 1,500 mm of rainfall per year (GoG 2016).



Figure 4: Boa Vista-Serra do Tucano-North Savannah aquifer (GoG 2016)

Bartica sits at the confluence of the Cuyuni, Mazaruni and Essequibo Rivers, in Region Seven. The Cuyuni and Mazaruni are tributaries of the Essequibo and they drain northwards bringing freshwater to the coast before finally emptying into the Atlantic Ocean. The Potaro River which drains the Mahdia area also flows northwards and is a tributary of the Essequibo. The quality of the water and freshwater habitats over the years the Cuyuni, Mazaruni and the Potaro Rivers have been continuously degraded due to discharges from mining activities within the mining districts, where high levels of turbidity, discolouration, changes in hydrology and mercury contamination are evident (Alofs et al.

2014; EPA 2016; Miller, Lechler, and Bridge 2003). This influences the quality of the water resources in smaller creeks and streams as well as the Essequibo river.

The National Land Use Plan (2013) points out that hydrologic data are lacking throughout the country, particularly since the late 1960's when data collection decreased dramatically.

3.4 Noise Emissions

3.4.1 Mahdia

The existing sound environment throughout the proposed Madia Project location was characterized almost completely as sounds of nature within a Residential Community. Noise measurements were taken at various strategic locations within and around the proposed location of the Solar PV Farm operation.

Noise levels were recorded at seven (7) points within the proposed project location (Figure 6) on May 30, 2018, using a Sound Level Meter (ExTech 407730) (Figure 5). Noise decibel levels are not to be greater than the established permissible noise levels/limits of the Guyana National Bureau of Standards (GNBS) Guideline values for Noise in specific environment (Table 5) which has been adopted by the Environmental Protection Agency (EPA).

Table 5: Guyana National Bureau of Standards (GNBS) Guideline Values for Noise in Specific Environment (Source: GNBS 2010)

Categories	Daytime Limits in dB (06:00 – 18:00h)	Night time Limits in dB (18:00 – 06:00h)	
Residential	75	60	
Institutional	75	60	
Educational	75	60	
Industrial	100	80	
Commercial	80	65	
Construction	90	75	
Transportation	100	80	
Recreational	100	18:00- 01:00hr	100
		01:00- 08:00hr	70

Table 6 below shows the noise conditions within the proposed project location.

Table 6: Noise Levels within the Proposed Mahdia Project Location

Sound Level (dB)						
Sample ID	Coordinates	Time		Data	Wind	
		Start	End	Decibel (dB)	Direction	Speed (m/s)
N1	21N - 0262550	6:34	6:37	40.0	-----	-----

	UTM - 0584701					
N2	21N - 0262479 UTM - 0584545	6:42	6:45	48.2	-----	-----
N3	21N - 0262456 UTM - 0584520	6:49	6:52	51.0	-----	-----
N4	21N - 0262494 UTM - 0584563	6:56	6:59	51.7	-----	-----
N5	21N - 0262513 UTM - 0584593	7:04	7:07	53.6	-----	-----
N6	21N - 0262517 UTM - 0584613	7:11	7:14	44.5	-----	-----
N7	21N - 0262572 UTM - 0584615	7:44	7:47	46.7	-----	-----

Figure 5 illustrates the instrument used to test the Noise emissions.



Figure 5: Noise Meter (Source: Ellis, 2018)

Results and Discussion (Mahdia)

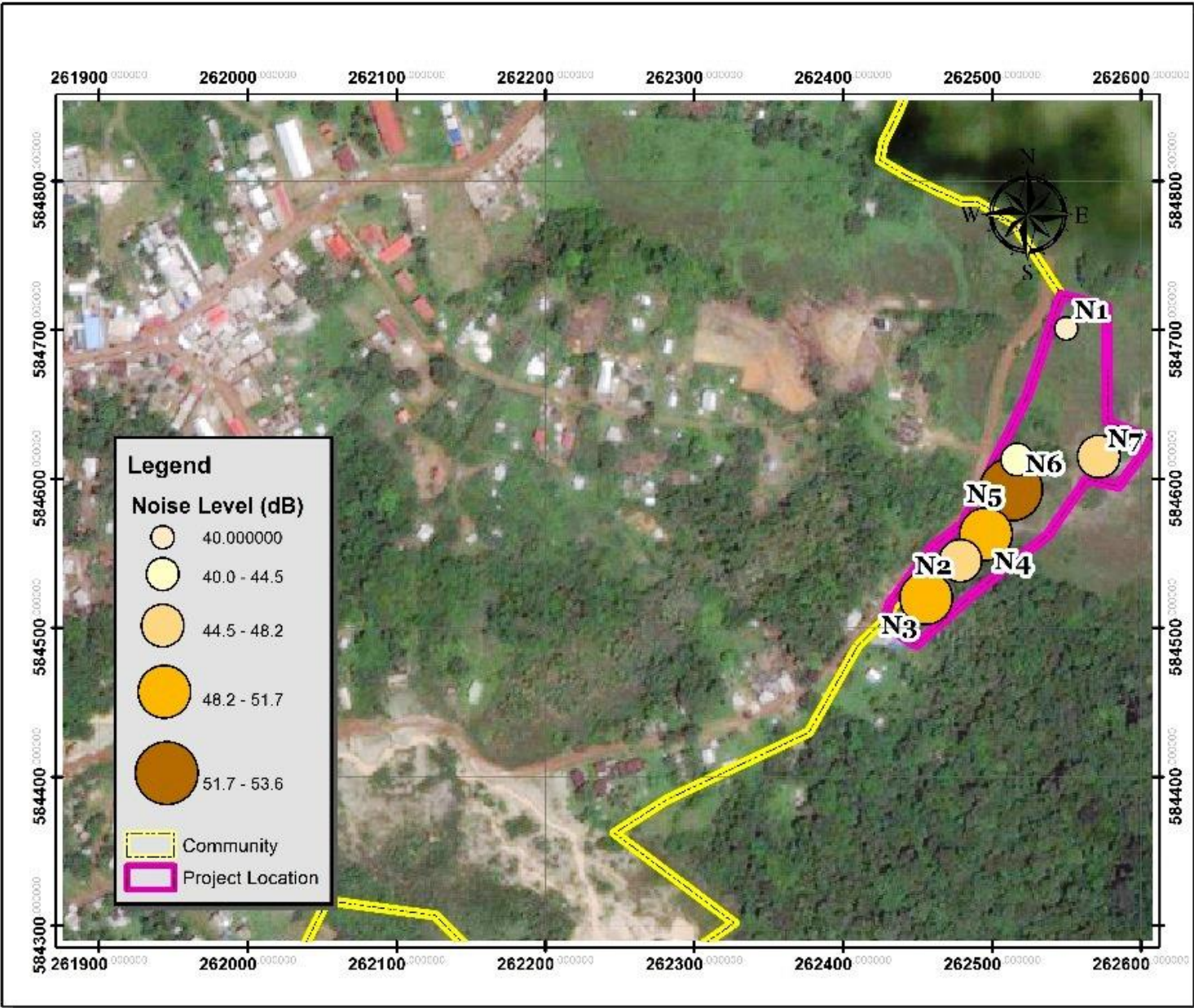
Noise levels within the proposed Solar PV Farm location at Mahdia ranged from 40.0 dB to 53.6 dB. The sampled areas never exceeded 60 decibels (dB). During the time of monitoring within the proposed project location, the highest noise level recorded was at N5 (53.6 dB) - recorded near the public road as a vehicle traversed the area). It is important to note that the noise measurement recorded at N5 was negligible (i.e. below 75 dB Residential Daytime limits).

The noise measurements of the other six (6) areas recorded within the proposed site were as follows: N1 (40.0 dB), N2 (48.2 dB), N3 (51.0 dB), N4 (51.7 dB), N6 (44.5 dB), and N7 (46.7 dB). These sample points showed small increments in noise levels and was as a result of sounds from vehicular traffic. However, these levels were all below the 75 dB Daytime (06:00 h - 18:00 h) Residential limits

of the Guyana National Bureau of Standards (GNBS) Guidelines for the Measurement and Assessment of Noise in the Environment.

Figure 6 illustrates the locations where noise levels were monitored in Mahdia.

Noise Level Sample Locations Map



SCALE: 1:4,000



CLIENT: Inter-American Development Bank (IDB)
 SITE: Mahdia, Region 8 (Potaro-Siparuni)
 DRAWN BY : Samuel A. D. Reid
 ENVIRONMENTAL ENGINEERING
 SOLUTIONS (EES) 06-JUNE-2018
 NOTE: DRAWING PROVIDED FOR INFORMATION
 PURPOSES ONLY

Figure 6: Noise Measurement Sample Points within the Proposed Solar PV Farm Project Location at Mahdia (Source:(Reid 2018)

3.4.2 Lethem

The existing sound environment throughout the proposed Lethem Solar PV Farm Project location was characterized as sounds of nature within a Town. Noise measurements were taken at various strategic locations within and around the proposed location of the Solar PV Farm operation.

Noise levels were recorded at twelve (12) points within the proposed project location (Figure 8) on June 01, 2018, using a Sound Level Meter (ExTech 407730). Noise decibel levels are not to be greater than the established permissible noise levels/limits of the Guyana National Bureau of Standards (GNBS) Guideline values for Noise in specific environment which has been adopted by the Environmental Protection Agency (EPA).

Table 7: Noise Levels within the Proposed Lethem Project Location

Sample ID	Coordinates	Sound Level (dB)				
		Time		Data	Wind	
		Start	End	Decibel (dB)	Direction	Speed (m/s)
N1	21N - 0189837 UTM - 0375414	11:49	11:52	57.4	South West	8.0
N2	21N - 0189834 UTM - 0375482	12:16	12:19	67.5	South West	7.2
N3	21N - 0189840 UTM - 0375524	12:31	12:34	65.5	South West	2.8
N4	21N - 0189843 UTM - 0375602	12:53	12:56	63.4	South West	1.3
N5	21N - 0189789 UTM - 0375617	13:06	13:09	61.2	South West	3.1
N6	21N - 0189715 UTM - 0375631	13:25	13:28	73.6	South West	3.5
N7	21N - 0189643 UTM - 0375642	13:38	13:41	60.7	South West	2.8
N8	21N - 0189601 UTM - 0375705	13:45	13:48	57.8	South West	1.8
N9	21N - 0189453 UTM - 0375571	14:05	14:08	64.8	South West	2.7
N10	21N - 0189536 UTM - 0375461	14:22	14:25	63.4	South West	4.3
N11	21N - 0189638 UTM - 0375477	14:50	14:53	63.2	South West	3.5
N12	21N - 0189749 UTM - 0375444	14:58	15:01	73.3	South West	2.0

Results and Discussion (Lethem)

Noise levels within the proposed Solar PV Farm location at Lethem ranged from 57.4 dB to 73.6 dB. The sampled areas never exceeded 75 decibels (dB). During the time of monitoring within the proposed project location, the highest noise level recorded was at N6 (73.6 dB) - recorded with high winds in the background). Another high noise level measurement was N12 (73.3 dB). These noise measurements (N6 and N12) were high but negligible (i.e. below 75 dB Residential Daytime limits).

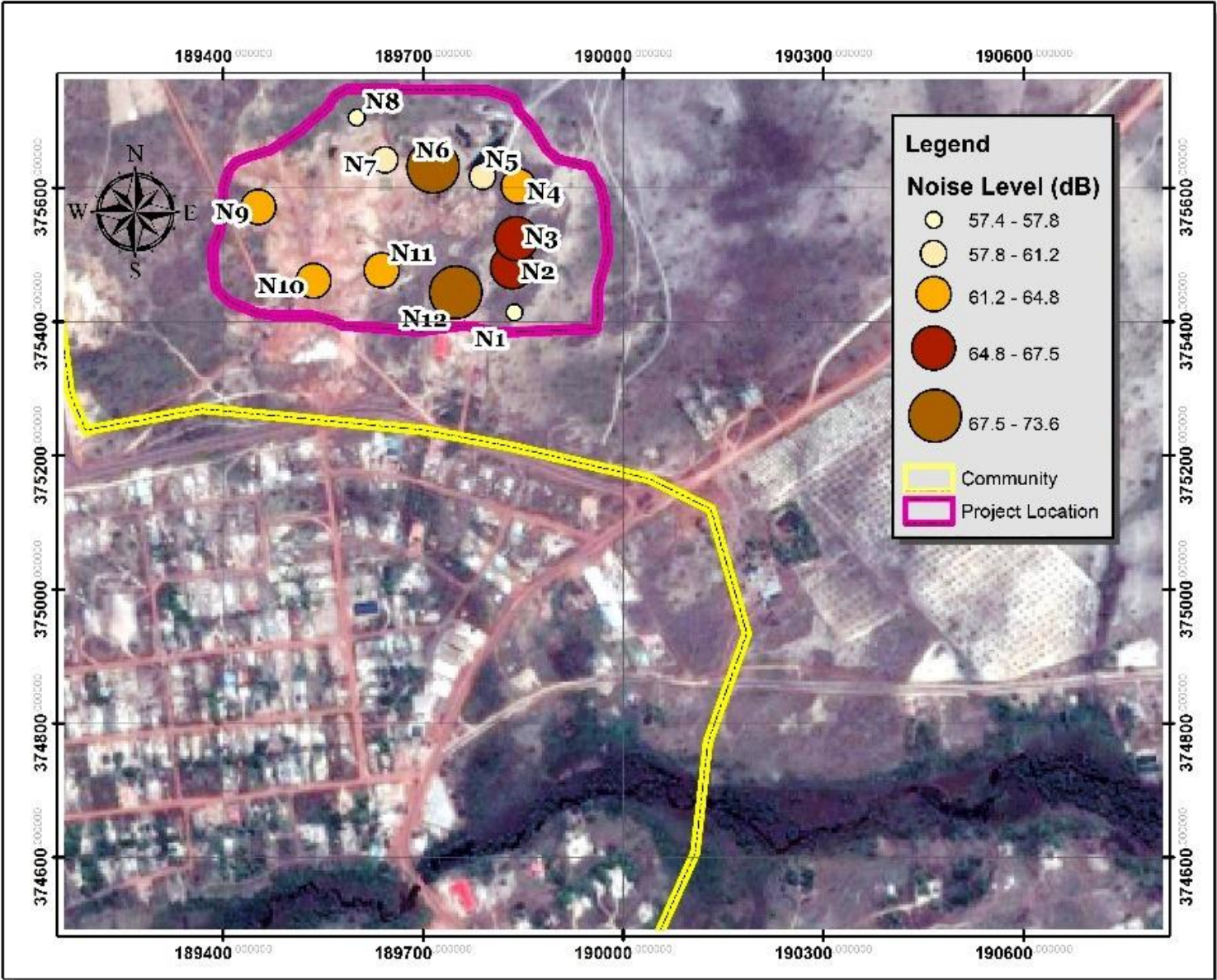
The noise measurements of the other ten (10) areas recorded within the proposed site were as follows: N1 (57.4 dB), N2 (67.5 dB), N3 (65.5 dB), N4 (63.4 dB), N5, (61.2 dB), N7 (60.7 dB), N8 (57.8 dB), N9 (64.8 dB), N10 (63.4 dB), and N11 (63.2 dB). These sample points showed small increments in noise levels and was as a result of sounds from high winds and vehicular traffic. However, these levels were all below the 75 dB Daytime (06:00 h - 18:00 h) Residential limits of the Guyana National Bureau of Standards (GNBS) Guidelines for the Measurement and Assessment of Noise in the Environment.



Figure 7: Noise Levels of the Lethem Solar PV Farm Project Area (Source: Ellis, 2018)

Figure 8 illustrates the locations where noise levels were monitored in Lethem.

Noise Level Sample Locations Map



SCALE: 1:9,000



CLIENT: Inter-American Development Bank (IDB)
SITE: Lethem, Region 9 (Upper Takutu - Upper Essequibo)
DRAWN BY : Samuel A. D. Reid
ENVIRONMENTAL ENGINEERING SOLUTIONS (EES) 06-JUNE-2018
NOTE: DRAWING PROVIDED FOR INFORMATION PURPOSES ONLY

Figure 8: Noise Measurement Sample Points within the Proposed Solar PV Farm Project Location at Lethem (Source: Reid 2018)

3.4.3 Bartica

The existing sound environment throughout the proposed Bartica Solar PV Farm Project location was characterized as sounds of nature within a Town. Noise measurements were taken at various strategic locations within and around the proposed location of the Solar PV Farm operation.

Noise levels were recorded at ten (10) points within the proposed project location (Figure 9) on June 04, 2018, using a Sound Level Meter (ExTech 407730). Noise decibel levels are not to be greater than the established permissible noise levels/limits of the Guyana National Bureau of Standards (GNBS) Guideline values for Noise in specific environment which has been adopted by the Environmental Protection Agency (EPA).

Table 8: Noise Levels within the Proposed Bartica Project Location

Sample ID	Coordinates	Sound Level (dB)				
		Time		Data	Wind	
		Start	End	Decibel (dB)	Direction	Speed (m/s)
N1	21N - 0320208 UTM - 0704135	14:48	14:51	49.8	South West	0.4
N2	21N - 0319930 UTM - 0703879	15:02	15:05	49.4	-----	-----
N3	21N - 0319826 UTM - 0703877	15:09	15:12	52.3	-----	-----
N4	21N - 0319769 UTM - 0703913	15:14	15:17	50.8	-----	-----
N5	21N - 0319700 UTM - 0703974	15:20	15:23	51.7	-----	-----
N6	21N - 0319793 UTM - 0704040	15:24	15:27	50.4	-----	-----
N7	21N - 0320030 UTM - 0703928	15:27	15:30	50.5	-----	-----
N8	21N - 0319965 UTM - 0703980	15:38	15:41	51.2	-----	-----
N9	21N - 0319867 UTM - 0703997	15:43	15:46	49.4	-----	-----
N10	21N - 0319839 UTM - 0703942	15:54	15:57	49.1	-----	-----

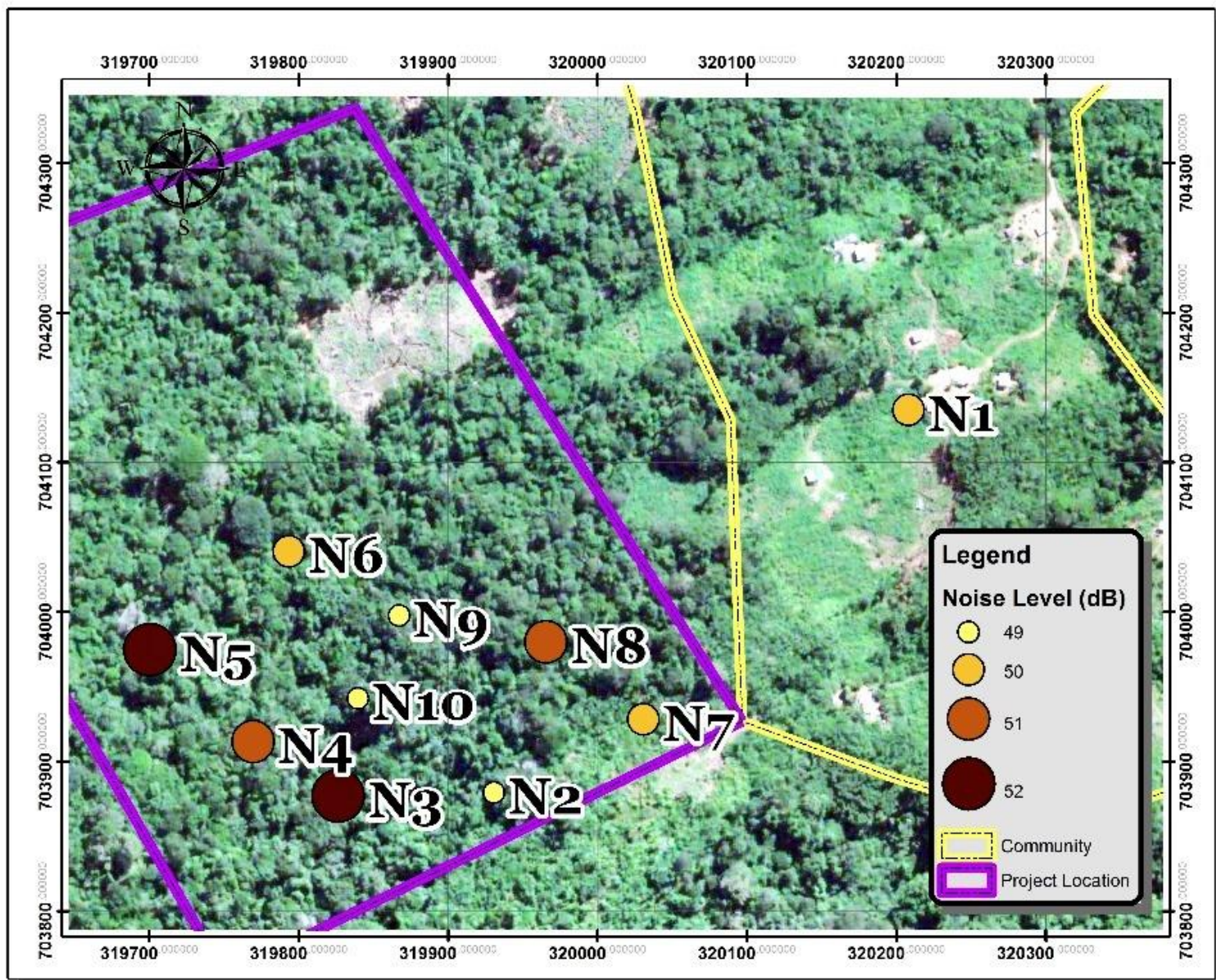
Results and Discussion (Bartica)

Noise levels within the proposed Solar PV Farm location at Bartica ranged from 49.1 dB to 52.3 dB. The sampled areas never exceeded 54 decibels (dB). During the time of monitoring within the proposed project location, the highest noise level recorded was at N3 (52.3 dB) - recorded with winds in the background). It is important to note that the noise measurement recorded at N3 was negligible (i.e. below 75 dB Residential Daytime limits).

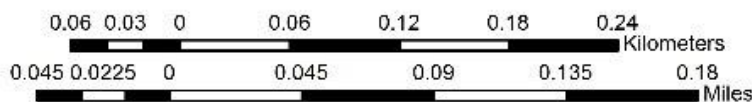
The noise measurements of the other nine (9) areas recorded within the proposed site were as follows: N1 (49.8 dB), N2 (49.4 dB), N4 (50.8 dB), N5, (51.7 dB), N6 (50.4 dB), N7 (50.5 dB), N8 (51.2 dB), N9 (49.4 dB), and N10 (49.1 dB). These sample points showed small increments in noise levels and was as a result of sounds from winds. However, these levels were all below the 75 dB Daytime (06:00 h - 18:00 h) Residential limits of the Guyana National Bureau of Standards (GNBS) Guidelines for the Measurement and Assessment of Noise in the Environment.

Figure 9 illustrates the locations where noise levels were monitored in Bartica.

Noise Level Sample Locations Map



SCALE: 1:4,000



CLIENT: Inter-American Development Bank (IDB)
SITE: Bartica, Region 8 (Cuyuni-Mazaruni)
DRAWN BY : Samuel A. D. Reid
ENVIRONMENTAL ENGINEERING SOLUTIONS (EES) 06-JUNE-2018
NOTE: DRAWING PROVIDED FOR INFORMATION PURPOSES ONLY

Figure 9: Noise Measurement Sample Points within the Proposed Solar PV Farm Project Location at Bartica (Source: Reid 2018)

3.5 Air Quality

Air pollution is contamination of the indoor or outdoor environment by any chemical, physical or biological agent that modifies the natural characteristics of the atmosphere (World Health Organization 2012). This is becoming an increasingly significant problem to growth and development of cities and communities. The air pollutants of major public health concern include: particulate matter, carbon monoxide, ozone, nitrogen dioxide and sulphur dioxide and metals, such as lead (Hedges 2004) (World-Health-Organization 2012).

Particulate Matter (PM) - This is the term for a mixture of solid particles (dust, dirt, soot, and smoke) and liquid droplets suspended in the air. These PM emissions originate from a variety of sources, such as vehicles, factories, industrial sites, construction sites, tilled fields, unpaved roads, stone crushing, and burning of wood (Hedges 2004, p.58). Particulate Matter comprises both coarse and fine particles. The coarse particles (PM_{10}) have an aerodynamic diameter between $2.5\mu m$ and $10\mu m$. They are formed by mechanical disruption (e.g. crushing, grinding, abrasion of surfaces); evaporation of sprays, and suspension of dust. Fine particles have an aerodynamic diameter less than $2.5\mu m$ ($PM_{2.5}$). These particles are formed from gas by chemical reactions; and condensation of high-temperature vapours during combustion (Fierro 2000).

Total Suspended Particulates (TSP) - This refers to all particles in the atmosphere that are less than 100 micrometers. The amount of PM_{10} and $PM_{2.5}$ are related to the amount of total suspended particulates (TSP) in the air (Alias, Hamzah, and Kenn 2007).

Particulate Matter guidelines and standards are instituted (Table 9) due to short term and long term health effects including premature mortality, chronic respiratory disease, acute respiratory systems, decreased lung functions and aggravated asthma, persistent cough, phlegm, wheezing and physical discomfort (Fierro 2000, p.5)(Alias, Hamzah and Kenn 2007, p.258). These health effects are especially associated with PM_{10} and $PM_{2.5}$. The PM_{10} fraction from TSP is able to reach the lower regions of the respiratory tract. On the other hand, $PM_{2.5}$ is able to absorb more toxic and carcinogenic compounds than larger particles and penetrate more easily deep into the lungs (Alias, Hamzah and Kenn 2007, p.256). Additionally, there is increased harm to the environment as PM is a major source of haze that reduces visibility, causes changes to nutrient and chemical balance of the soil and aquatic environment, erosions and staining of structures (residential, commercial, or cultural monuments) (Hedges 2004, p.58).

Air Quality Standards/Guidelines

The purpose of the ambient air quality standards are to establish maximum limits on parameters of air quality considered desirable for the preservation and enhancement of the quality of air resources and health (Mecklenburg-County-NC 2012). Air quality standards, are set by each country to protect the public health of their citizens and as such are an important component of national risk management and environmental policies. National standards will vary according to the approach adopted for balancing health risks, technological feasibility, economic considerations and various other political

and social factors, which in turn will depend on, among other things, the level of development and national capability in air quality management (World-Health-Organisation 2006).

Air quality data in Guyana is extremely limited given the constraints relating to the unavailability of equipment and cost associated with this type of data collection. There was no historical air quality data for the three (3) areas i.e. in Mahdia, Lethem and Bartica, however, a preliminary assessment of air quality was done on May 30, 2018, June 01, 2018 and June 04, 2018, and it reflected the Particulate Matter (PM_{2.5} and PM₁₀) and Total Suspended Particles (TSP) concentration of the three (3) proposed Solar PV Farm Project locations.

Monitoring Procedure

The Particulate Matter (PM) measurements were taken using the Temtop Airing-1000 Air Quality Monitor Real Time Display High Accuracy PM_{2.5}/PM₁₀ Detector. PM_{2.5} and PM₁₀ measurements recorded in micrograms per cubic meter (µg/m³), were taken at various sample locations after a log interval of 5 minutes. After the log time, the PM_{2.5} and PM₁₀ concentration in micrograms per cubic meter (µg/m³) were recorded from each sample site. The Total Suspended Particulate (TSP) measurements were taken using the Thermo pDR-1000AN personalDataRAMTM Particulate Monitor. TSP measurements recorded in milligram per cubic meter (mg/m³), were taken at various sample sites after a log interval of 5 minutes (Thermo-Electron-Corporation 2005). After the 5 minute interval log time, the real time Concentration value, the Maximum Concentration value and the Time Weighted Average (TWA) concentration in milligrams per cubic meter (mg/m³) were recorded from each sample site. The wind direction and temperature at time of monitoring at each site was recorded. Conversions from milligrams per cubic meter (mg/m³) to micrograms per cubic meter (µg/m³) were done by taking the milligrams per cubic meter (mg/m³) measurements x 1000 (Hedges 2004, p.23). Micrograms per cubic meter (µg/m³) results were then compared to the United States Environmental Protection Agency (USEPA) 1971- 2012 National Ambient Air Quality Standards (NAAQS) for Particulate Matter, as a current PM_{2.5}, PM₁₀ and TSP limit permissible utilised (See Table 9). Quality assurance and quality control (QA/QC) was practiced, as well as routine parts of the air quality monitoring during the calibration, operation and maintenance of the monitoring equipment.

Table 9: National Ambient Air Quality Standards for Particular Matter
During the Period 1971 - 2012. (Source:(USEPA 2016)

Indicator	National Ambient Air Quality Standards (NAAQS) 1971 - 2012	Averaging Time	Level (µg/m ³)	Form
PM _{2.5}	Primary	Annual	12.0 µg/m ³	Annual arithmetic mean, averaged over 3 years.
	Secondary	Annual	15.0 µg/m ³	Annual arithmetic mean, averaged over 3 years.
	Primary and	24-hour	35 µg/m ³	98 th percentile, averaged over 3 years.

	Secondary			
PM ₁₀	Primary and Secondary	24-hour	150 µg/m ³	Not to be exceeded more than once per year on average over a 3-year period.
Total Suspended Particles (TSP)	Primary	24-hour	260 µg/m ³	Not to be exceeded more than once per year.
		Annual	75 µg/m ³	Annual geometric mean.
	Secondary	24-hour	150 µg/m ³	Not to be exceeded more than once per year.
		Annual	60 µg/m ³	Annual geometric mean.

Data

The following tables and maps show the results of Particulate Matter and Total Suspended Particulates concentration taken within the proposed Solar PV Farm locations in Mahdia, Lethem and Bartica. Table 10 below contains the PM_{2.5}, PM₁₀, Average Concentration, Time Weighted Average (TWA) and Maximum Concentration of the air quality during the monitoring period.

3.5.1 Mahdia

Table 10: Results of Particulate Matter and TSP Measurement at the Proposed Solar PV Farm Location in Mahdia

Sample ID	Coordinates	Time		Data µg/m ³					Wind		Temperature (°C)
		Start	End	TWA	Max. Con	Avg. Con	PM _{2.5}	PM ₁₀	Direction	Speed (m/s)	
AQ1	21N - 0262550 UTM - 0584701	6:34	6:40	13	24	13	11.5	15.4	----	----	24.5
AQ2	21N - 0262479 UTM - 0584545	6:42	6:48	106	115	111	10.6	14.4	----	----	25.5
AQ3	21N - 0262456 UTM - 0584520	6:49	6:55	115	178	113	9.9	13.8	----	----	26.4
AQ4	21N - 0262494 UTM - 0584563	6:56	7:01	109	119	104	9.6	13.3	----	----	27.6
AQ5	21N - 0262513 UTM - 0584593	7:04	7:10	108	148	97	10.5	13.9	----	----	29.3
AQ6	21N - 0262517 UTM - 0584613	7:11	7:17	102	112	104	8.6	12.5	----	----	30.6
AQ7	21N - 0262572 UTM - 0584615	7:44	7:50	110	115	106	11.9	17.2	----	----	30.6

Results and Discussion (Mahdia)

Under clean atmospheric conditions; the TSP level can be as low as 0 – 10 $\mu\text{g}/\text{m}^3$. In a very dusty environment, TSP concentration can be as high as 1500 $\mu\text{g}/\text{m}^3$ (Alias, Hamzah and Kenn 2007, p.258).

- Monitoring showed Particulate Matter ($\text{PM}_{2.5}$ and PM_{10}) concentration during the period. $\text{PM}_{2.5}$ concentration of the monitored area ranged from 8.6 - 11.9 $\mu\text{g}/\text{m}^3$, during the monitoring period. The highest $\text{PM}_{2.5}$ measurement was recorded at AQ7 (11.9 $\mu\text{g}/\text{m}^3$), this value was below the $\text{PM}_{2.5}$ USEPA 1971 - 2012 National Ambient Air Quality Standards (NAAQS) 35 $\mu\text{g}/\text{m}^3$ 24-hours average along with the other six (6) values.
- PM_{10} concentration of the monitored area ranged from 12.5 - 17.2 $\mu\text{g}/\text{m}^3$, during the monitoring period. The highest PM_{10} measurement was recorded at AQ7 (17.2 $\mu\text{g}/\text{m}^3$), this value was below the PM_{10} USEPA 1971 - 2012 National Ambient Air Quality Standards (NAAQS) 150 $\mu\text{g}/\text{m}^3$ 24-hours average along with the other six (6) values.
- Monitoring also showed the TSP levels of TWA and Maximum Concentration (Max. Conc.). TWA of the monitored area ranged from 13 – 115 $\mu\text{g}/\text{m}^3$, while maximum concentration ranged from 24 – 178 $\mu\text{g}/\text{m}^3$ respectively, during the monitoring period (Table 10). The TWA readings varied among the seven (7) sites, with the highest TWA concentration recorded at AQ3 (115 $\mu\text{g}/\text{m}^3$). In comparison with the TSP USEPA 1971 - 2012 National Ambient Air Quality Standard (NAAQS) 150 $\mu\text{g}/\text{m}^3$ 24-hours average, the values recorded at AQ3 was below the TSP Air Quality Standard. TWA levels for the other six (6) sample points were all below the limit during the monitoring period.
- The highest Maximum Concentration was recorded at AQ3 (178 $\mu\text{g}/\text{m}^3$). The Maximum Concentration is the highest value detected by the sensor during the monitoring time (5 minutes); therefore this does not represent the average maximum concentration. In comparison with the USEPA 1971 – 2012 NAAQS 150 $\mu\text{g}/\text{m}^3$ 24-hours average, measurements showed that AQ3 was above the USEPA 1971 - 2012 NAAQS - TSP AQS during the time of monitoring while the other six sample points were all below the limit.
- The highest average concentration values recorded at AQ3 (113 $\mu\text{g}/\text{m}^3$), this value was below the USEPA 1971 - 2012 National Ambient Air Quality Standards (NAAQS) 150 $\mu\text{g}/\text{m}^3$ 24-hours average along with the other six (6) values were below.

The majority of the TWA, Average and Maximum concentration readings were below the USEPA 1971 – 2012 National Ambient Air Quality Standards (NAAQS) 150 $\mu\text{g}/\text{m}^3$ 24-hours with the exception of AQ3 perhaps due to higher human activity (mechanical workshop) such as increase in vehicular traffic during the time of monitoring.

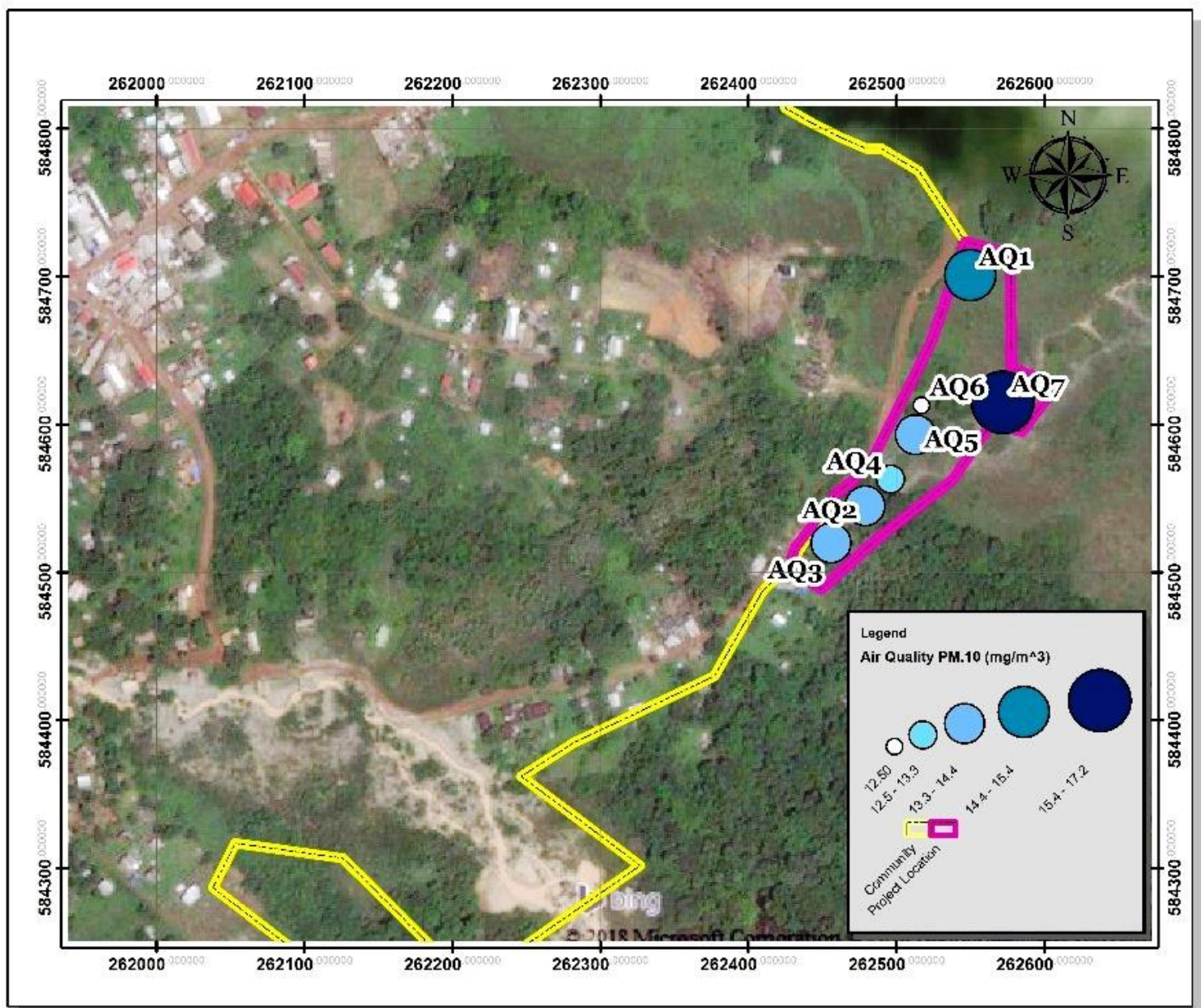


**Figure 10: Solar PV Farm Project Area in Mahdia
(Source: Ellis, 2018)**

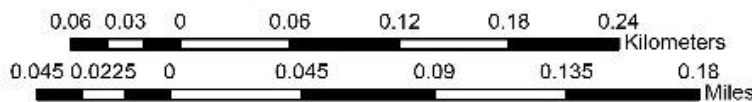


**Figure 11: Air Quality Monitoring of the Solar PV
Farm Project Area in Mahdia (Source: Ellis, 2018)**

Air Quality Sample Locations Map



SCALE: 1:4,000



CLIENT: Inter-American Development Bank (IDB)
SITE: Mahdia, Region 8 (Potaro-Siparuni)
DRAWN BY : Samuel A. D. Reid
**ENVIRONMENTAL ENGINEERING
SOLUTIONS (EES) 06-JUNE-2018**
NOTE: DRAWING PROVIDED FOR INFORMATION
PURPOSES ONLY

Figure 12: Air Quality Sample Locations within the Proposed Solar PV Farm Project in Mahdia (Source: Reid, 2018)

3.5.2 Lethem

Table 11: Results of Particulate Matter and TSP Measurement at the Proposed Solar PV Farm Location in Lethem

Sample ID	Coordinates	Time		Data µg/m³					Wind		Temperature (°C)
		Start	End	TWA	Max. Con	Avg. Con	PM _{2.5}	PM ₁₀	Direction	Speed (m/s)	
AQ1	21N - 0189837 UTM - 0375414	11:49	11:55	75	89	88	6.5	10.2	South West	8.0	35.8
AQ2	21N - 0189834 UTM - 0375482	12:16	12:22	76	80	75	5.8	8.2	South West	7.2	33.6
AQ3	21N - 0189840 UTM - 0375524	12:31	12:37	69	80	74	5.8	8.6	South West	2.8	33.9
AQ4	21N - 0189843 UTM - 0375602	12:53	12:59	73	90	67	6.1	8.2	South West	1.3	34.8
AQ5	21N - 0189789 UTM - 0375617	13:06	13:12	68	97	70	4.6	7.7	South West	3.1	33.0
AQ6	21N - 0189715 UTM - 0375631	13:25	13:30	69	76	58	4.2	6.7	South West	3.5	34.1
AQ7	21N - 0189643 UTM - 0375642	13:38	13:43	72	78	71	5.2	7.1	South West	2.8	36.3
AQ8	21N - 0189601 UTM - 0375705	13:45	13:50	87	95	68	4.7	6.6	South West	1.8	39.2
AQ9	21N - 0189453 UTM - 0375571	14:05	14:10	70	72	71	5.1	6.9	South West	2.7	39.8
AQ10	21N - 0189536 UTM - 0375461	14:22	14:28	74	90	74	4.6	6.4	South West	4.3	34.1
AQ11	21N - 0189638 UTM - 0375477	14:50	14:55	76	110	76	3.8	8.0	South West	3.5	31.6
AQ12	21N - 0189749 UTM - 0375444	14:58	15:04	77	81	75	3.9	5.0	South West	2.0	30.2

Results and Discussion (Lethem)

PM_{2.5} concentration of the monitored area ranged from 3.8 – 6.5 µg/m³, during the monitoring period. The highest PM_{2.5} measurement was recorded at AQ1 (6.5 µg/m³), this value was below the PM_{2.5} USEPA 1971 - 2012 National Ambient Air Quality Standards (NAAQS) 35 µg/m³ 24-hours average along with the other eleven (11) values.

PM₁₀ concentration of the monitored area ranged from 5.0 - 10.2 µg/m³, during the monitoring period. The highest PM₁₀ measurement was also recorded at AQ1 (10.2 µg/m³), however, this value was below the PM₁₀ USEPA 1971 - 2012 National Ambient Air Quality Standards (NAAQS) 150 µg/m³ 24-hours average along with the other eleven (11) values.

- TWA of the monitored area ranged from 68 – 87 µg/m³, respectively, during the monitoring period. The TWA readings varied among the twelve (12) sites, with the highest TWA concentration recorded at AQ8 (87 µg/m³). In comparison with the TSP USEPA 1971 - 2012 National Ambient Air Quality Standard (NAAQS) 150 µg/m³ 24-hours average, the value recorded at AQ8 was below the TSP Air Quality Standard. TWA levels for the other eleven (11) sample points were all below the limit during the monitoring period.
- Maximum concentration ranged from 72 – 110 µg/m³. The highest Maximum Concentration was recorded at AQ11 (110 µg/m³). In comparison with the USEPA 1971 – 2012 NAAQS 150 µg/m³ 24-hours average, measurements showed that AQ11 was below the USEPA 1971 - 2012 NAAQS - TSP AQS during the time of monitoring while the other eleven sample points were all below the limit.
- The highest average concentration value was recorded at AQ1 (88 µg/m³), this value was below the USEPA 1971 - 2012 National Ambient Air Quality Standards (NAAQS) 150 µg/m³ 24-hours average along with the other eleven (11) values.

All the TWA, Average and Maximum concentration readings were below the USEPA 1971 – 2012 TSP National Ambient Air Quality Standards (NAAQS) 150 µg/m³ 24-hours.

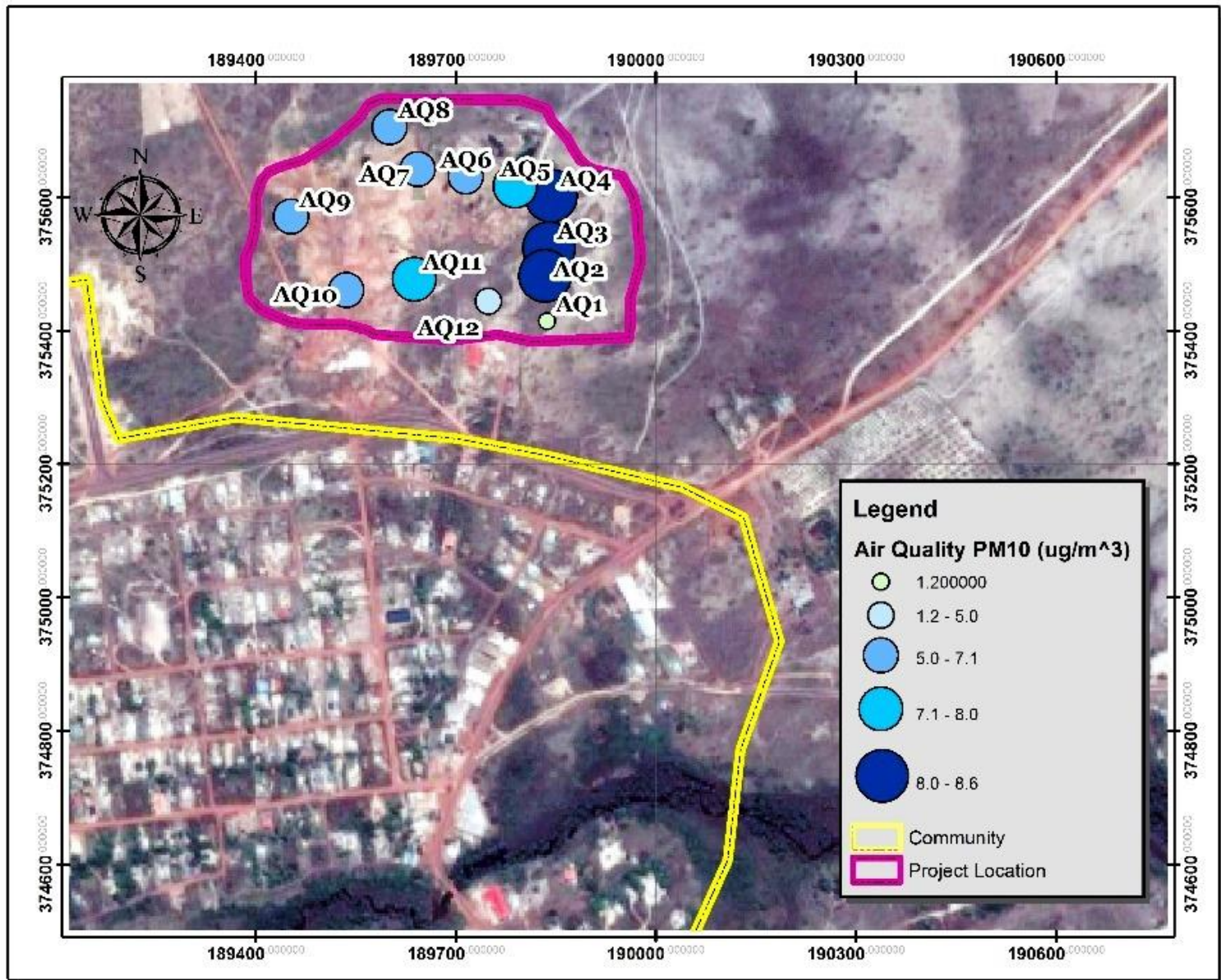


Figure 13: Testing for Particulate Matter in Air at the Solar PV Farm Project Site in Lethem (Source: Ellis, 2018)

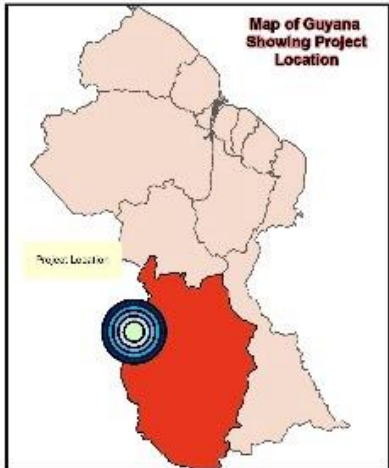
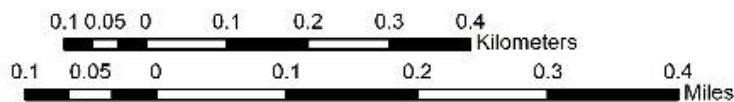


Figure 14: Air Quality Monitoring of the Solar PV Farm Project Area in Lethem (Source: Ellis, 2018)

Air Quality Sample Locations Map



SCALE: 1:9,000



CLIENT: Inter-American Development Bank (IDB)
SITE: Lethem, Region 9 (Upper Takutu - Upper Essequibo)
DRAWN BY : Samuel A. D. Reid
ENVIRONMENTAL ENGINEERING SOLUTIONS (EES) 06-JUNE-2018
NOTE: DRAWING PROVIDED FOR INFORMATION PURPOSES ONLY

Figure 15: Air Quality Sample Locations within the Proposed Solar PV Farm Project in Lethem (Source: Reid, 2018)

3.5.3 Bartica

Table 12: Results of Particulate Matter and TSP Measurement at the Proposed Solar PV Farm Location in Bartica

Sample ID	Coordinates	Time		TWA	Data $\mu\text{g}/\text{m}^3$				Wind		Temperature ($^{\circ}\text{C}$)
		Start	End		Max. Con	Avg. Con	PM _{2.5}	PM ₁₀	Direction	Speed (m/s)	
AQ1	21N - 0320208 UTM - 0704135	14:48	14:51	117	120	118	7.2	10.5	South West	0.4	33.7
AQ2	21N - 0319930 UTM - 0703879	15:02	15:05	106	119	114	6.9	9.6	----	---	34.4
AQ3	21N - 0319826 UTM - 0703877	15:09	15:12	112	123	110	10.7	15.7	----	---	35.3
AQ4	21N - 0319769 UTM - 0703913	15:14	15:17	114	129	106	10.6	12.4	----	---	35.5
AQ5	21N - 0319700 UTM - 0703974	15:20	15:23	119	166	116	8.7	11.8	----	---	33.1
AQ6	21N - 0319793 UTM - 0704040	15:24	15:27	116	156	105	9.2	12.7	----	---	31.9
AQ7	21N - 0320030 UTM - 0703928	15:27	15:30	113	120	108	12.1	16.2	----	---	32.0
AQ8	21N - 0319965 UTM - 0703980	15:38	15:41	115	124	111	7.7	10.1	----	---	31.5
AQ9	21N - 0319867 UTM - 0703997	15:43	15:46	110	123	114	7.1	10.4	----	---	30.0
AQ10	21N - 0319839 UTM - 0703942	15:54	15:57	107	113	109	8.4	12.2	----	---	29.9

Results and Discussion (Bartica)

PM_{2.5} concentration of the monitored area ranged from 6.9 – 12.1 $\mu\text{g}/\text{m}^3$, during the monitoring period. The highest PM_{2.5} measurement was recorded at AQ7 (12.1 $\mu\text{g}/\text{m}^3$), this value was below the PM_{2.5} USEPA 1971 - 2012 National Ambient Air Quality Standards (NAAQS) 35 $\mu\text{g}/\text{m}^3$ 24-hours average along with the other nine (9) values.

PM₁₀ concentration of the monitored area ranged from 9.6 - 16.2 $\mu\text{g}/\text{m}^3$, during the monitoring period. The highest PM₁₀ measurement was also recorded at AQ7 (16.2 $\mu\text{g}/\text{m}^3$), however, this value was below the PM₁₀ USEPA 1971 - 2012 National Ambient Air Quality Standards (NAAQS) 150 $\mu\text{g}/\text{m}^3$ 24-hours average along with the other nine (9) values.

- TWA of the monitored area ranged from 106 – 119 $\mu\text{g}/\text{m}^3$, respectively, during the monitoring period. The TWA readings varied among the ten (10) sites, with the highest TWA concentration recorded at AQ5 (119 $\mu\text{g}/\text{m}^3$). In comparison with the TSP USEPA 1971 - 2012 National Ambient Air Quality Standard (NAAQS) 150 $\mu\text{g}/\text{m}^3$ 24-hours average, the value recorded at AQ5 was below the TSP Air Quality Standard. TWA levels for the other (9) sample points were below the limit during the monitoring period.

- Maximum concentration ranged from 113 – 166 $\mu\text{g}/\text{m}^3$. The highest Maximum Concentration was recorded at AQ5 (166 $\mu\text{g}/\text{m}^3$). In comparison with the USEPA 1971 – 2012 NAAQS 150 $\mu\text{g}/\text{m}^3$ 24-hours average, measurements showed that AQ5 and AQ6 (156 $\mu\text{g}/\text{m}^3$) was above the USEPA 1971 - 2012 NAAQS - TSP AQS during the time of monitoring while the other eight sample points were all below the limit.
- The highest average concentration value was recorded at AQ1 (118 $\mu\text{g}/\text{m}^3$), this value was below the USEPA 1971 - 2012 National Ambient Air Quality Standards (NAAQS) 150 $\mu\text{g}/\text{m}^3$ 24-hours average along with the other eleven (9) values.

The majority of the TWA, Average and Maximum concentration readings were below the USEPA 1971 – 2012 National Ambient Air Quality Standards (NAAQS) 150 $\mu\text{g}/\text{m}^3$ 24-hours with the exception of the maximum concentration for AQ5 and AQ6 due to human activity.



Figure 16: Testing for Particulate Matter in Air at the Solar PV Farm Project Area in Bartica (Source: Ellis, 2018)



Figure 17: Testing for Total Suspended Particles in Air at the Solar PV Farm Project Area in Bartica (Source: Ellis, 2018)



Figure 18: Air Quality Monitoring at the Bartica Project Site (Source: Ellis, 2018)

Air Quality Sample Locations Map

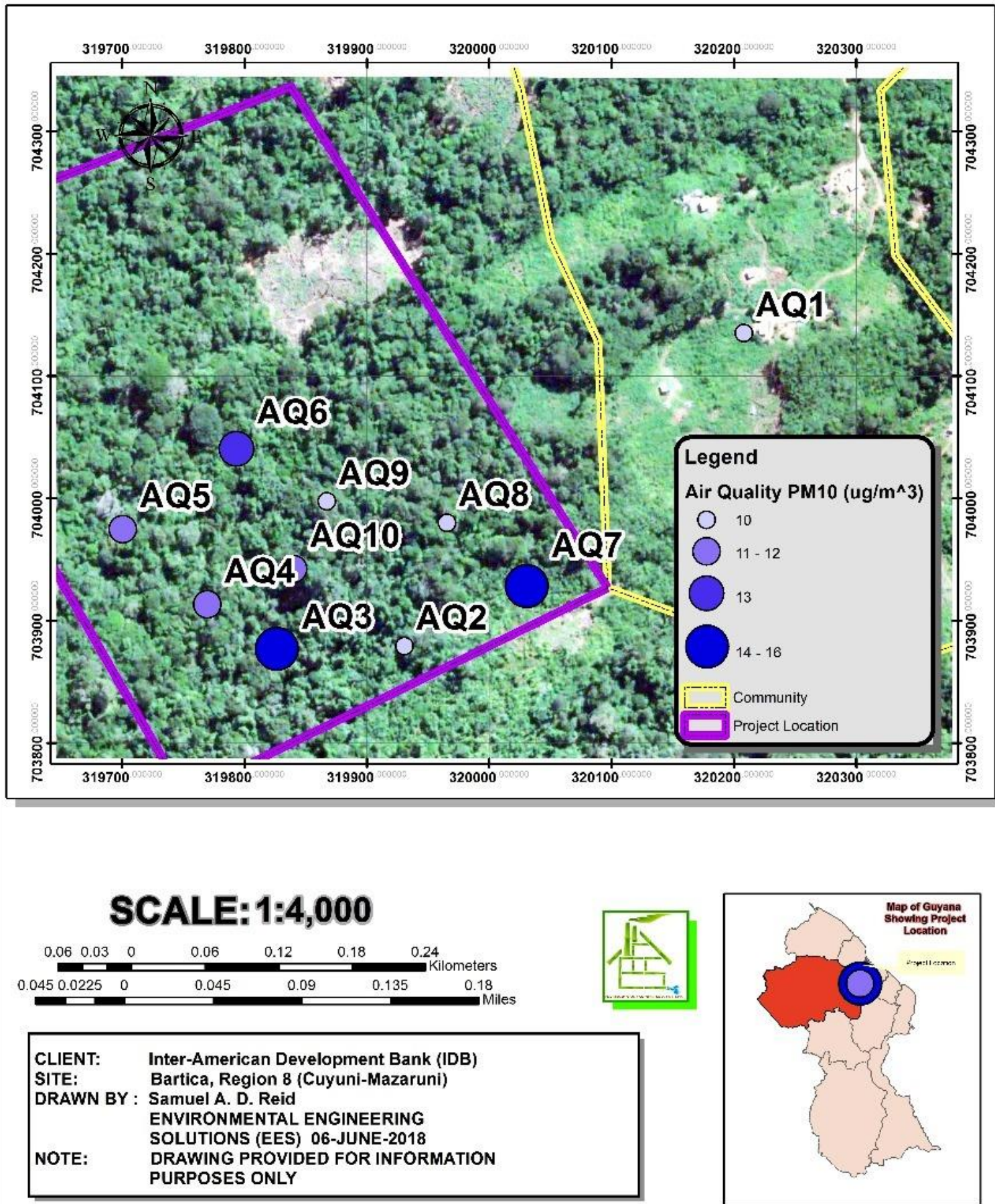


Figure 19: Air Quality Sample Locations within the Proposed Solar PV Farm Project in Bartica (Source: Reid, 2018)

3.6 Biological Resources (Biogeographic Provinces, Ecosystems, Habitats, Flora and Fauna)

Lethem

This project site is located in the township of Lethem, which lies in the savannah biogeographical province, specifically the Rupununi Savannah (NARI, 1995). Lethem is situated in close proximity to the Takutu River. The site which has been identified for the project can be considered as disturbed since much of its primary vegetation and natural habitats have been lost over many years of infrastructure development and expansion of commercial and industrial activities (see Figure 20 below).

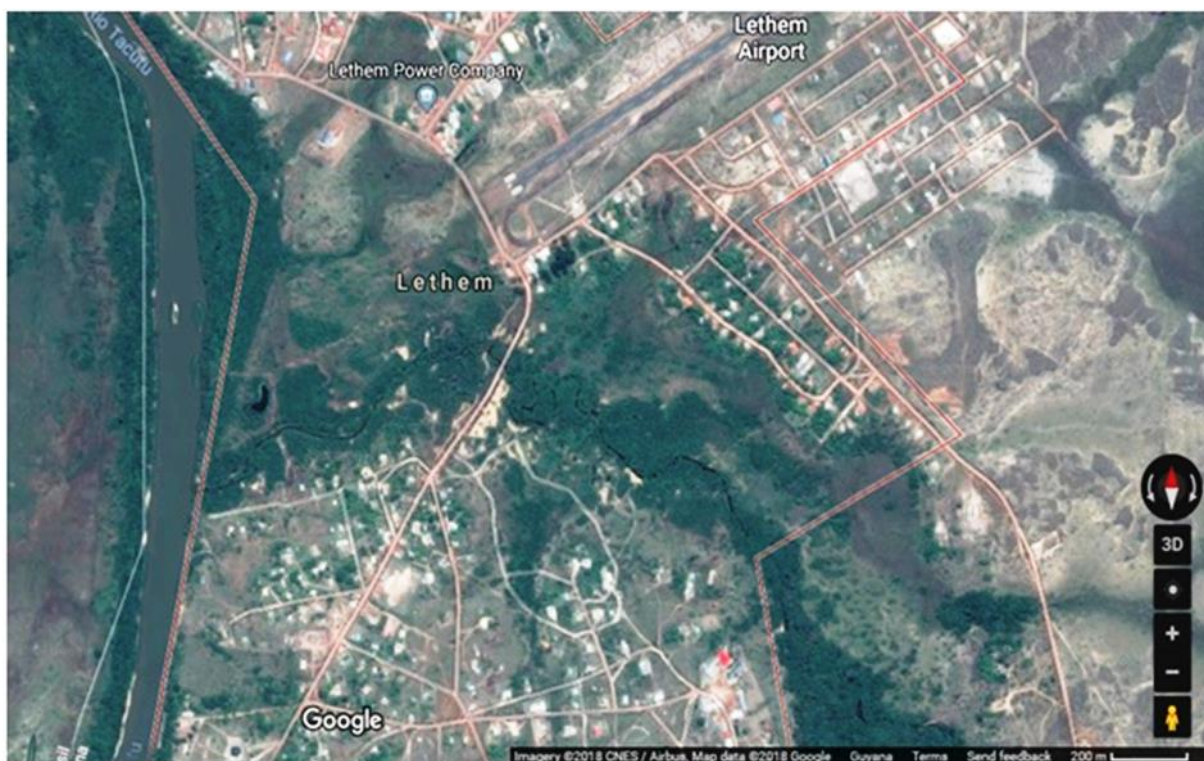


Figure 20: General overview of habitats associated with the project site. To the left is the Takutu River.

Several types of habitats are associated with this project site:

1. Open savannah. Savannahs are characterized by large, open areas that often reach relatively high temperatures. The area associated with the project site has sparse vegetation and consists primarily xerophytic and wet savannah grasses, shrubs and trees. It has experienced high degree of disturbance over the decades - nearby the project site there is the current power generation station, the municipal market, gas stations, airstrip; and existing network of roads and foot paths. Beyond this, land is used for housing, commercial and industrial development. Sandpaper trees (*Curatella americana*) are found in the general project area. This species is a woody fire-resistant treelet with xerophytic leaves are widespread in the Rupununi savannah and is able to tolerate the alternating dry and rainy (and flooding) periods, common in this region of Guyana. *Byrsonima verbascifolia*

trees, known locally as savannah toilet paper, are found in association with *Curatella americana* and is drought tolerant, withstanding the immense heat of the open savannahs. Wild cashew or bush cashew, *Anacardium occidentale*, occurs in the vicinity of the site. Grasses are also present at the site and these are adapted to survive extreme conditions brought on by droughts and flooding.

These species are found at higher densities beyond the project site in the northern and southern Rupununi Savannahs. In the southern Rupununi for instance, Fanshawe (1952) classified the fire - climax savannah vegetation as the *Curatella*-*Byrsonima* association, with characteristic species such as: *Curatella americana*, *Byrsonima crassifolia*, *Byrsonima coccolobifolia*, *Antonia ovata*, *Palicourea rigida*, *Tibouchina aspera* and *Amasonia campestris*. In the south Rupununi, groves of *C. americana* at the forest-savannah interface serve as nesting areas for the Red Siskin, a critically endangered species (Alonso, L. et. al. 2016). Several species of grasses are also identified, with the main ones belonging to the genera *Trachypogon*, *Paspalum*, *Axonopus* and *Andropogon* and the main sedges to the genera *Rhynchospora* and *Bulbostylis* (Jansen-Jacobs and ter Steege, 2000).

The Rupununi savannahs are also known as Guianan savannah and represents the largest such ecosystem in Guyana and the Guianas (Alonso, L. et al. 2016). Its soils are naturally very poor in nutrients, but its role in providing critical ecosystem services for local communities and ensuring the persistence of species, natural processes and healthy habitats are well known (De-Souza-et.al. 2012; Pos and Alonso 2016; Watkins, Oxford, and Bish 2010). Flooding in these savannahs during the annual rainy season results in the formation of vast areas of wetland areas which are vital to the long-term health and persistence of the ecosystem. Please see discussion below on 'Areas of Recognized Importance to Biodiversity' for additional information.

2. Riparian forest. These forests are found along the Takatu River which separates Lethem and Brazil. These forests can be inundated if there is extensive rainfall and flooding during the wet season. As a result riparian forests are mostly dominated by woody species that often disperse by water (Pos, E. et al. 2017). Trees such as *Macaranga acaciifolia* and *Senna latifolia* occur along the rivers and occur in other parts of Guyana as well (Pos, E. et al. 2017). Riparian vegetation serve as important refuges for wildlife seeking to escape the intense heat of the savannahs during the day, particularly in the dry season. The soils here are more fertile and hold a more reliable supply of water which supports biodiversity.

As it pertains to faunal diversity, the project site exhibits lower levels of biodiversity than areas beyond it. This is due to the high level of disturbance in the area, as highlighted above. House wren (*Troglodytes aedon*; Family: Troglodytidae); blue-grey tanager (*Thraupis episcopus*; Family: Thraupidae); great kiskadee (*Pitangus sulpharatus*; Family: Tyrannidae); lesser kiskadee (*Pitangus lictor*; Family: Tyrannidae); toucan (*Ramphastos sp.*; Family: Ramphastidae); lineated woodpecker (*Dryocopus lineatus*; Family: Picidae); orange-winged parrot (*Amazona amazonica*; Family: Psittacidae) and muscovy duck (*Cairina moschata*; Family: Anatidae) and vultures (Family: Cathartidae) are among the species of avifauna which can be observed in the Lethem area. Reptiles such as *Ameiva ameiva* (Family: Teiidae) and *Anolis sp.* (Family: Polychrotidae); and small mammal species such as bats are associated with the general area.

Mahdia

Mahdia lies within the forest biographical province described for Guyana and forests in these regions are classified as brown sands forest (NARI, 1995). This town, which is the administrative hub of Region 8, is known widely for its gold mining activities, occurring at medium and small/artisinal scales, and the impacts of which are evident on forests and freshwater resources. Figure 21 below shows the condition of vegetation in a section of Mahdia; the area to the right demonstrates forest loss due to gold mining.



Figure 21: Example of vegetation cover in central Mahdia.

The project site is expected to be located about 1.6 km from current power generation facilities/utilities and within access by current road networks, and thus can be considered disturbed. To the south of Mahdia, on higher elevations, the vegetation includes species such as Black Kakaralli (*Eschweilera subglandulosa*), Guava Skin Kakaralli (*Eschweilera alala*), Mora (*Mora excelsa*), Clump Walaba (*Dicymbe altsoni*), Bulletwood (*Manilkara bidentata*) and Crabwood (*Carapa guianensis*), Whitee (*Inga sp.*) and favourable density of Kufa (*Clusia spp.*), bactris palms, ferns, bromeliads, epiphytes, ginger lillies, and heliconias. On lower elevations, where mining has resulted in heavy disturbance, the land is dominated by Congo pump (*Cecropia sp.*), *Visima sp.*, short scrubby vegetation and grasses (Bayney, A. pers. comm. 2018).

Faunal diversity within Mahdia is expected to be lower compared to intact, forested areas beyond because of its level of disturbance. In such areas, the most common species are those considered generalists and those that are not disturbance sensitive. At Mahdia, the matrix of trees and other vegetation serve as habitat for various species, including: psittids such as orange-winged parrots (*Amazona amazonica*), yellow crowned amazon (*Amazona ochrocephala*) and red-shouldered macaw (*Diopsittaca nobilis*); toucans (*Ramphastos sp.*; Family: Ramphastidae); blue-grey tanagers (*Thraupis episcopus*; Family: Thraupidae); and woodpeckers (Family: Picidae). Widely distributed species of reptiles such as *Ameiva ameiva* (Family: Teiidae) and *Anolis sp.* (Family: Polychrotidae); and small mammal species such as common opossums and bats are associated with the general area. Habitat suitability increases beyond Mahdia, supporting higher levels of diversity (but being influenced by the extent of mining activities). Forty minutes south of central Mahdia, for example, 32 species of non-volant mammals were detected, based on physical evidence, including scat and tracks, and interviews. Red-rumped Agouti (*Dasyprocta leporina*), Paca/ Labba (*Agouti paca*), Red howler monkey (*Alouatta seniculus*) and Black Spider Monkey (*Ateles paniscus*; IUCN - Vulnerable) were the most common sightings; felids including Jaguar (*Panthera onca*; IUCN- Near threatened), Jaguarundi (*Herpailurus yagouaroundi*), Ocelot (*Leopardus pardalis*), Margay (*Leopardus wiedii*; IUCN - Near threatened) and Puma (*Puma concolor*); and other species such as Common Opossum (*Didelphis marsupialis*), Tyra (*Eira Barbara*) and deer (*Mazama sp*) were also detected (Bayney 2018; IUCN 2018).

Bartica

Bartica lies within the forest biographical province described for Guyana and forests in this region are classified as brown sands forest (NARI 1995). Its major freshwater ecosystems are the Cuyuni, Mazaruni and Essequibo rivers. Bartica, which is the administrative hub of Region 7, is long known for its linkage with the gold mining, which occurs at large, medium and small/artisanal scales. Within Region 7, the impacts are evident on forests and freshwater resources.

Figure 22 below shows the general condition of vegetation at the proposed project site; the area to the right demonstrates forest loss due to housing and commercial infrastructure expansion.

The proposed site is approximately 5 km by road and existing footpaths from central Bartica and approximately 2 km away from the proposed new location for Guyana Power and Light generation station. Short shrubs and dense forest are associated with the project site. The canopy in the dense forest was noted to be approximately 30 feet tall.



Figure 22: Vegetation cover of the project site.

Soils and forests are strongly associated. (Steege, Welch, and Zagt 2002), reports that in the region of the Bartica Triangle which consists of brown sands the most common species are: *Eschweilera sagotiana/subgrandulosa* (Family: Lecythidaceae), *Chlorocardium rodiei* (greenheart; Family: Lauraceae); *Mora gonggrijpii* (Family: Leguminosae), *Licania alba/majuscula* (Family: Chrysobalanaceae), *Swartzia leiocalycina* (Family : Fabaceae), *Mora excelsa* (Family: Leguminosae), *Pentaclethra macroloba* (Family : Fabaceae), *Eperua falcata* (Family : Fabaceae), *Pouteria guianensis* (Family: Sapotaceae) and *Inga spp* (Family : Fabaceae). In disturbed areas, congo pump (*Cecropia sp*) would be found.

Expanding infrastructure for housing and commercial activities influences faunal diversity within the general location. The scale and extent disturbance influences species composition and abundance. The forests within and surrounding the project site provide habitat for several species. Avifauna include: yellow crowned amazon (*Amazona ochrocephala*); orange-winged parrots (*Amazona amazonica*);

blue and yellow macaw (*Ara ararauna*); blue-headed parrot (*Pionites melanocephalus*); red-and-green macaw (*Ara chloropterus*); screaming piha (*Lipaugus vociferans*); toucans (*Ramphastos sp.*), blue-grey tanagers (*Thraupis episcopus*); great kiskadee (*Pitangus sulpharatus*); parakeets (Family: Psittacidae); woodpeckers (Family: Picidae); marudi (*Penelope marail*); and waracabra or grey-winged trumpeter (*Psophia crepitans*) (Edwards, L. pers. comm. 2018). Jaguars (*Panthera onca*; IUCN - Near threatened) and small cats (Family: Felidae) are likely associated with the general area as there have been local reports of felines preying on livestock (Edwards, L. pers. comm. 2018; IUCN Red List, 2018). Other mammalian fauna include agouti (*Dasyprocta leporina*) and labba (*Cuniculus paca*). Reptiles include: green iguana (*Iguana iguana*), and *Ameiva ameiva* (Family: Teiidae) and *Anolis sp.* (Edwards 2018).

3.6.1 Areas of Recognized Importance to Biodiversity

The towns of Lethem, Bartica, and Mahdia are not contained within any areas designated nationally as important biodiversity areas, including protected areas and forest reserves as identified in the National Land Use Plan 2013 (see Figure 23 below). As per the National Protected Areas Act, 2011, the Kaieteur National Park, Iwokrama International Forest Reserve, Shell Beach, Kanuku Mountains and Konashen Community Protected Area are legally designated protected areas in Guyana. The latter three have been declared within the past decade, in an effort to ensure greater protection for biodiversity, ecosystem services and livelihoods of local people who depend on resources of these areas to support subsistence activities. Konashen is the most recent addition, being designated under the PA Act in 2017. Forest Reserves such as Mabura Hill and Moraballi, established under forestry legislation, are also conserved for their biodiversity. For example, the National Forest Policy Statement 2011 relates that areas such as the Moraballi Forest Reserve have been excised from the forest estate to be protected in perpetuity through the careful monitoring and management, and with the enablement of special legislation. The Moraballi Forest Reserve is a major seed bank for one of Guyana's most valuable timber species, Greenheart (*Chlorocardium rodiei*). Over the years biodiversity priority setting exercises have identified several additional areas have been considered as areas of biological interest. The National Biodiversity Strategy and Action Plan I identifies: Mount Roraima and upper Cuyuni River Area, Essequibo Islands, South Eastern Forests, Karanambu and Orinduik. The National Strategy for the Establishment of a System of Protected Areas (2002) identifies other potential areas for conservation including: Bartica Triangle, Shiriri Mountains, Amakokopai, Barabina, some areas of the Canje River, Pakaraima Mountains, and some parts of the Coastal Zone. However it notes that further studies are needed on these areas before further determination can be made (EPA 2002).

The northern and southern Rupununi savannahs are considered to be biologically important areas, although not formally recognized as part of the Guyana's system of protected areas. Watkins et. al. (2010) refers to the Rupununi as 'one of the last great wilderness areas in the world'. This description is apt considering that its vertebrate diversity surpasses that of other key biodiversity areas and wetlands around the world such as the Pantanal (Brazil) and Okavango (Botswana) (Watkins et. al. 2010). The savannahs of the Rupununi are reported to be the largest remaining representative of the

Guianan Savannah ecosystem in Guyana and the Guianas (Alonso et. al. 2016). Research conducted at Kusad Mountains and Parabara concludes that the southern savannahs are a critical contributor to the livelihoods and culture of indigenous people and also support high levels of species and habitat diversity, which make these savannahs areas of important conservation value (Alonso et. al. 2016). The north Rupununi savannahs are also a critical area for biodiversity and livelihoods (EPA 2016; Watkins, Oxford, and Bish 2010) and communities of the north Rupununi are advocating for its protection as a RAMSAR site (NRDDB 2018). The Rupununi savannah floods during the rainy season creating vast areas of wetlands which are vital to the persistence of the region's diverse habitats and species. Extensive flooding during the rainy season creates a complex transboundary hydrological connection is created with the Amazon river system facilitating movement of species (Pos and Alonso 2016).

Guyana is not a signatory to the RAMSAR convention; hence other options for protection of also have to be considered if this area is to be formally recognised under national frameworks.

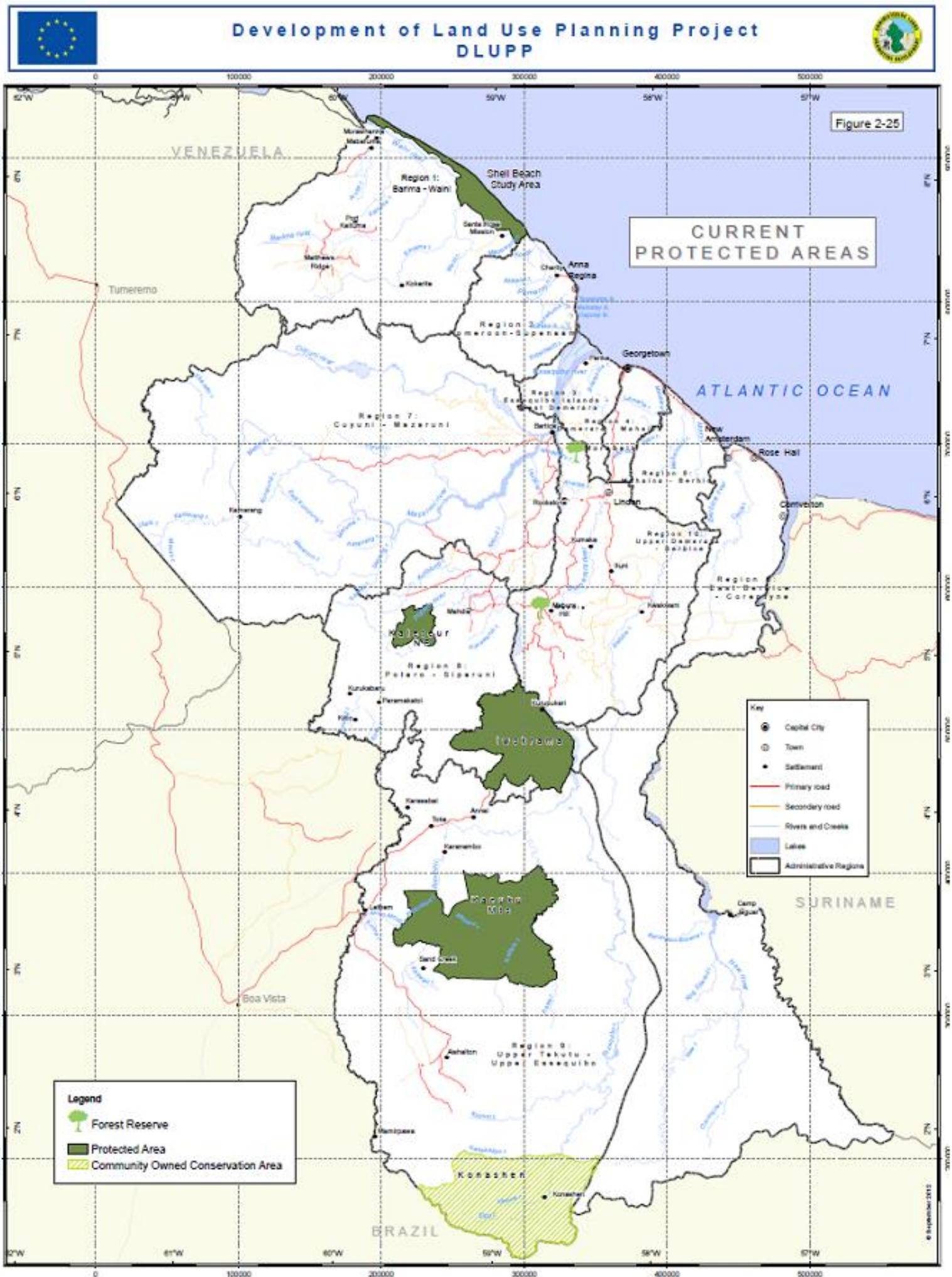


Figure 23: Conservation areas in relation to project sites - Lethem, Bartica and Mahdia (Source: GL&SC 2013).

There are no officially designated areas in Guyana identified as Important Bird Areas (Birdlife-International. 2018). However, there are ten proposed sites: Shell Beach, Karaw/Aruka (Barima Waini); Ireng River, North Rupununi - Karanambu Ranch, Mapari - Kanuku Mountain, South Central Rupununi, Karasabai (Upper Takutu - Upper Essequibo); Iwokrama (Potaro-Siparuni); Northeast Coastline (Mahaica- Berbice); and Pacaraima Mountains (Cuyuni - Mazaruni) (Narine et al. 2009). The project sites do not lie within the proposed sites.

3.7 Climate

Guyana has a tropical climate with two wet and two dry seasons and is characterised by high but variable rainfall, high humidity and a small temperature range (GoG 2016). Annual rainfall varies within the country from about 2,200mm on the coast to 2,800mm inland, although it rises to over 4,000mm in the Upper Mazaruni/Pakaraima Mountains area (Ministry-of-Agriculture 2013). Mahdia is within the climatic zone that is classified as extremely wet. This zone experiences annual precipitation of between 3,200 - 4,000 mm (GoG 2013). Bartica on the other hand is considered wet, lying in the climatic zone which has 2,200 - 2,800 mm of rainfall annually (GoG 2013). Mean air temperature ranges between 25 to 27.5°C throughout the year at these two sites (Encyclopaedia-Britannica 2018).

In contrast to central and north Guyana, with two dry and two wet seasons, the Rupununi area experiences only one wet and one dry season (Elliot et. al., undated). The annual rainfall in the Rupununi Savannah is between 1500-2000 mm annually and is considered moderately moist (Jansen - Jacobs et. al 2000; GOG 2013). Between 70-80 % falls during the wet season from May-August (Elliot et. al., undated; Jansen - Jacobs et. al 2000). The savannah areas also have the highest amount of sunshine hours of the country. The temperature can rise to an average of 33.6°C and be as low as 22.5°C. Close to Takutu River, the temperature can reach even more than 36°C, while in the Kanuku Mountains, the maximum temperature does not pass 28°C (Elliot, Paredes, and Montero). Savannahs tend to experience higher temperatures.

Figure 24 below shows a map of the climatic zones in relation to the three areas.

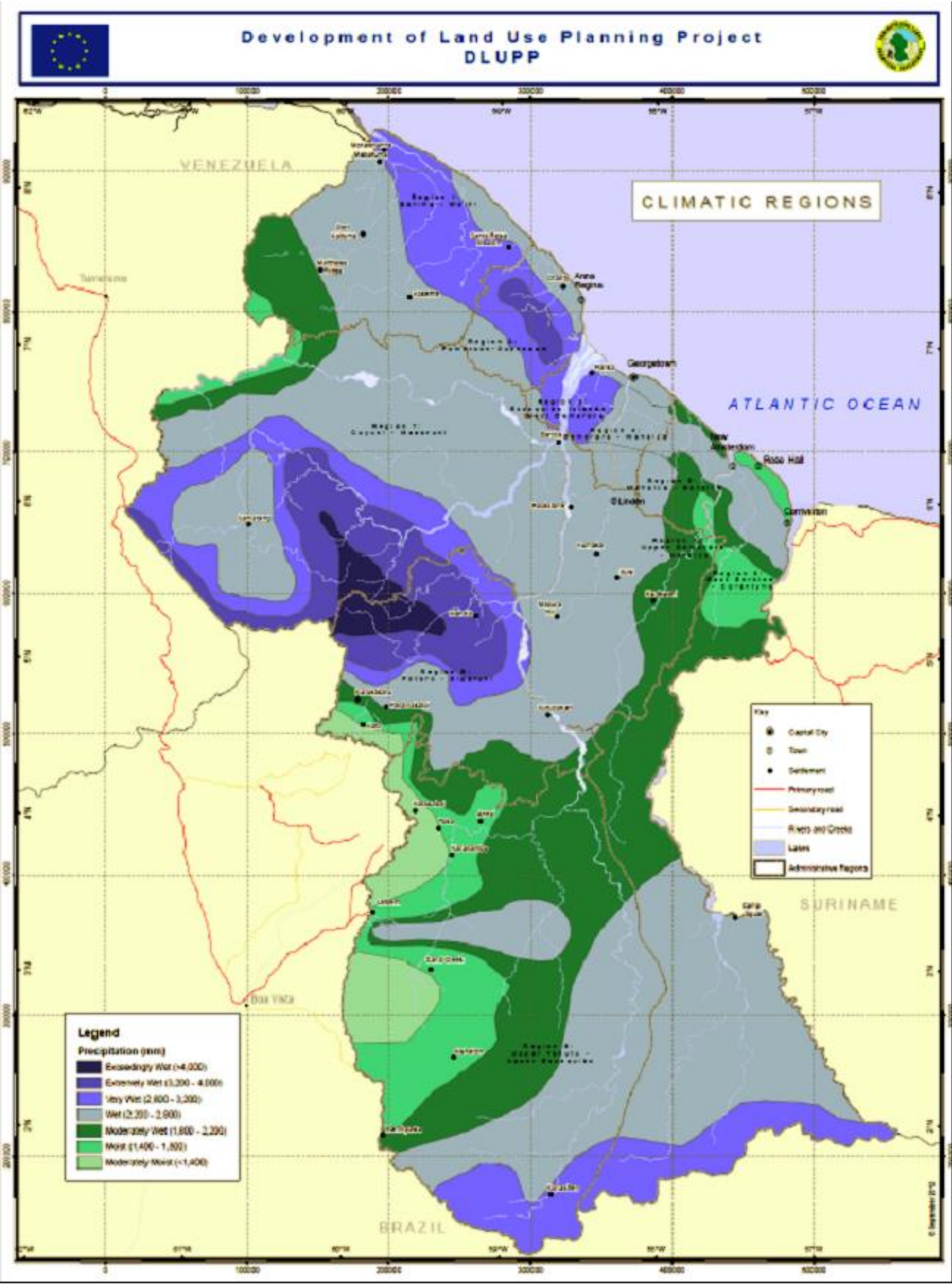


Figure 24: Climatic regions of Guyana (inc sites: Lethem, Mahdia and Bartica; Source: GoG 2013)

3.8 Natural Disasters and Hazards

3.8.1 Flooding and Droughts

The National Integrated Disaster Risk Management Plan and Implementation Strategy for Guyana reports that the hazards Guyana is most prone to are floods and droughts. This is linked to changing climates. Over the last half-century, Guyana has experienced changes and variability in its climate system. Since the 1960s, mean annual temperatures have increased by more than 1°C and frequently occurring extreme rainfall events have triggered intense periods of flooding and drought (Kaieteur News 2016). The Rupununi has experienced several major drought events over the past two decades - for example in 1997, 1998, 2010, 2014 and 2015 - which has resulted in forest and savannah fires, collapse of crop production in indigenous communities, food insecurity and severely limited people's access to potable water for household use (Chabrol 2014; Guyana-Chronicle 2015a; Stabroek-News 2010; Wahlström and Weber 1998). The impacts of these drought events have also been felt in Lethem, but not as profoundly as in the savannah communities. Flooding has also affected Lethem. To some extent this is represented in total annual rainfall at Lethem for the ten-year period, 2004-2013, with 2010 and 2011 characterized by exceptionally high rainfall with the total precipitation reaching levels similar to those usually experienced on Coastal regions of Guyana where a bimodal rainfall pattern is the norm (CI-Guyana and IDB 2015). The long-term average annual total of approximately 1500 mm was exceeded in both years resulting in unusually widespread flooding and destruction of crops. The situation was further exacerbated in 2011 when water from the Rio Branco in neighboring Brazil overtopped the river banks inundating the plains of both countries (CDEMA 2011; CI-Guyana and IDB 2015). Again, in 2017 the region was flooded due to heavy rainfall and trans-boundary flooding associated with the increase in water levels of Branco River (Rio Branco) in Brazil's Roraima State (Stabroek-News 2017). It resulted in the main access trail to Lethem becoming flooded which cut-off access to some areas, bridges being negatively affected and shelters being set up to house flood affected residents (Stabroek News, 2017). In Mahdia, flooding has limited access to the town, led to displacement of residents, impacted the local economy and resulted in loss of integrity of infrastructure. In 2017, floods were reported to have been caused by persistent rainfall over a two week period, which resulted in several waterways surpassing their optimum levels (Solomon 2017). Other recent events have occurred in 2010, 2011 and 2016 (Guyana-Times-International 2012). Significant flooding have also occurred in Bartica. In 2013 residents were affected by 'record' flooding which resulted in impacts to local businesses, health, residential homes. The inadequacy of drainage infrastructure was cited as a contributory factor (Stabroek-News 2013). Flooding has also been reported for the years 2017, 2016 and 2012. Guyana's Second National Communication to the UNFCCC (2016) projects climate change induced changes in the precipitation patterns leading to severe droughts and intense rainfall. During field visit observation where taken related to flood risk. For Lethem there is not flood risk based on elevation of the terrain with an average of 99 m above the sea level. In Bartica the

conditions of the proposed site shows no risk of flooding and in Mahdia the proposed site shows indication of flooding since the nature of the place shows water stagnated.

3.8.2 Seismic Activity

Seismicity in the northern part of the South America continent is largely controlled by plate boundary events occurring along the southern rim of the Caribbean Basin (GSEC, 2014). Major earthquakes frequently occur along the plate boundary between the South American and Caribbean Plates and earthquake activity is concentrated in a circular pattern around the perimeter of the Caribbean tectonic plate (GSEC 2014).

Earthquakes are identified as a risk for Guyana - for example within the National Integrated Disaster Risk Management Plan and Implementation Strategy (2013), National Multi-Hazard Disaster Preparedness and Response Plan (2013) and Disaster Risk Management Plan for the Agriculture Sector 2013 - 2018. However the risk is low. While official information regarding their occurrence is limited there are several reports of tremors following earthquakes in the Caribbean (Guyana-Chronicle 2015b; Stabroek-News 2007). Tremors have been reported as far away as Bartica and Mahdia - this was following a 6.4 magnitude earthquake in Trinidad and Tobago (NationNews 2013).

4 SOCIO-ECONOMIC FACTORS

4.1 Social Environment Survey

In order to offer concise information on socio-economic factors and characterisation, a social environment survey was designed and carried out within the three sites identified in the project area. A total of 125 households were targeted during the survey (Bartica – 40, Mahdia - 40 and Lethem - 45) and data were collected on various parameters including, among other things, cost of living indicators, health and education indicators, health and sanitation infrastructure (water, sewage, and solid waste), energy, cultural sites, community well-being, and gender and social issues. Analyses of the data gathered during the survey, in accordance with the three sites and categories mentioned above, are summarized and presented below.

4.2 Bartica

4.2.1 Level of Urbanization

Bartica, which was recently declared a town, is situated 80 km inland from the Atlantic Ocean and is bounded by the Mazaruni River to the west and the Essequibo River to the north and east in Administrative Region 7 (Cuyuni/Mazaruni). The commercial centre is approximately 176km² and has a population of 7,423 persons (Bureau-of-Statistics 2002). It is governed by a newly elected mayor and city council which is the legislative branch of the government.

4.2.2 Demographics and Household Composition

Of the 40 households that were surveyed in the Bartica area, 18% were Africans and 15% were East Indians which represent the two largest ethnic groups in the country (Figure 25). Half of the surveyed households comprised of persons with mixed ethnic groupings while 17% comprised of Amerindians. Amerindians are Guyana's first peoples, and currently make up approximately 9% of the country's population. While there are special laws in place for the protection of indigenous peoples in Guyana and internationally, the individuals within the project area currently reside in the Bartica township, and not within an Amerindian community, and as such indigenous land ownership rights are not applicable under this project.

As it relates to household composition, 42% of the surveyed households comprised of four persons, 27% comprised of three persons, and 13% comprised of six or more persons. Gender parity was a notable factor in the survey with 50% of the respondents being males and 50% being females. Thirty-five percent of the respondents were self-employed and a further 30% were employed by either government or private entities. Thirteen percent were students while 15% were housekeepers, all of which were females. Thirty-five percent of the respondents who were employed (including self-employed) were males as compared to 30% who were females (Figure 26).

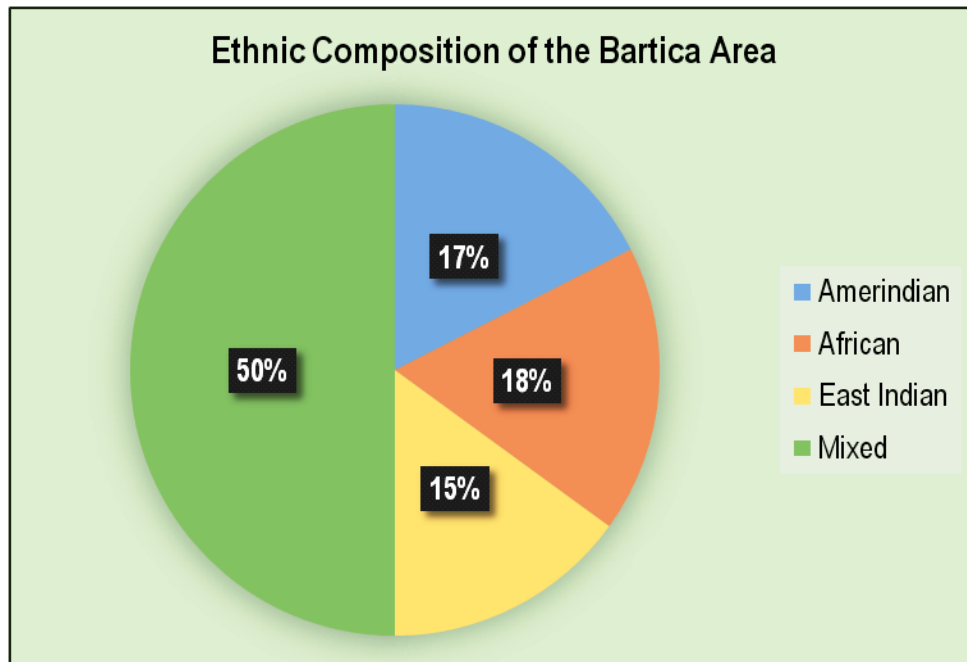


Figure 25: Ethnic Composition of the Surveyed Households in Bartica

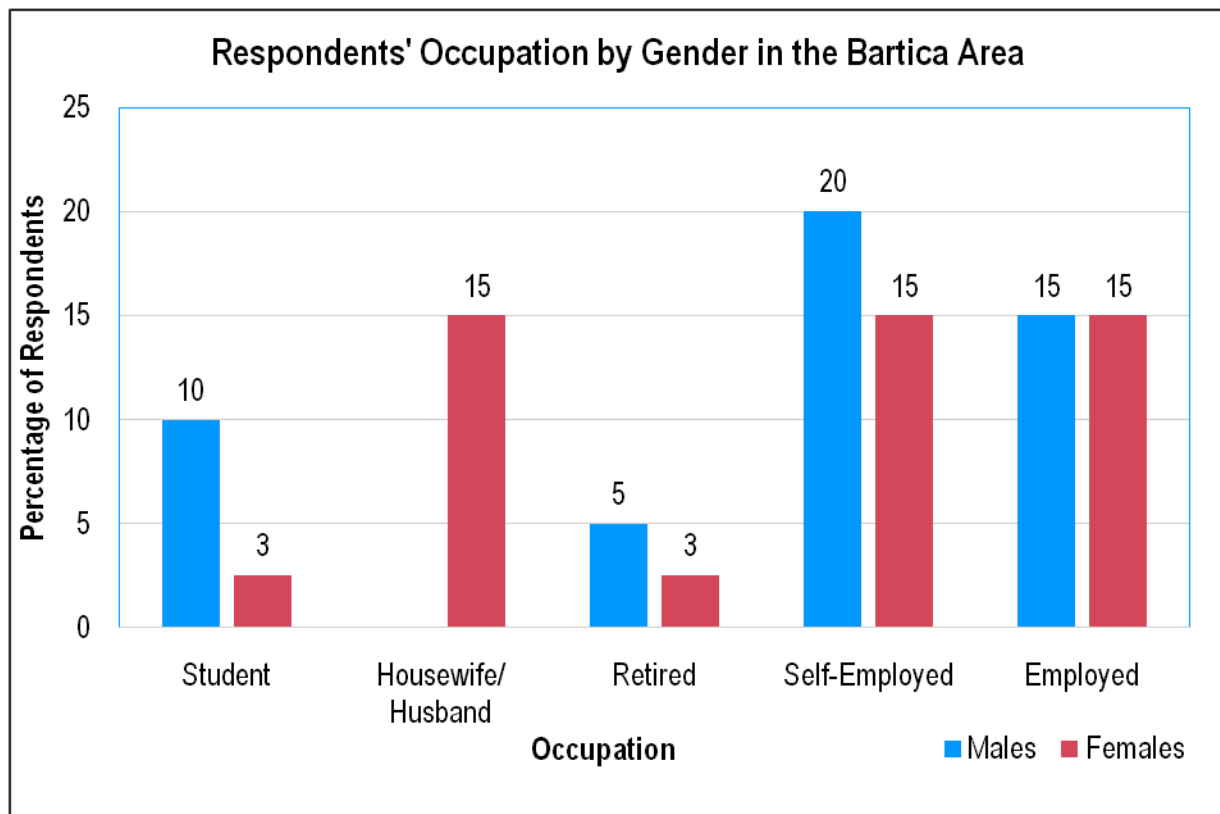


Figure 26: Comparison of Respondents' Occupation by Gender in the Bartica Area

4.2.3 Cost of Living

A livelihood census was carried out to determine the productive systems, work, level of income, and overall living standards of the residents in the project area. Of the 40 households that were surveyed in the Bartica area, it was found that 28% only had one person who was employed. Thirty-five percent had two persons employed, while a further 23% had three persons employed. Only 3% of the surveyed households had six or more persons in employment (Figure 27).

As it relates to the income generated by each household, 10% received an income of more than \$175,000. Currently, the national minimum wage in Guyana is \$55,000 while private sector minimum wage stands at \$44,200 (Newsroom 2017; Guyana-Chronicle 2016). The income tax threshold is currently \$60,000 per month. Based on the survey, only 3% of the households were working for a below monthly income of \$54,000 (Figure 28) which is considered nationally to be within the low-income bracket (GRA 2017).

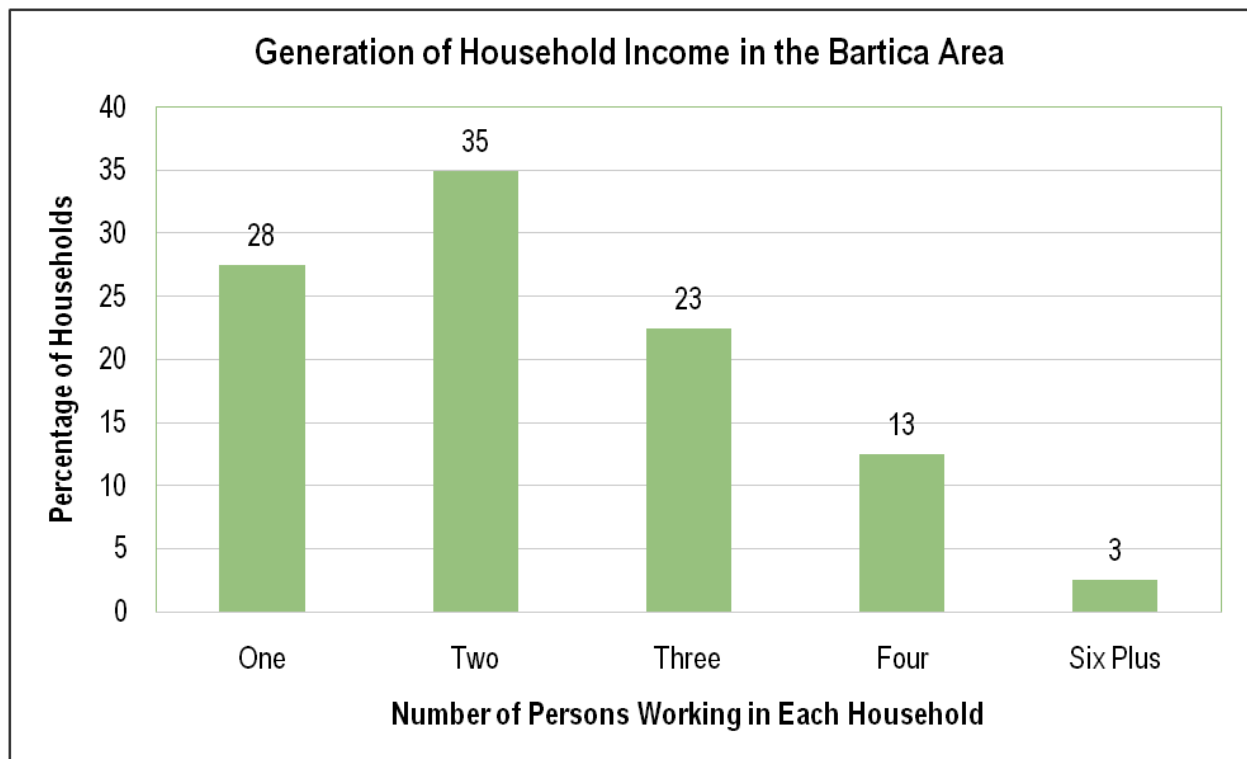


Figure 27: Number of Persons Generating Household Income in the Bartica Area

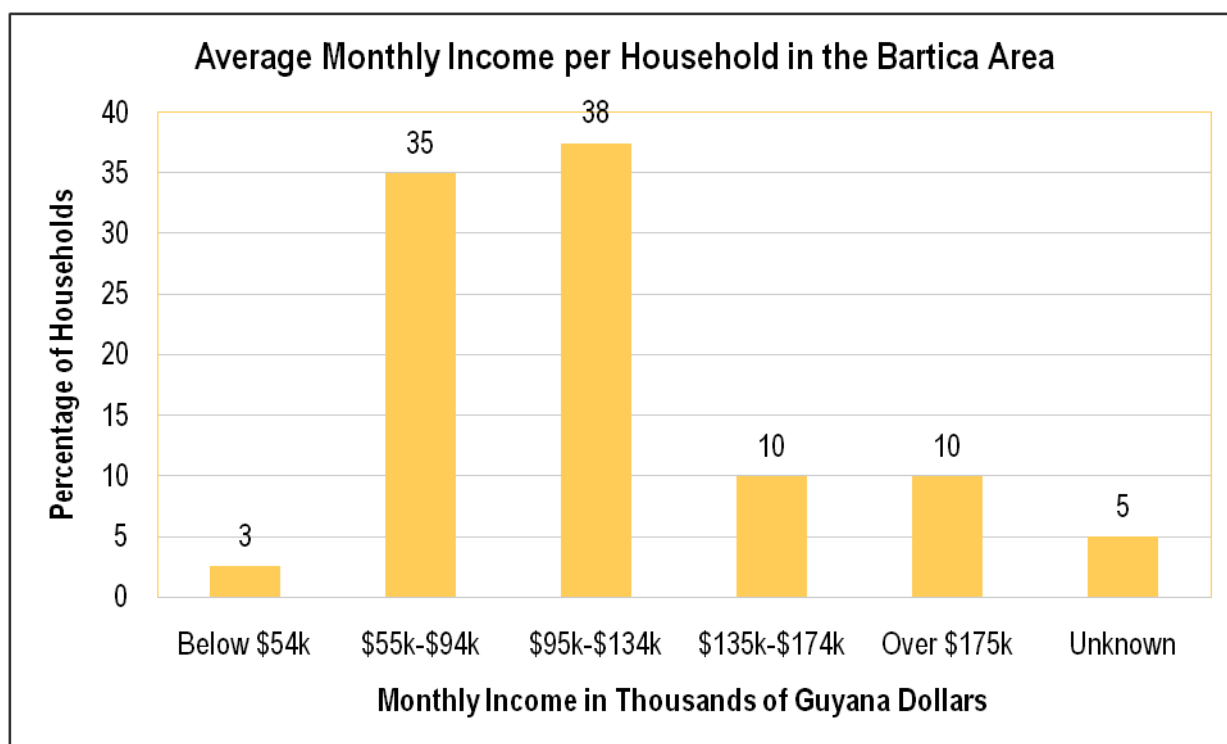


Figure 28: Average Monthly Income by Household in the Bartica Area

4.2.4 Health and Education

Good health and well-being has been identified as Goal 3 of the 17 sustainable development goals set by the United Nations and its member states including Guyana (UN 2018). Ensuring healthy lives and promoting the well-being for all at all ages is considered to be essential for achieving sustainable development. Further, the IDB considers the promotion of better health conditions to be an important component of its vision and operations. Within the Bartica area, 25% of the households surveyed cited that they had health concerns within their respective families. Most noted among these health concerns were injuries, respiratory illnesses, diabetes and hypertension.

The United Nations has also identified education as the fourth of its sustainable development goals. Obtaining a quality education is considered to be the foundation to improving people's lives and sustainable development. Further, girls' education and advancing skills and job opportunities for young girls and young women are considered important pillars of societal development. Of the households surveyed, it was noted that the same percentage of males and females completed school at the Primary, Secondary and Tertiary levels. However, more females (8%) completed Sixth Form and Vocation while more males (10%) completed Technical studies. A further 3% of the female respondents surveyed did not have any formal education (Figure 29).

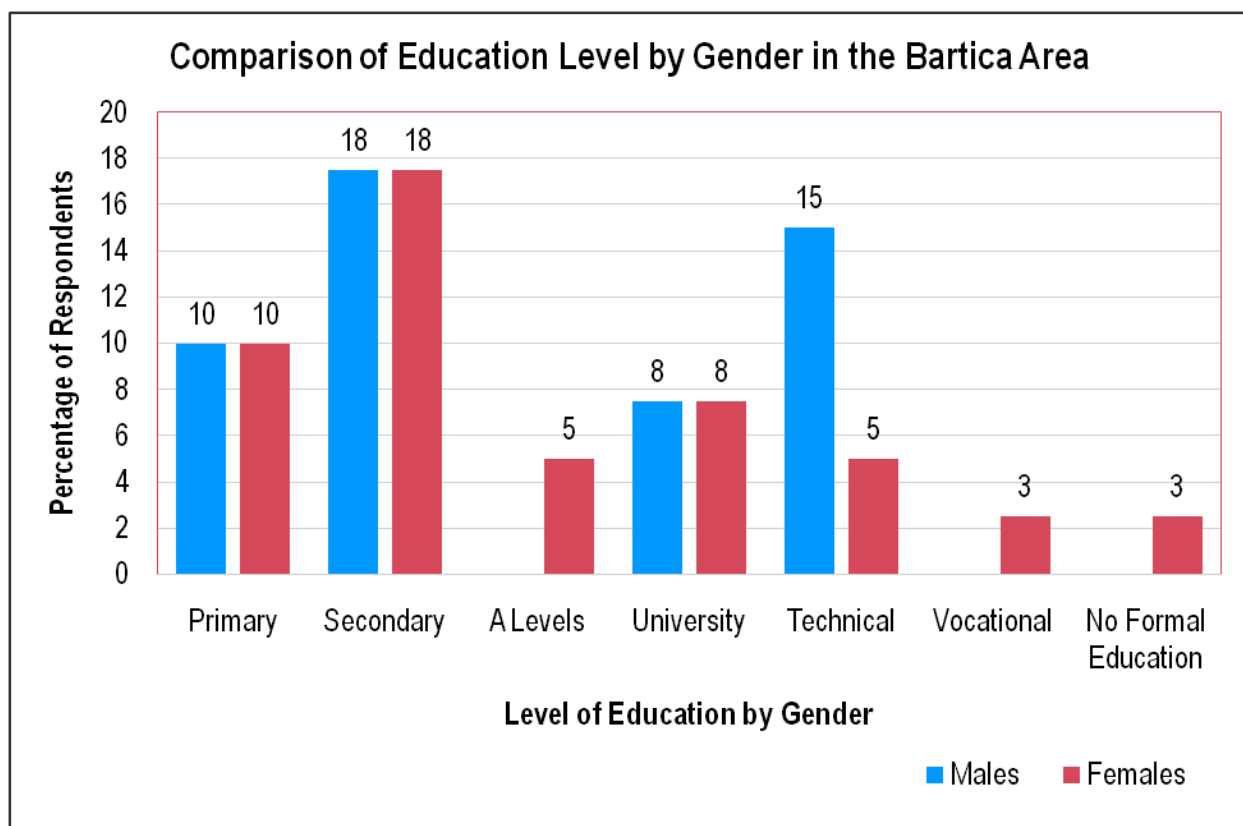


Figure 29: Comparison of Level of Education by Gender in Surveyed Households in the Bartica Area

4.2.5 Health and Sanitation Infrastructure

Access to safe water and sanitation is considered to be essential to human health, environmental sustainability and economic development. Goal 6 of the United Nations sustainable development goals speak to ensuring the availability and sustainable management of water and sanitation. Within the Bartica area, all of the surveyed households currently have access to water from the Guyana Water Incorporated (GWI). Of these households, 85% consider the water provision services to be good or fair, while 15% percent classified the service to be poor.

Eighty-three percent of the surveyed households consume mostly bottled water. A further 33% also utilize rain water, while a mere 3% use the tap water provided by the GWI for drinking purposes (Figure 30).

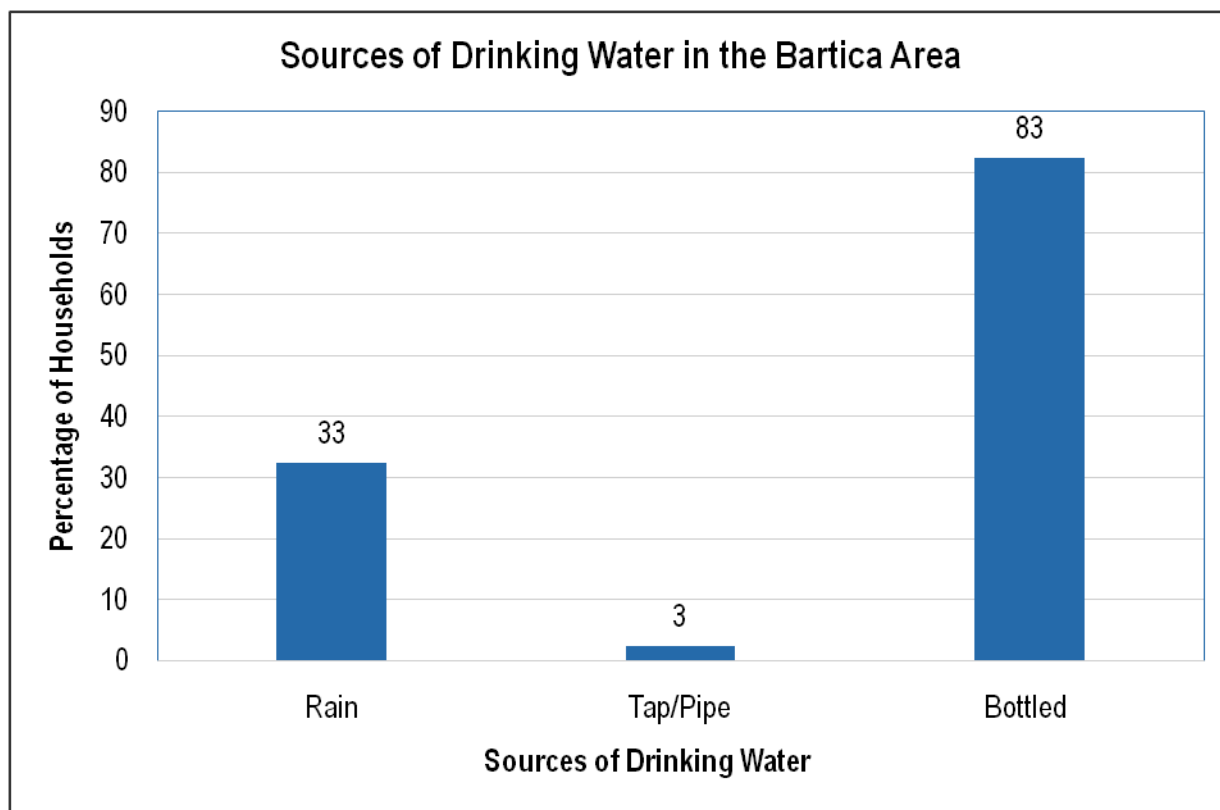


Figure 30: Sources of Drinking Water in Surveyed Households in the Bartica Area

In terms of sanitation, 98% of the surveyed households have septic tank systems for the disposal of sewage. The majority of households within the Bartica project area (90%) utilize the city council and private collection services for the disposal of solid wastes. However, 10% of the households surveyed still engage in burning of their solid wastes. Of the households that utilize the collection service, over two-thirds of the respondents (71%) have their solid wastes collected on a weekly basis (Figure 31).

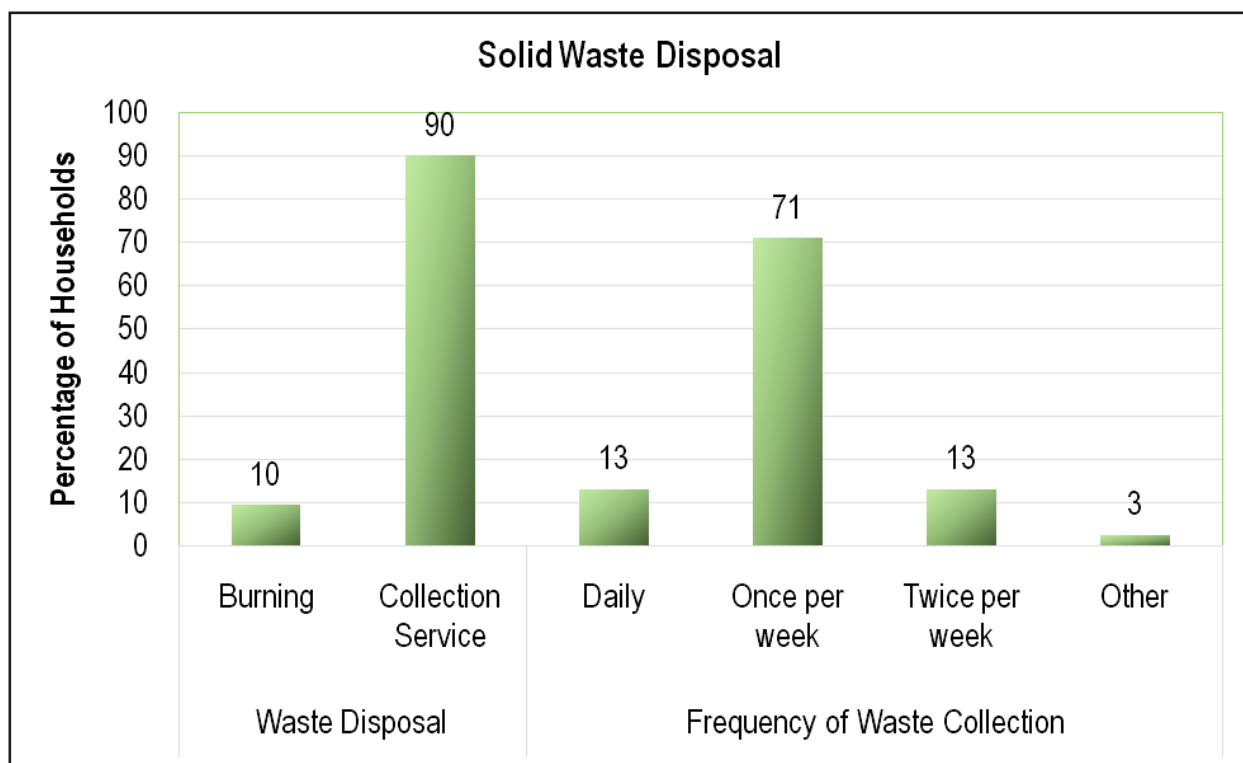


Figure 31: Solid Waste Disposal in Surveyed Households in the Bartica Area

The major public health concerns identified by the respondents during the survey include the dumping of solid wastes, flooding, the prevalence of mosquitoes, and malaria. Of these, the households were mostly concerned about the prevalence of mosquitoes (68%) followed by the dumping of solid wastes which accounted for 26% of the concerns and flooding which accounted for 4%.

The Mayor and City Council is responsible for drainage and irrigation works throughout Bartica and maintaining government reserves in front of private properties. Within the project area, 60% of the respondents were aware that cleaning works were conducted at the front portion of their property while 23% indicated that no works were completed. The remaining 18% of respondents were unaware of any cleaning being done.

4.2.6 Energy

Goal 7 of the sustainable development goals speaks to the supply of clean and affordable energy. Energy is considered to be crucial for achieving almost all of the Sustainable Development Goals. This includes its role in the eradication of poverty through improvements in health, education, water supply and industrialization, and in climate change adaptation. Within the Bartica area, all of the surveyed households had access to power provided by the GPL and utilised the service for lighting purposes. Additionally, 5% of the households also utilised

kerosene lamps/candles. Of all the households surveyed, 82% considered the quality of the service to be either good or fair, while 18% considered it to be poor.

For cooking purposes, the household use of liquefied petroleum gas (LPG) has been identified as one of several pathways to meet the goal of universal access to clean cooking and heating. In the Bartica area, it was found that 98% of the respondents mostly utilised LPG for cooking, while 18% and 8% also utilised kerosene and electricity, respectively (Figure 32).

In terms of perception of renewable energy, 62% of the respondents within the Bartica project area indicated that they are aware of the term while 53% have never heard of renewable energy. Of the respondents that heard of renewable energy, 7% reported having knowledge of it, 63% indicated that they had some knowledge of it, while 30% did not have any knowledge of renewable energy. Two percent of the respondents believed that renewable energy uses petroleum to generate power, while 22% were unsure of petroleum use in power generation. Further, 2% of the respondents perceived renewable energy to be harmful to the environment as compared to 75% who believed that it did not have any adverse environmental effects. Eighty percent of the respondents expressed that solar energy was a form of renewable energy. As it relates to the need for renewable energy in Guyana, 22% of the respondents strongly agreed with this statement, while a further 37% indicated their agreement. Three percent indicated that renewable energy was not necessary for Guyana. Sixty percent of the respondents were in favour of focusing on renewable energy sources while 37% were unsure of whether Guyana should pursue the development of renewable energy.

As it relates to investment in renewable energy, 59% of the respondents believed that it will bring benefits to consumers, while 3% felt that it will not bring any benefits. Sixty-seven percent of the respondents were willing to support renewable energy development in Guyana, while 3% were strongly against renewable energy development. In terms of increasing knowledge on renewable energy, 80% of the respondents were willing to learn more about the subject, while 2% of the respondents expressed that they did not have any interest in learning more about renewable energy.

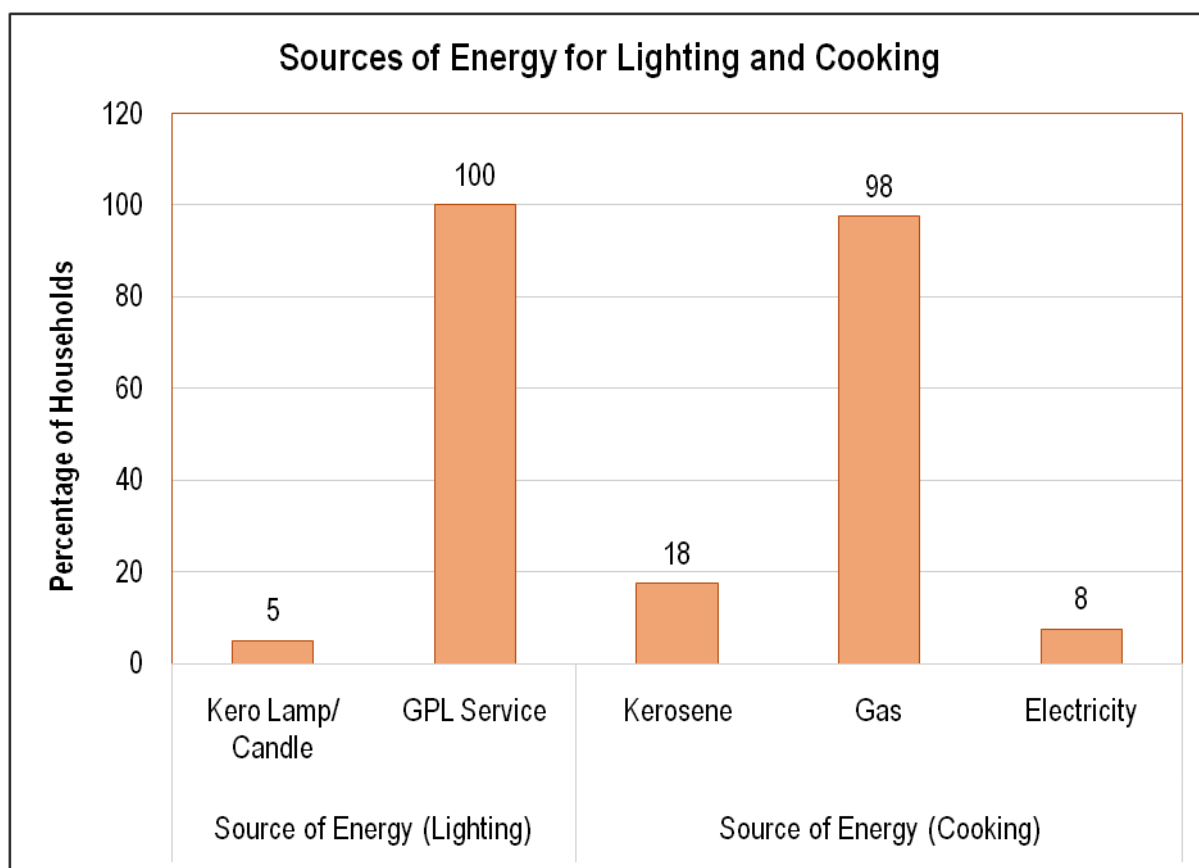


Figure 32: Sources of Energy for Lighting and Cooking within the Bartica Area

4.2.7 Community Well-being

At the community level, persons identified lack of employment (98%), poverty (2%), and use of marijuana (2%) as the most prevalent social issues. No discrimination has been cited by the respondents in the Bartica area. Issues of domestic violence were noted to occur in the area with 5% of the respondents highlighting it as a concern. There is also some level of sexual abuse and no perceived occurrence of gender inequality in the area as noted by 5% and all of the respondents, respectively (Figure 33).

In terms of issues affecting children, neglect is considered to be the most common form of child abuse and may lead to other physical, emotional and physiological problems if allowed to persist. Within the Bartica area, there are no perceived incidences of physical abuse, sexual abuse or neglect occurring in the area (National Society for the Prevention of Cruelty to Children 2017).

As it relates to the level of social cohesion, 60% of the respondents believed that the Bartica area had good cohesion, while 3% ranked it as average. Another 35% thought that social cohesion was excellent while a mere 3% rated it as being poor. More than half of the respondents (53%) believed that there were no opportunities for local employment while a further 15% were unsure or unaware of any employment opportunities. For the respondents (33%) that thought that there

were job opportunities, these were identified as mechanics, welders, boat hands, porters, truck drivers, grocers, shopkeepers, caterers, seamstresses, cleaners, miners including pork knockers, and public servants.

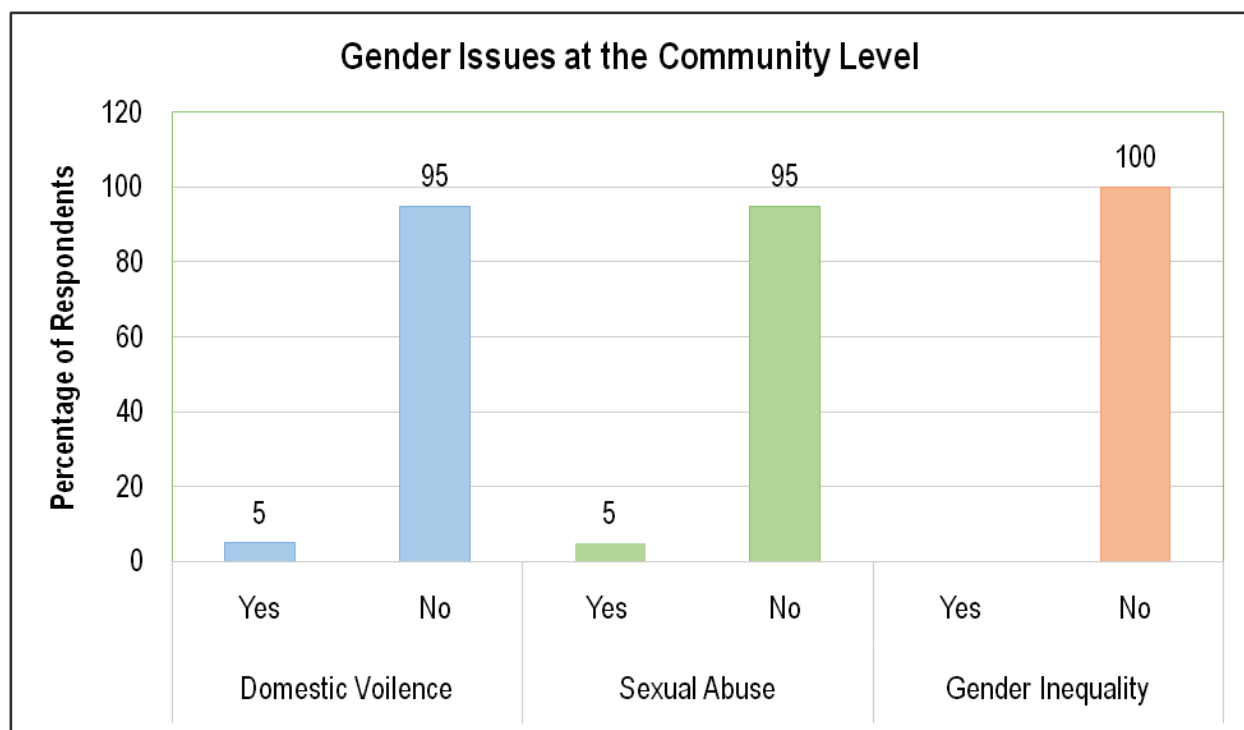


Figure 33: Gender Issues – Domestic Violence, Sexual Abuse and Equality - at the Bartica Community Level

4.2.8 Cultural Sites

As it relates to the cultural features of the area, the residents primarily belonged to one of the three major religious groups in the country – Hinduism, Christianity and Islam – with Christianity accounting for 72% of the households surveyed in the Bartica area (Figure 34). Several churches, temples and mosques were also noted within the area.

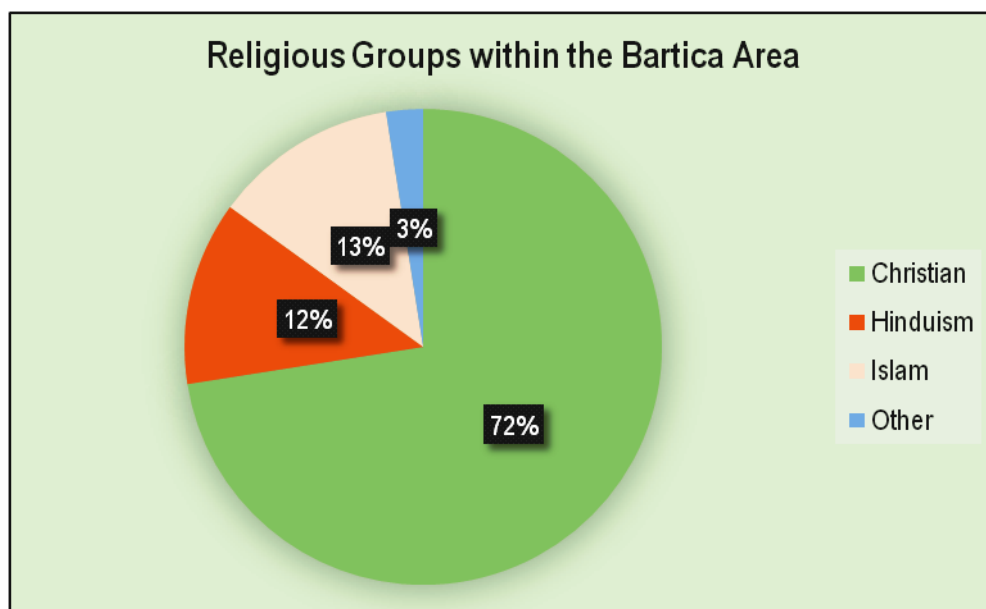


Figure 34: Religious Groups within the Bartica Area

4.2.9 Physical Assets and Social Services

There are a number of physical and economical assets, and social services within the area that are important for the well-being of the community. Currently, there are both government and private schools; government and private health clinics/outposts/hospitals; private financial institutions; markets; privately-owned shops and stores; places of worship; public spaces; one police station/outpost; one fire service station; and one government post office in the Bartica area. Additionally, several other developmental initiatives such as paved roads and telephone services have been completed in the area.

4.3 Mahdia

4.3.1 Level of Urbanization

Mahdia is a small community situated near the centre of the country in Administrative Region 8 (Potaro/Siparuni). It has a population of 1,617 people (Bureau of Statistics, 2002) who are involved primarily in commercial gold and diamond mining. Mahdia has recently been identified by the Government of Guyana to be declared a town, as part of its initiative to have one township in every region of the country.

4.3.2 Demographics and Household Composition

Of the 40 households that were surveyed in the Mahdia area, 25% were Africans and 23% were East Indians, the two largest ethnic groups in the country (Figure 35). Thirty-five percent of the surveyed households comprised of persons with mixed ethnic groupings while 17% comprised of

Amerindians. While there are special laws in place for the protection of indigenous peoples in Guyana and internationally, the individuals within the project area that currently reside in the Mahdia area are not a community, and as such indigenous land ownership rights are not applicable under this project.

As it relates to household composition, 28% of the households comprised of four persons, 25% percent comprised of three persons, and 10% comprised of six or more persons. Five percent of the households surveyed were only inhabited by one person.

In terms of the respondents in the survey, 45% were males as compared to 55% who were females. Thirty-eight percent of the respondents were self-employed and a further 38% were employed by either government or private entities. Six percent were students while 10% were housekeepers, all of which were female. While 76% of respondents from both gender was in employment, 5% more females were unemployed than males (Figure 36).

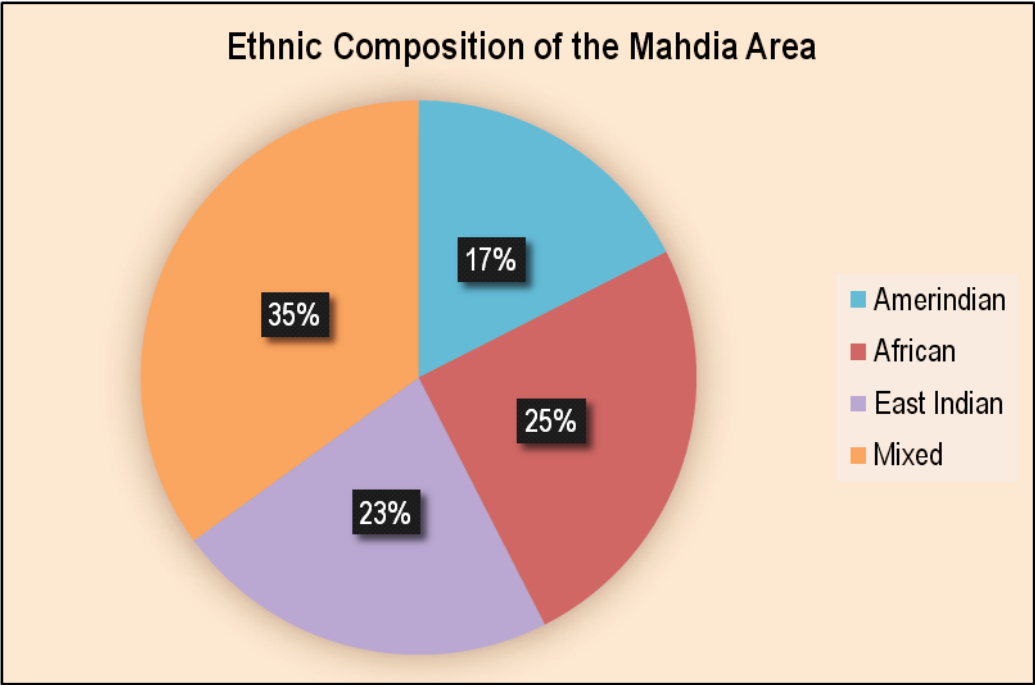


Figure 35: Ethnic Composition of the Surveyed Households in Mahdia

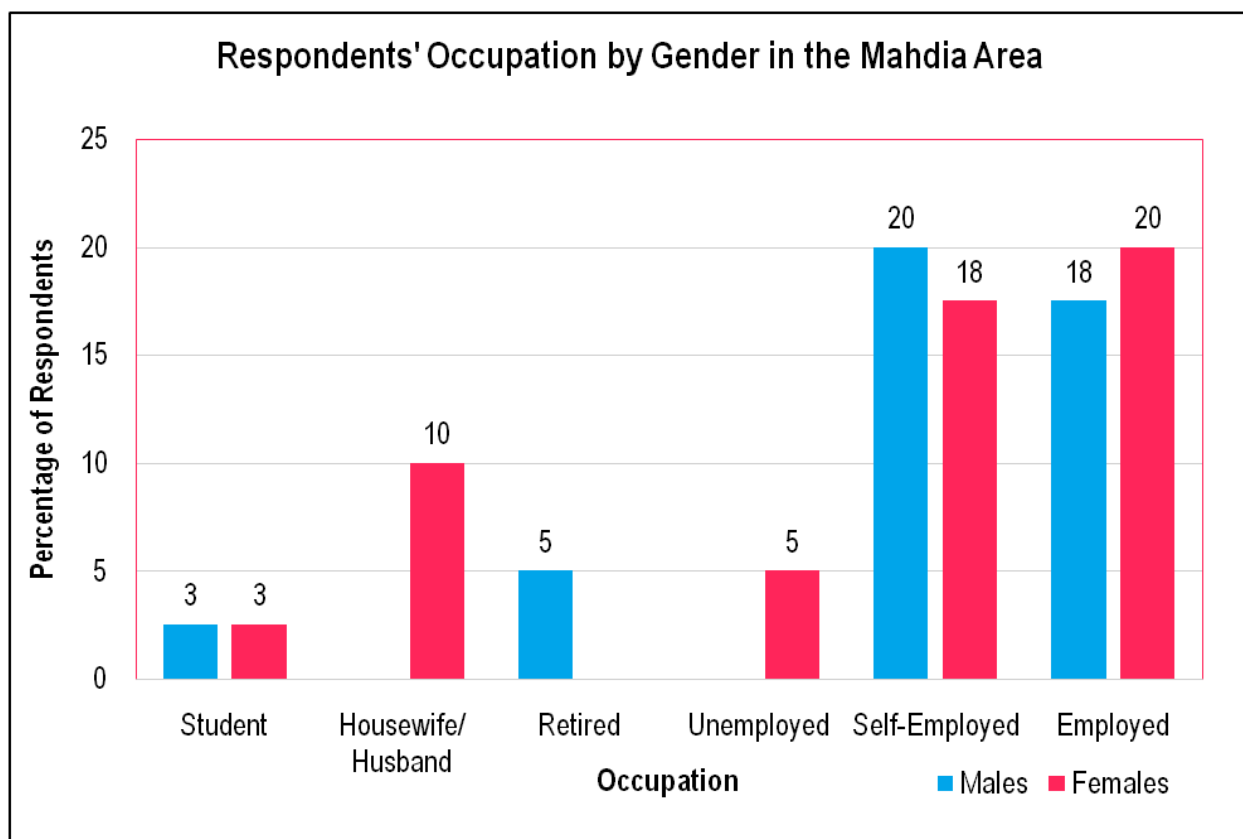


Figure 36: Comparison of Respondents' Occupation by Gender in the Mahdia Area

4.3.3 Cost of Living

Of the 40 households that were surveyed in the Mahdia area, it was found that 30% only had one person who was employed. Forty percent had two persons employed, while a further 15% had three persons employed. Sixteen percent of the households had four or five persons in employment (Figure 37). As it relates to the income generated by each household, 10% received an income of more than \$175,000. Based on the survey, none of the households were working for below a monthly income of \$55,000 which is the national minimum wage in Guyana (Figure 38).

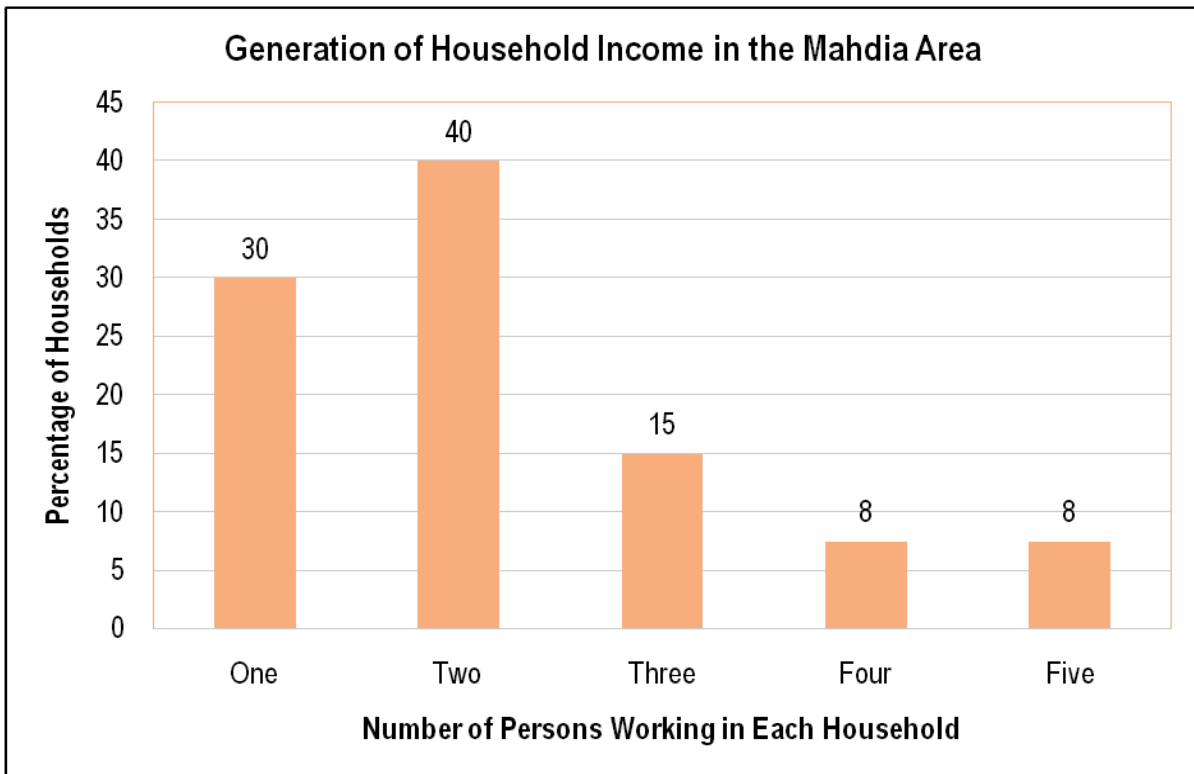


Figure 37: Number of Persons Generating Household Income in the Mahdia Area

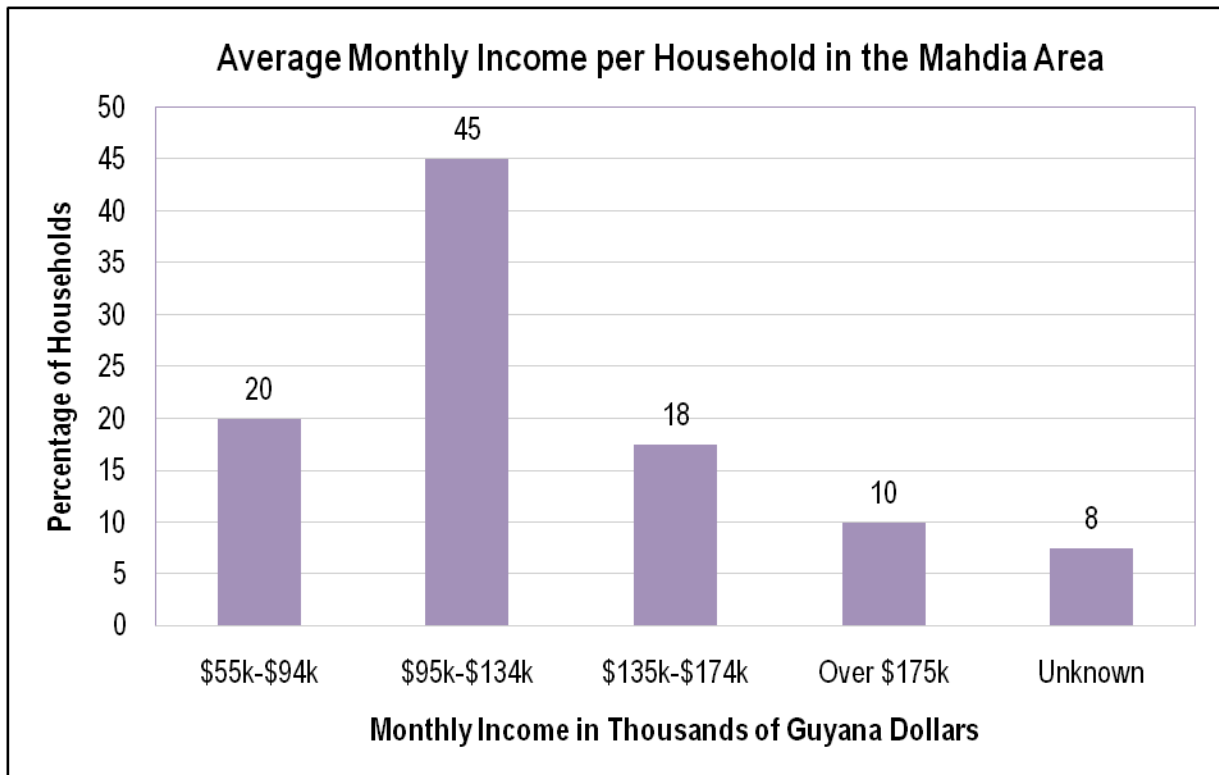


Figure 38: Average Monthly Income by Household in the Mahdia Area

4.3.4 Health and Education

Within the Mahdia area, 18% of the households surveyed cited that they had health concerns within their respective families. Most noted among these health concerns were injuries, respiratory illnesses, skin infections and malaria.

In terms of education, all of the respondents within the Mahdia area had some level of formal education. Of the households surveyed, it was noted that more females completed school at the Primary (10%) and Secondary (10%) levels, however, more males completed studies at the Tertiary (5%) and Technical levels (5%). An equal percentage of males and females (3%) completed school at the sixth form level (Figure 39).

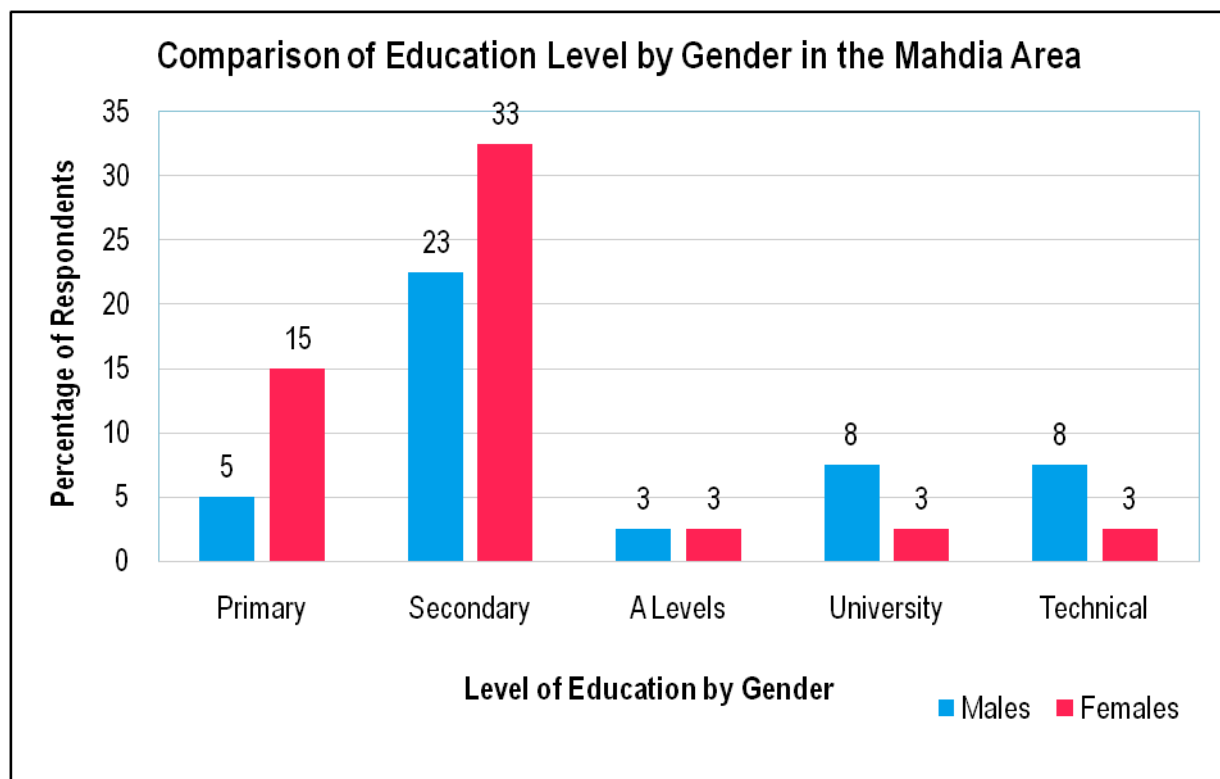


Figure 39: Comparison of Level of Education by Gender in Surveyed Households in the Mahdia Area

4.3.5 Health and Sanitation Infrastructure

Within the Mahdia area, 82% of the surveyed households currently have access to water from the GWI. Of these households, 82% consider the water provision services to be either good or fair, while 5% percent classified the service to be poor.

Sixty-three percent of the surveyed households consume mostly bottled water. A further 38% also utilize rain water, while 15% use the tap water provided by the GWI for drinking purposes (Figure 40).

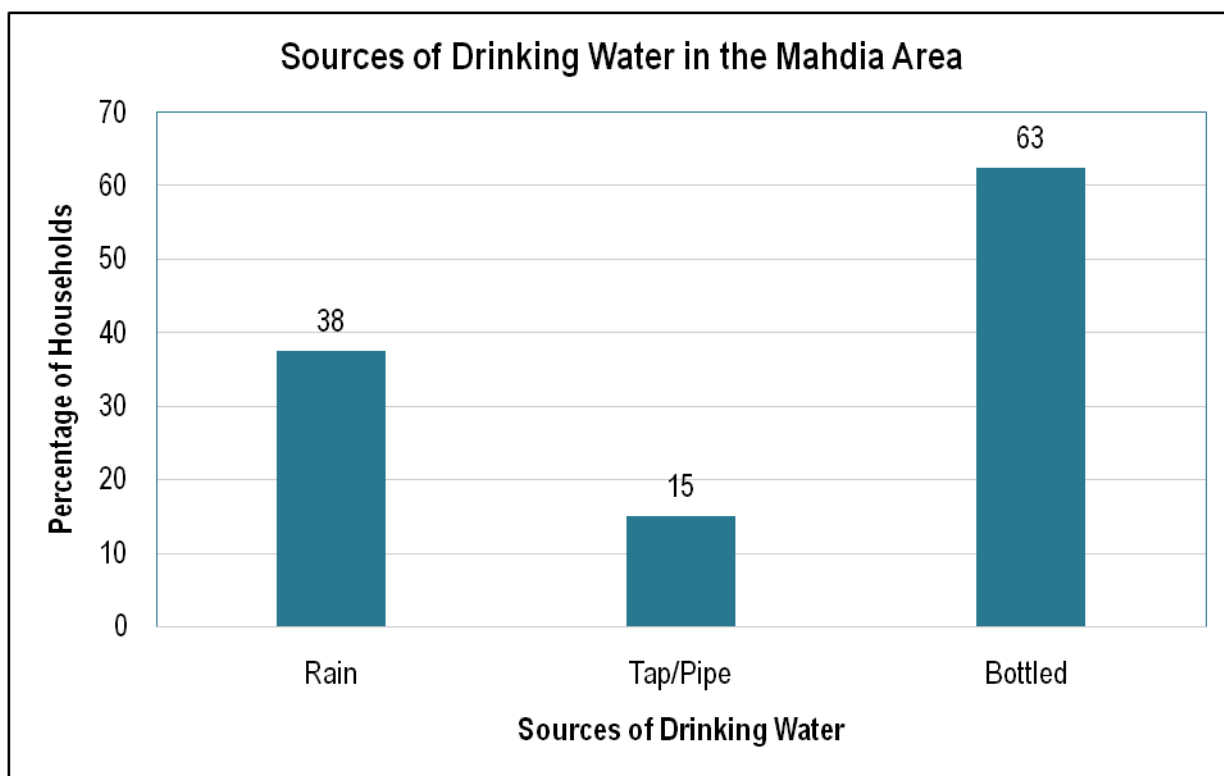


Figure 40: Sources of Drinking Water in Surveyed Households in the Mahdia Area

In terms of sanitation, 82% of the surveyed households have septic tank systems for the disposal of sewage while the remaining households utilise other means for sewage disposal such as pit latrines. The majority of households within the Mahdia area (58%) utilize waste collection services and burning (33%) for the disposal of solid wastes. The remaining 16% of the households engage in burying and dumping of their solid wastes. Of the households that utilize the collection service, most of the respondents (96%) have their solid wastes collected on a weekly basis (Figure 41).

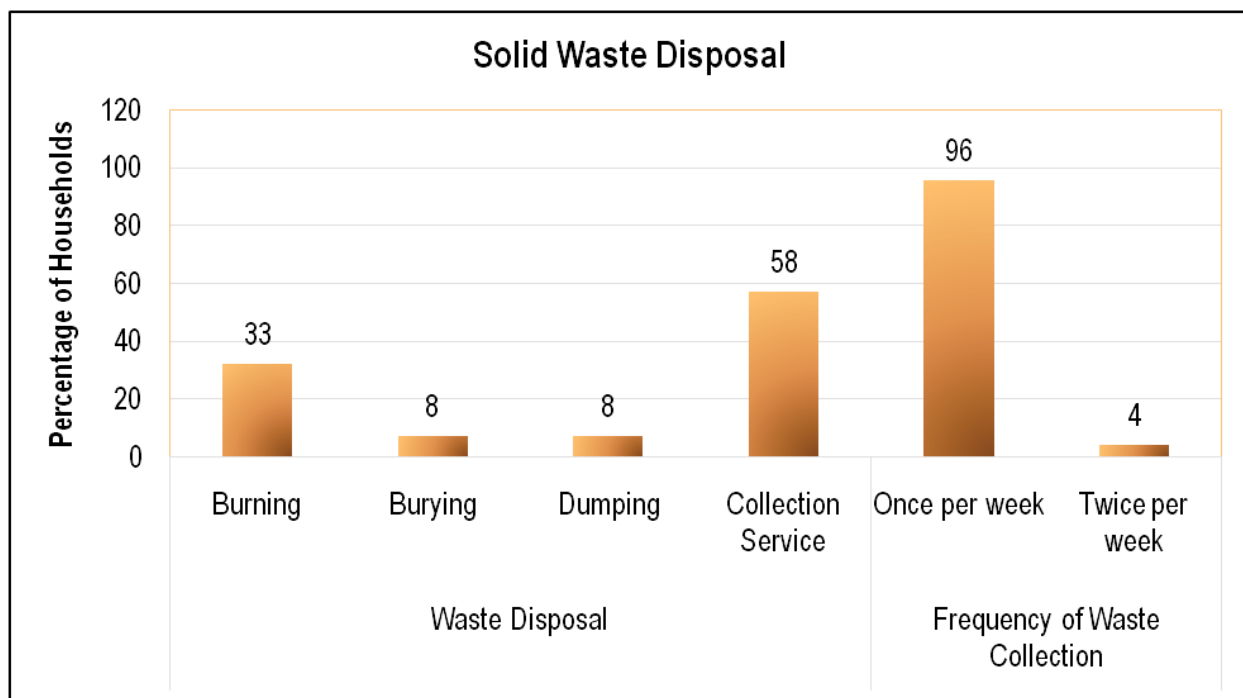


Figure 41: Solid Waste Disposal in Surveyed Households in the Mahdia Area

The major public health concerns identified by the respondents during the survey include the dumping of solid wastes, the prevalence of mosquitoes and fogging. Of these, the households were mostly concerned about the prevalence of mosquitoes (64%) followed by the dumping of solid wastes which accounted for 34% of the concerns and fogging which accounted for 2%.

The Regional Democratic Council is responsible for drainage and irrigation works throughout Mahdia and maintaining government reserves in front of private properties. Within the project area, 60% of the respondents were aware that cleaning works were conducted within the area while 22% indicated that no works were completed. The remaining 18% of respondents were unaware of any cleaning being done.

4.3.6 Energy

Within the Mahdia area, 95% of the surveyed households have access to power provided by the Mahdia Power Company (MPC). Of these households, 88% utilised MPC power for lighting purposes. Additionally, 5% of the households also utilised kerosene lamps/candles, and 8% utilised gas/diesel generator. Of all the households surveyed, 82% considered the quality of the service to be either good or fair, while 10% considered it to be poor.

For cooking purposes, it was found that 95% of the respondents mostly utilised LPG for cooking, while 18% and 3% also utilised kerosene and firewood, respectively (Figure 42).

In terms of perception of renewable energy, 47% of the respondents within the Mahdia area indicated that they are aware of the term while 53% have never heard of renewable energy. Of the respondents, 2% reported having knowledge of it, 20% indicated that they had some knowledge of it, while 53% did not have any knowledge of renewable energy. Seven percent of the respondents believed that renewable energy uses petroleum to generate power, while 25% were unsure of petroleum use in power generation. Further, 5% of the respondents perceived renewable energy to be harmful to the environment as compared to 70% who believed that it did not have any adverse environmental effects. Eighty-seven percent of the respondents expressed that solar energy was a form of renewable energy. As it relates to the need for renewable energy in Guyana, 22% of the respondents strongly agreed with this statement, while a further 60% indicated their agreement. Eighteen percent were unsure of whether renewable energy was necessary for Guyana. Eighty-five percent of the respondents were in favour of focusing on renewable energy sources while 15% were unsure of whether Guyana should pursue the development of renewable energy.

As it relates to investment in renewable energy, 77% of the respondents believed that it will bring benefits to consumers, while 23% were unsure of whether it will bring any benefits. Ninety-two percent of the respondents were also willing to support renewable energy development in Guyana. In terms of increasing knowledge on renewable energy, 92% of the respondents were willing to learn more about the subject, while 8% of the respondents expressed that they were unsure of whether they wanted to learn more about renewable energy.

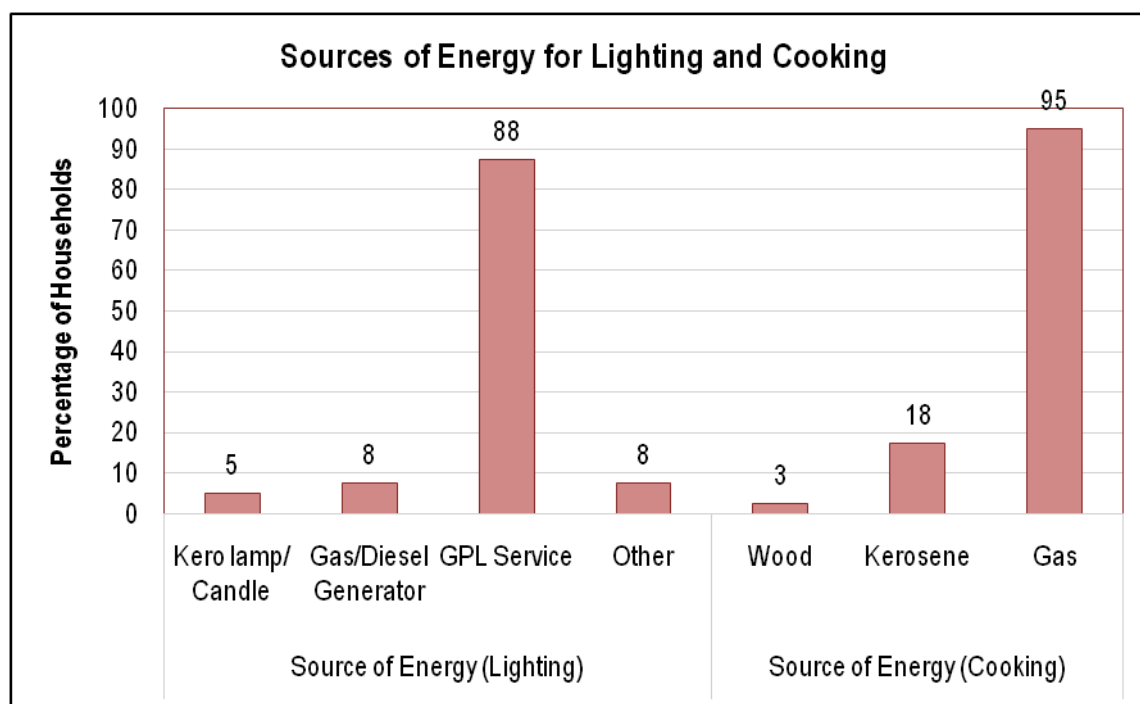


Figure 42: Sources of Energy for Lighting and Cooking within the Mahdia Area

4.3.7 Community Well-being

At the community level, persons identified lack of employment (62%), poverty (9%), crime (2%) and teenage pregnancy (18%) as the most prevalent social issues. Incidences of discrimination (2%) were also cited by the respondents in the area. Issues of domestic violence were noted to occur in the area with 5% of the respondents highlighting it as a concern. There are no perceived instances of sexual abuse and gender inequality occurring in the area as noted by all of the respondents during the survey (35).

In terms of issues affecting children, there are no perceived incidences of sexual abuse or neglect occurring in the area. However, there is some level of physical abuse in the area as noted by 3% of the respondents (Figure 44).

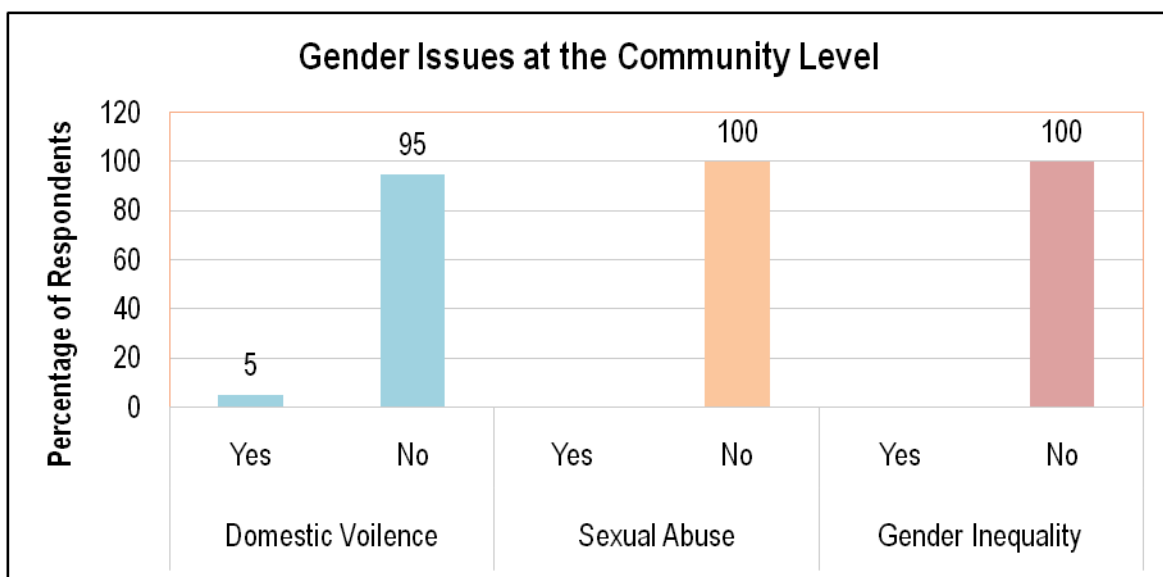


Figure 43: Gender Issues – Domestic Violence, Sexual Abuse and Equality - at the Mahdia Community Level

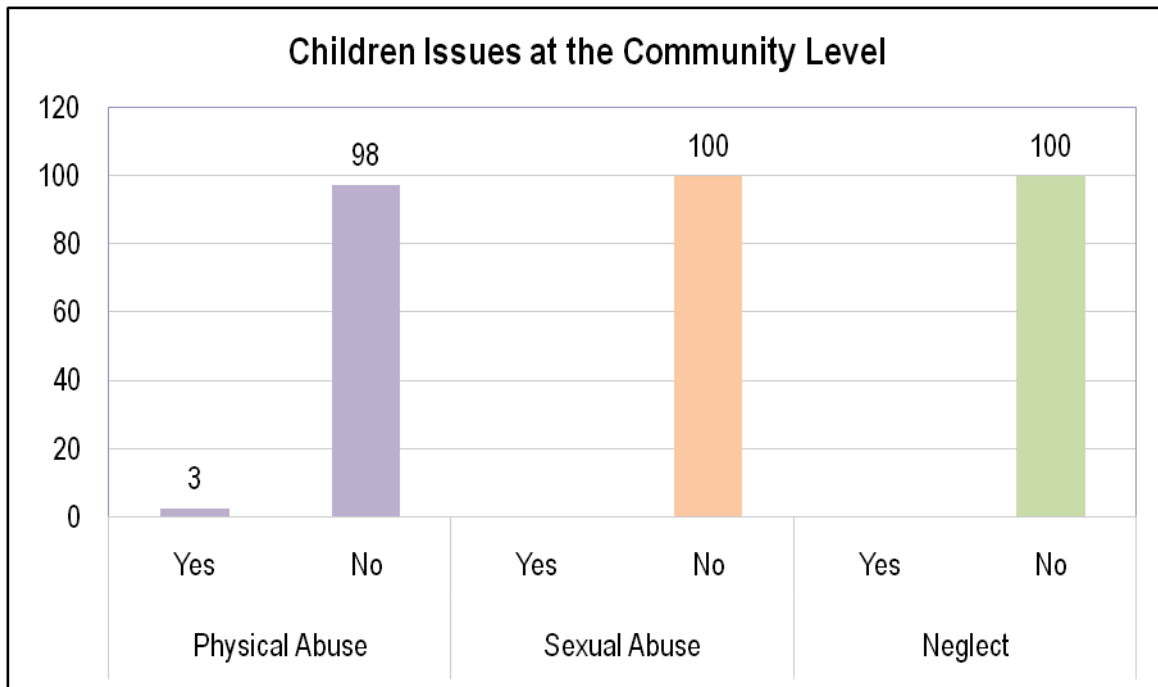


Figure 44: Children Issues - Physical Abuse, Sexual Abuse and Neglect - at the Mahdia Community Level

As it relates to the level of social cohesion, 58% of the respondents believed that the Mahdia area had good cohesion, while 27% ranked it as average. Another 10% thought that social cohesion was excellent while a mere 2% rated it as being poor. Forty-two percent of the respondents believed that there were no opportunities for local employment while a further 18% were unsure or unaware of any employment opportunities. For the respondents (37%) that thought that there were job opportunities, these were identified to be miners, shopkeepers, mechanics, grocers, sales representatives, porters, caterers, welders, cooks, and the provision of transportation services.

4.3.8 Cultural Sites

As it relates to the cultural features of the area, the residents primarily belonged to one of the three major religious groups in the country – Hinduism, Christianity and Islam – with Christianity accounting for 77% of the households surveyed in the Mahdia area (Figure 45). Several churches, a temple and a mosque were also noted within the area.

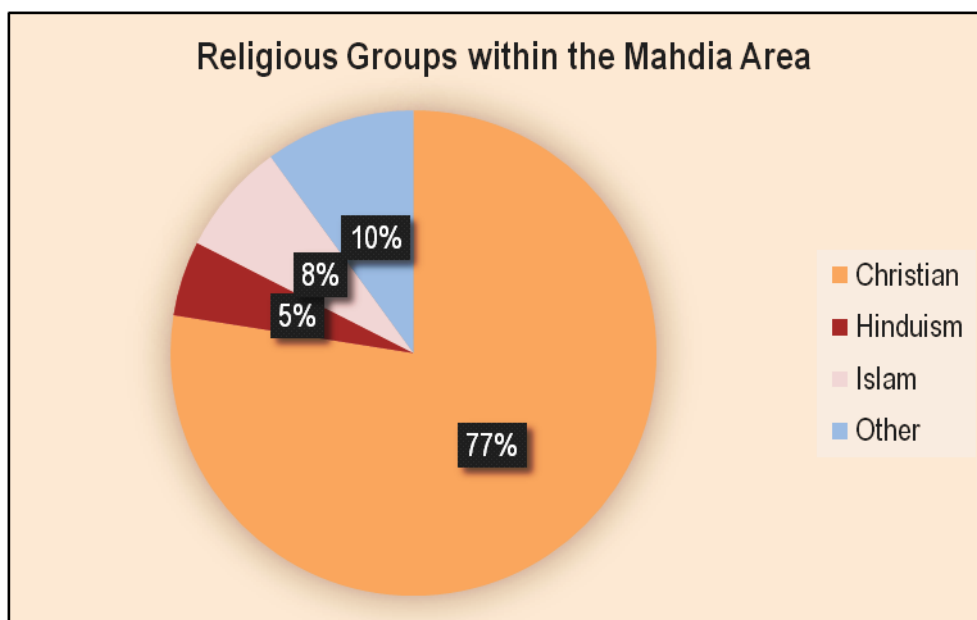


Figure 45: Religious Groups within the Mahdia Area

4.3.9 Physical Assets and Social Services

There are a number of physical and economical assets, and social services within the Mahdia area that are important for the well-being of the community. Currently, there are both government and private schools; government health clinics/outposts/hospitals; markets; privately-owned shops and stores; places of worship; public spaces; one police station/outpost; one fire service station; one government post office; and paved as well as unpaved roads. However, there are no government or private financial institutions, and landline telephone services in the area.

4.4 Lethem

4.4.1 Level of Urbanization

Lethem, which was recently declared a town, is situated on Guyana's border with Brazil in Administrative Region 9 (Upper Takutu/Upper Essequibo). It is the commercial centre of the region, and acts as a hub linking many of the indigenous villages to the capital city of Georgetown. Lethem has a population 1,158 persons (Bureau of Statistics, 2002). It is governed by a newly elected mayor and city council which is the legislative branch of the government.

4.4.2 Demographics and Household Composition

Of the 45 households that were surveyed in the Lethem area, 7% were Africans and 11% were East Indians the two largest ethnic groups in the country. A little over half of the surveyed households (51%) comprised of Amerindians while 27% comprised of persons with mixed ethnic

groupings. A further 4% of the households surveyed comprised of Portuguese residents (Figure 46). While there are special laws in place for the protection of indigenous peoples in Guyana and internationally, the individuals within the project area currently reside in the Lethem township, and not within a community, and as such indigenous land ownership rights are not applicable under this project.

As it relates to household composition, 13% of the households comprised of three persons, 40% comprised of four persons, and 16% comprised of five persons. A mere 2% of the households comprised of two persons, while 29% of the households comprised of six or more persons.

In terms of the respondents in the survey, 51% were males as compared to 49% who were females. Forty-nine percent of the respondents were self-employed and a further 22% were employed by either government or private entities. Four percent were students while 22% were housekeepers, all of which were female. Forty-nine percent of the respondents who were employed (including self-employed) were males as compared to 22% who were females (Figure 47).

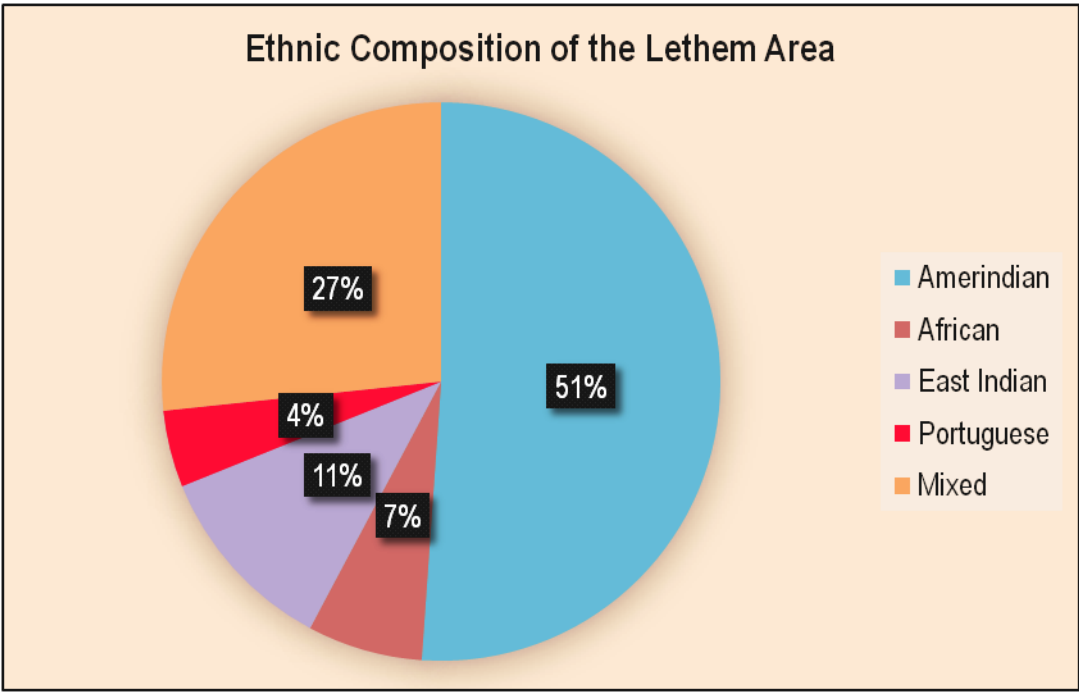


Figure 46: Ethnic Composition of the Surveyed Households in Lethem

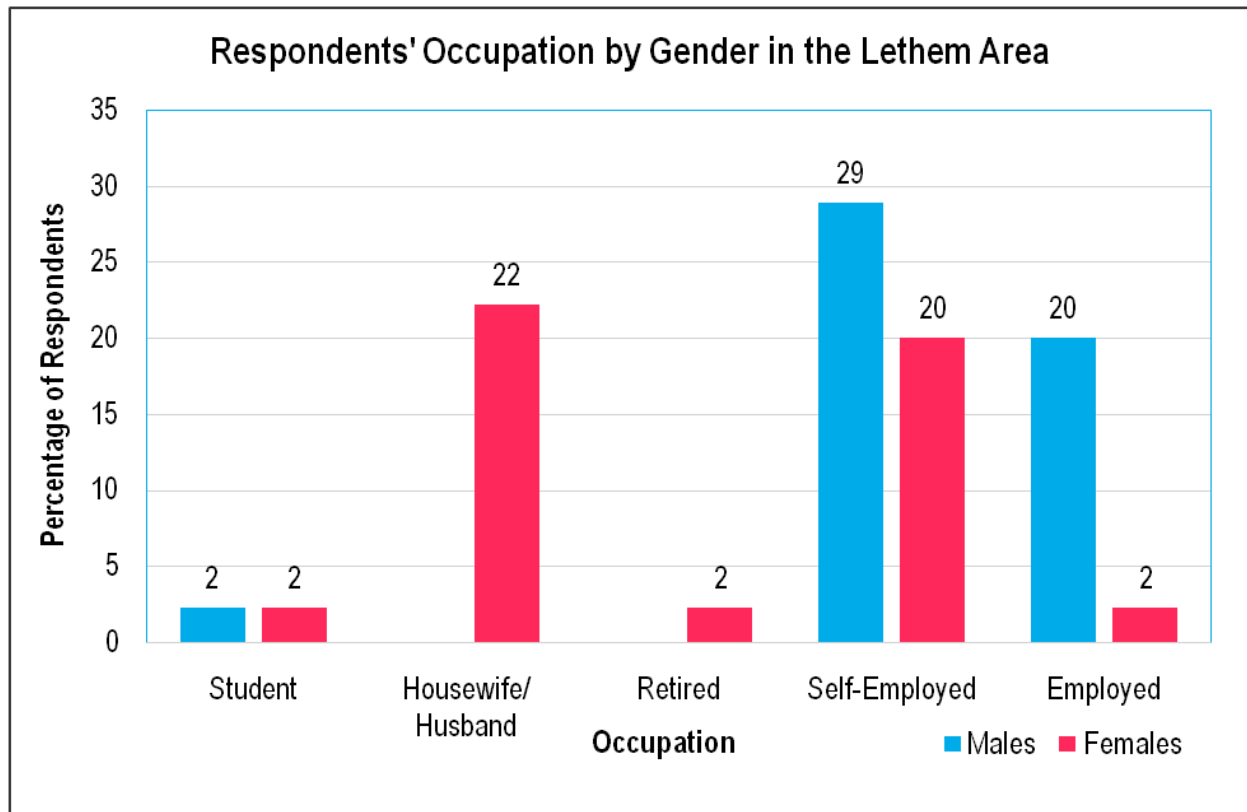


Figure 47: Comparison of Respondents' Occupation by Gender in the Lethem Area

4.4.3 Cost of Living

Of the 45 households that were surveyed in the Lethem area, it was found that 16% only had one person who was employed. More than half of the households (56%) had two persons employed, while a further 20% had three persons employed. Only 2% of the surveyed households had six or more persons in employment (Figure 48). As it relates to the income generated by each household, 4% received an income of more than \$175,000. Further, only 2% of the households were working for below a monthly income of \$54,000 (Figure 49) which is considered nationally to be within the low-income bracket.

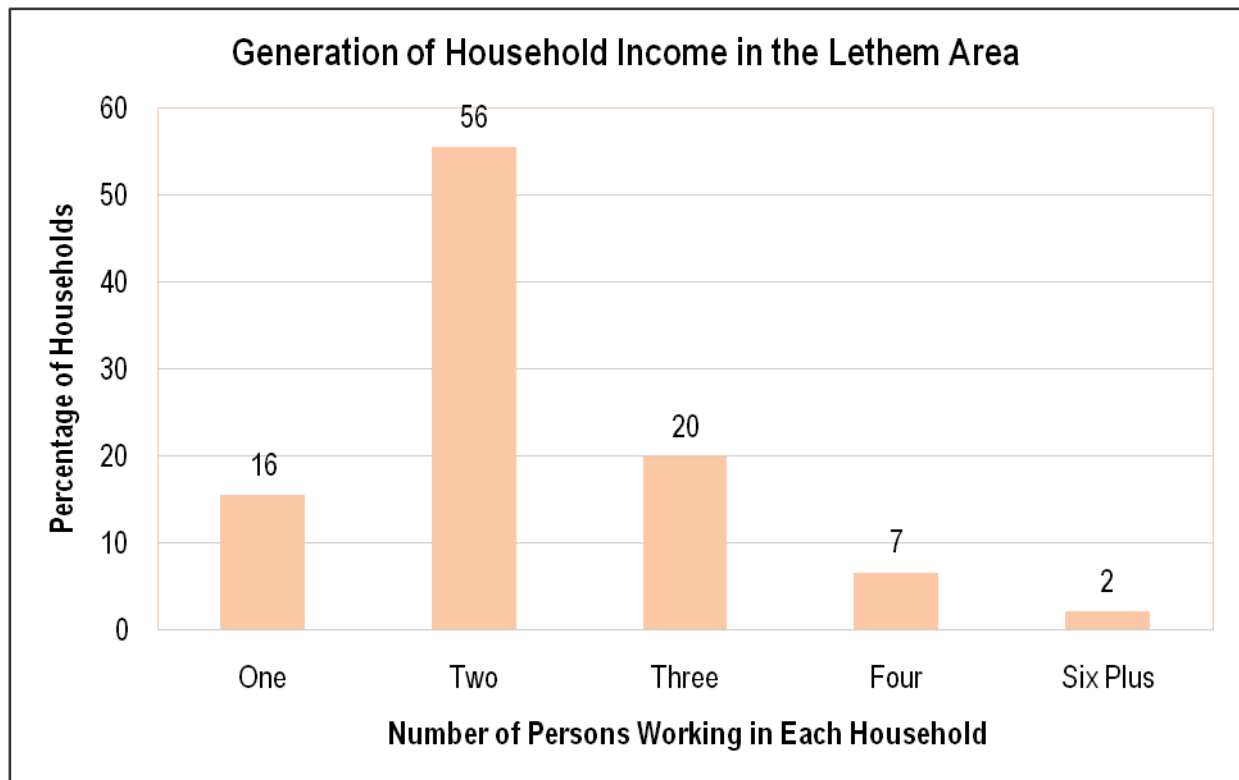


Figure 48: Number of Persons Generating Household Income in the Lethem Area

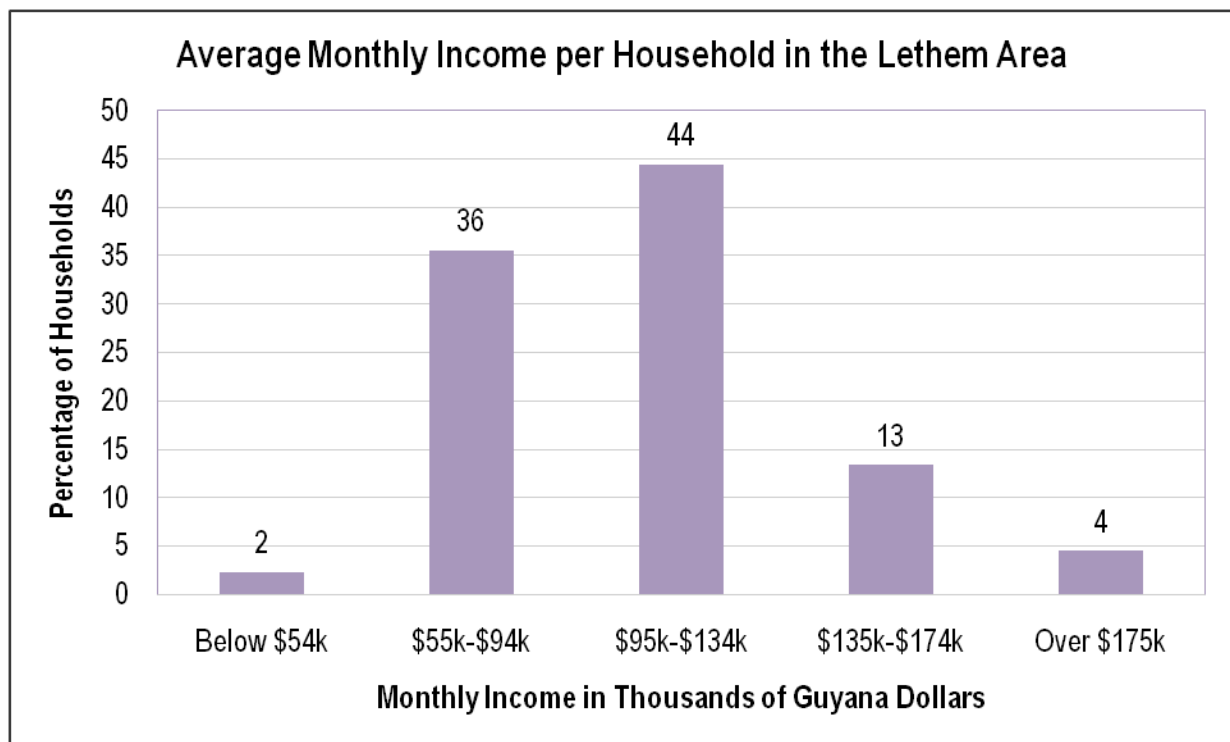


Figure 49: Average Monthly Income by Household in the Lethem Area

4.4.4 Health and Education

Within the Lethem area, 11% of the households surveyed cited that they had health concerns within their respective families. Most noted among these health concerns were respiratory illnesses, skin infections, diabetes, stomach ailments and polio.

In terms of education, all of the respondents in the Lethem area had some level of formal education. Of the households surveyed, it was noted that more males completed studies at the Secondary (24%) and Technical (7%) levels, while more females completed school at the Primary (22%) and Sixth Form (2%) levels. The same percentage of both gender completed studies at the Tertiary (2%) level (Figure 50).

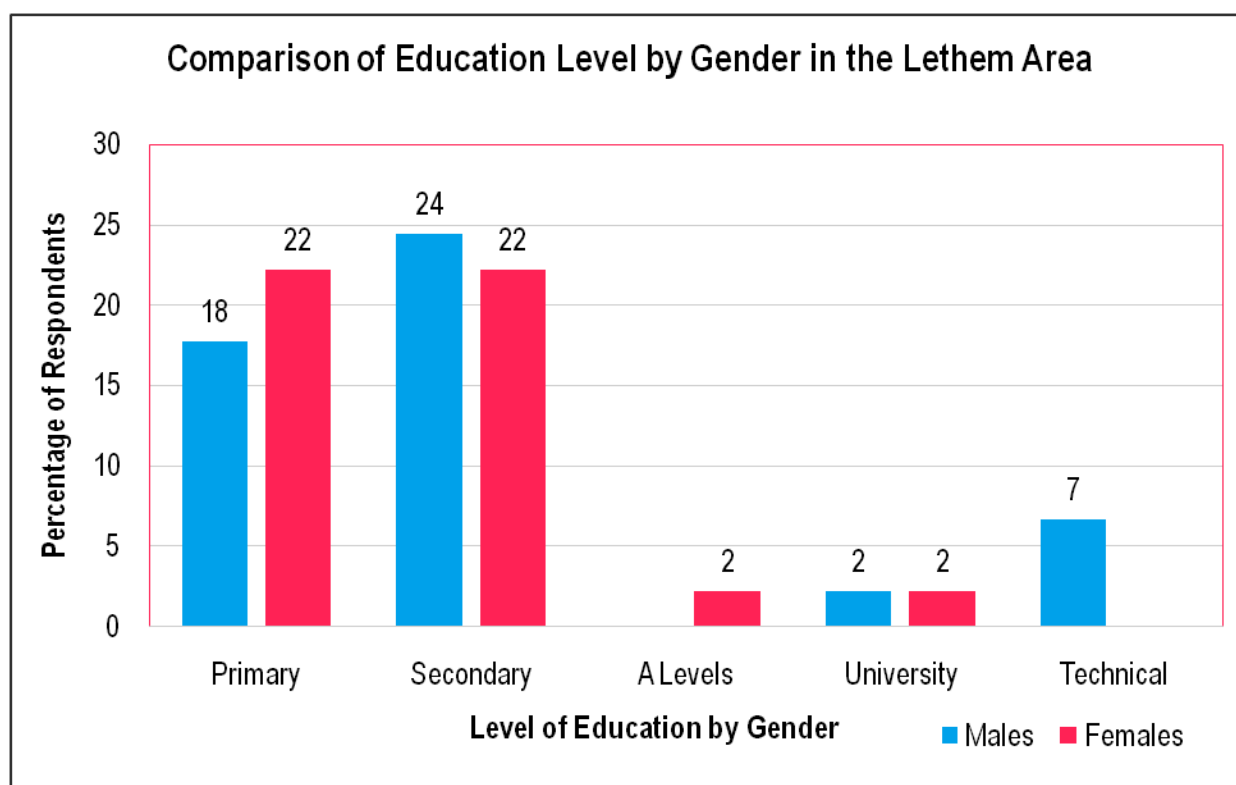


Figure 50: Comparison of Level of Education by Gender in Surveyed Households in the Lethem Area

4.4.5 Health and Sanitation Infrastructure

Within the Lethem area, 93% of the surveyed households currently have access to water from the GWI. Of these households, 89% consider the water provision services to be good or fair, while 9% classified the service to be poor.

Twenty seven percent of the surveyed households consume mostly bottled water. Twenty percent utilize rain water, while 24% use the tap water provided by the GWI. A further 29% use other sources including well water for drinking purposes (Figure 51).

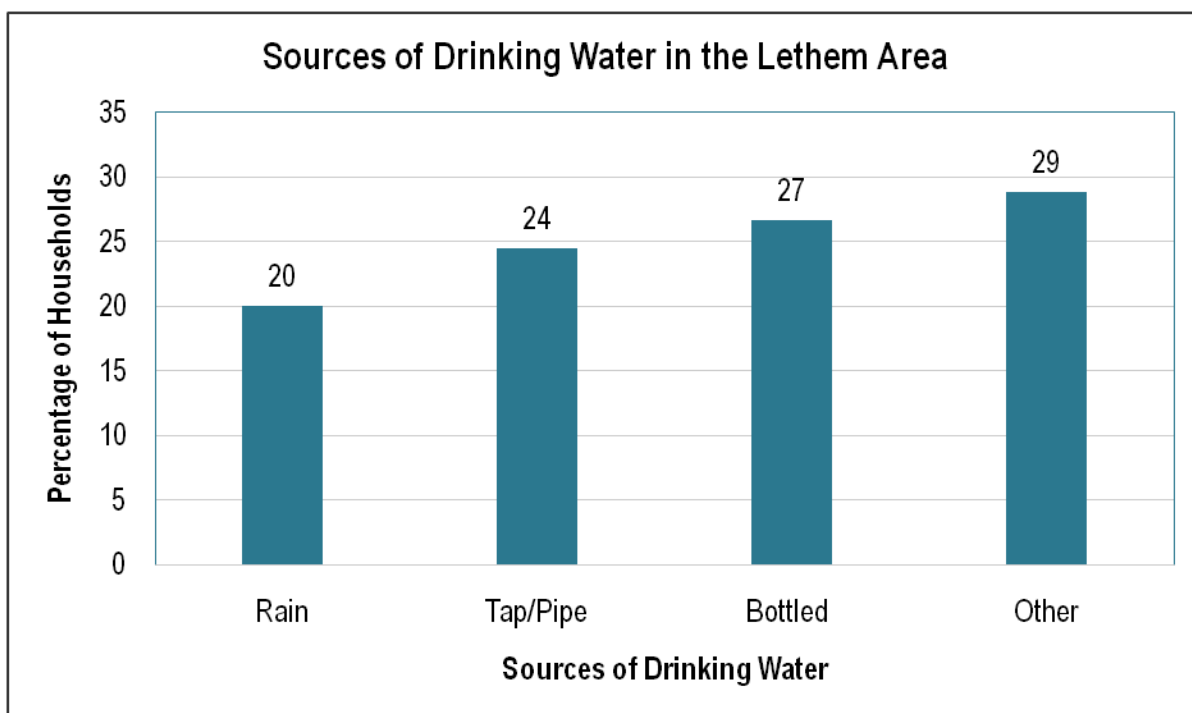


Figure 51: Sources of Drinking Water in Surveyed Households in the Lethem Area

In terms of sanitation, 78% of the surveyed households have septic tank systems for the disposal of sewage. The majority of households within the Lethem area (90%) utilize waste collection services (42%) and burning (49%) for the disposal of solid wastes. The remaining 9% engage in dumping of their solid wastes. Of the households that utilize the collection service, almost three quarters of the respondents (74%) have their solid wastes collected on a bi-weekly basis (Figure 52).

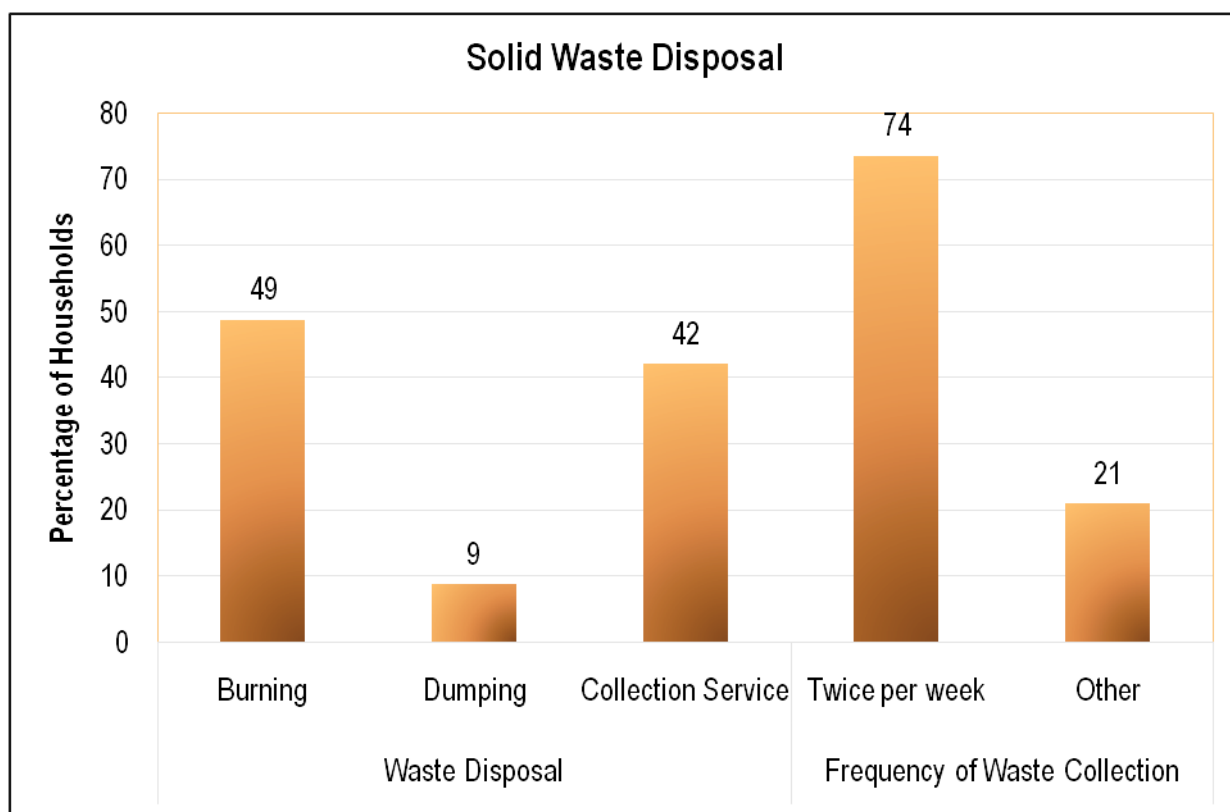


Figure 52: Solid Waste Disposal in Surveyed Households in the Lethem Area

The major public health concerns identified by the respondents during the survey include the dumping of solid wastes, flooding, the prevalence of mosquitoes and rodents, and improper drainage. Of these, the households were mostly concerned about the prevalence of mosquitoes (70%), followed by flooding which accounted for 12% of the concerns and dumping of solid wastes which accounted for 10%.

The newly elected Mayor and City Council is responsible for drainage and irrigation works throughout Lethem and maintaining government reserves in front of private properties. Within the project area, 47% of the respondents were aware that cleaning works were conducted at the front portion of their property while 22% indicated that no works were completed. The remaining 31% of respondents were unaware of any cleaning being done.

4.4.6 Energy

Within the Lethem area, all of the surveyed households had access to power provided by the LMPC, however only 98% of the households utilised the service for lighting purposes. Two percent of the households utilised gas/diesel generator for lighting. Of all the households surveyed, 98% considered the quality of the service to be either good or fair, while 2% considered it to be poor. For cooking purposes, it was found that 98% of the respondents utilised LPG for cooking, while 2% of the households utilised firewood (Figure 53).

In terms of perception of renewable energy, 49% of the respondents within the Lethem area indicated that they are aware of the term while 51% have never heard of renewable energy. Of the respondents, 32% reported having some knowledge of it, while 68% did not have any knowledge of renewable energy. Seventeen percent of the respondents believed that renewable energy uses petroleum to generate power, while 31% were unsure of petroleum use in power generation. Further, 9% of the respondents perceived renewable energy to be harmful to the environment as compared to 76% who believed that it did not have any adverse environmental effects. Eighty-two percent of the respondents expressed that solar energy was a form of renewable energy. As it relates to the need for renewable energy in Guyana, 29% of the respondents strongly agreed with this statement, while a further 56% indicated their agreement. Fifteen percent were unsure of whether renewable energy was necessary for Guyana. Eighty-five percent of the respondents were in favour of focusing on renewable energy sources while 15% were unsure of whether Guyana should pursue renewable energy.

As it relates to investment in renewable energy, 82% of the respondents believed that it will bring benefits to consumers, while 18% were unsure of whether it will bring any benefits. Eighty-seven percent of the respondents were willing to support renewable energy development in Guyana. In terms of increasing knowledge on renewable energy, 87% of the respondents were willing to learn more about the subject, while 13% of the respondents expressed that they were unsure of whether they wanted to learn more about renewable energy.

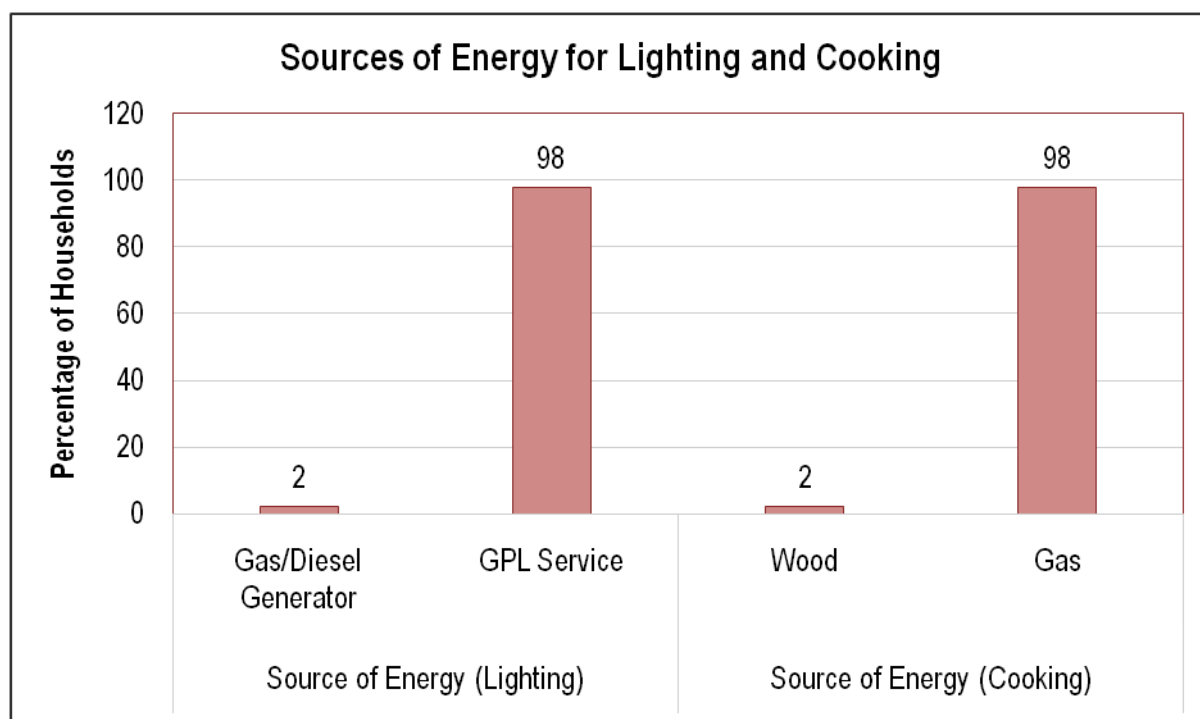


Figure 53: Sources of Energy for Lighting and Cooking within the Lethem Area

4.4.7 Community Well-being

At the community level, persons identified lack of employment (96%), lack of cooperation (2%) and crime (2%) as the most prevalent social issues. No instances of discrimination have been cited by the respondents. Issues of domestic violence were noted to occur in the area with 2% of the respondents highlighting it as a concern. There is no perceived occurrence of sexual abuse and gender inequality occurring in the area as noted by all of the respondents (Figure 54).

Within the Lethem area, there are no perceived incidences of physical abuse, sexual abuse or neglect relating to children in the area.

As it relates to the level of social cohesion, 64% of the respondents believed that the Lethem area had good cohesion, while 16% ranked it as average. Another 13% thought that social cohesion was excellent while 7% rated it as being poor. Eighty-two percent of the respondents believed that there were no opportunities for local employment while a further 7% were unsure or unaware of any employment opportunities. For the respondents (11%) that thought that there were job opportunities, these were identified as mechanics, shopkeepers, grocers, miners, masons and the provision of transportation services.

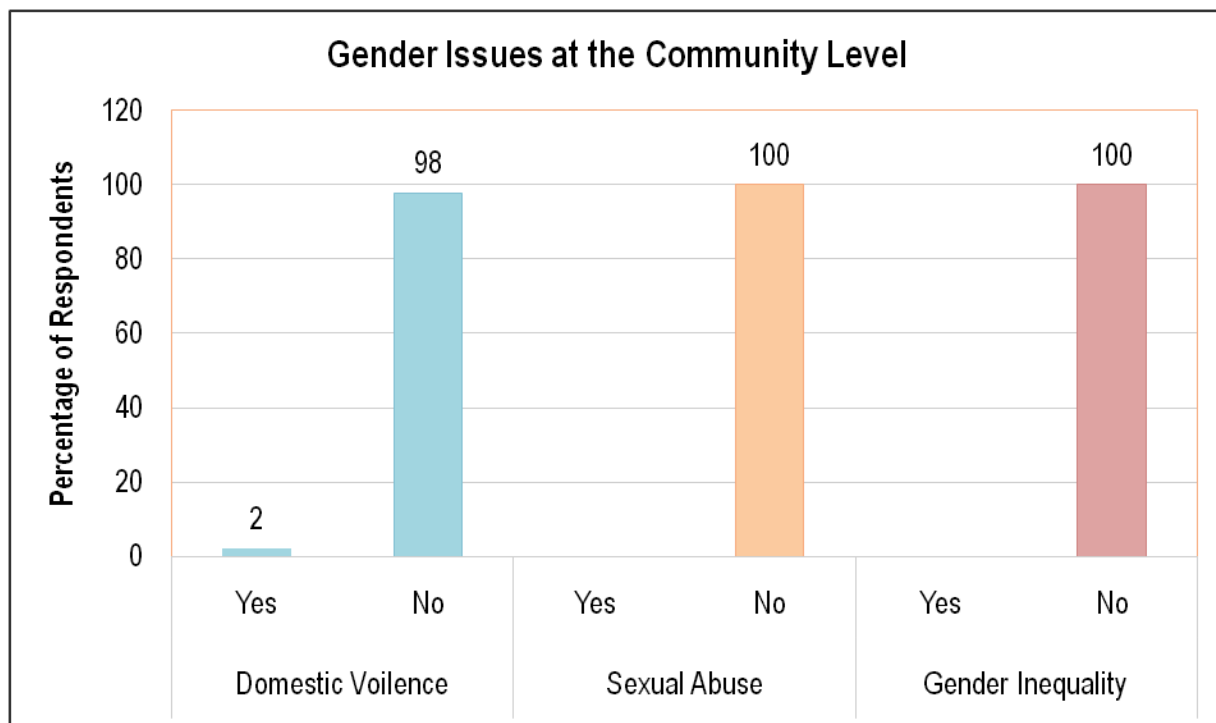


Figure 54: Gender Issues – Domestic Violence, Sexual Abuse and Equality - at the Lethem Community Level

4.4.8 Cultural Sites

As it relates to the cultural features of the area, the residents primarily belonged to one of the three major religious groups in the country – Hinduism, Christianity and Islam – with

Christianity accounting for 84% of the households surveyed in the Lethem area (Figure 55). Several churches, temples and mosques were also noted within the area.

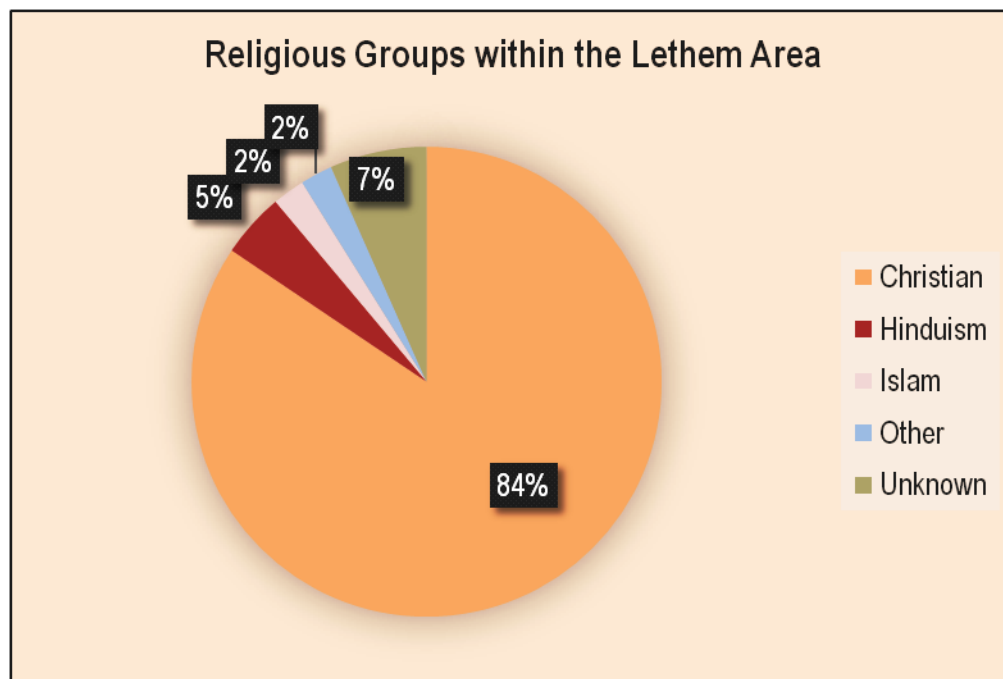


Figure 55: Religious Groups within the Lethem Area

4.4.9 Physical Assets and Social Services

There are a number of physical and economical assets, and social services within the Lethem area that are important for the well-being of the community. Currently, there are government schools; government health clinics/outposts/hospitals; private financial institutions; markets; privately-owned shops and stores; places of worship; public spaces; one police station/outpost; one fire service station; and one government post office in the project area. Additionally, there are mostly unpaved and some paved roads, as well as limited telephone service in the area.

5 CONSULTATION REPORT

5.1 Introduction

The Consultation Report (CR) accompanies the Environmental and Social Analysis (ESA) for detailed planning for solar farms of up to 3.15 MW and associated development (the Proposals) on Bartica, Lethem and Mahdia, Guyana South America (the Sites). This CR provides explanation of the consultation process that has been undertaken in order to inform the Proposals.

EES team (Environmental Engineering Solutions) sought to inform and engage with interested parties. The team organised a stakeholders and community consultation programme to inform them of the Proposals and to gain an insight into local issues to guide the planning and design processes. It is important to mention that for the stakeholder meeting, the invitation also was extended to the community based on the population size: Lethem with 5000 residents, Bartica with 15000 residents and Mahdia with 4,200 residents.

The consultation events provided local people with an opportunity to learn more about the Proposals raise issues and discuss these with members of the EES project team. Illustrative presentations were used to set out information on the Proposals and the background to PV farms development.

The CR is submitted as a part of a requirement, commitment and effort to involve main stakeholders and local community in the Solar PV Farms proposal. The CR highlights the response from main stakeholders and resident of the communities of interest also draws together the key messages and issues raised during the course of the consultation, and summarises what has been done to address these in terms of the Proposals for which approval to the proposal is now sought.

5.2 Consultation Approach

The effective management of stakeholder expectations and of the consultation process is of prime importance to the successful progression and delivery of all development proposals. As such, EES is committed to a comprehensive strategy of community engagement. The views of local communities are valued, alongside local opinions, aspirations, expectations and requirements, all of which help to shape development the proposals. As a result, a wide range of consultation activity has been undertaken prior to this submission. These activities included a series of questionnaires for social survey, for community leaders and questionnaires for Impact verification in the case of resettlement. So far resettlement is not an option based on site survey and a verification of no impacts was found in all three communities.

Main activities engaging with the local communities during a public scoping meeting and for the representative of government institutions, non government institution, industrial sector and

private sector were interviewed as a face to face engagement finalizing with a stakeholders scoping meeting where the feedback in the three proposed Solar PV farms was successful.

The wide scope of project related to renewable energy developments often raises interests and concerns within local communities. EES team made a face to face approach to ensure positive, long term effects on the local communities and environment.

The consultation process was designed to engage, consult, listen and provide opportunities for community involvement. This methodology ensured value feedback from residents of communities and main stakeholders. EES staff meet the needs of residents and community leaders gaining the approval and permission avoiding during the presentation of project description negative feedback and also the understanding completely of the benefits versus minimal negative impact on the host communities.

The main objectives of this plan of consultation have been to:

- ✓ Identify project stakeholders;
- ✓ Mapping affected potentials and other interested parties to capture their views and perceptions of the Project process;
- ✓ Conduct the consultation to expose the risks and opportunities of the Project, gather the concerns of the interested parties and take them into account to improve the Environmental and Social Management Plan of the Project;
- ✓ Propose timely and effective information channels that allow the exchange of information and continuous feedback between the Project and the potential affected;

During the preparation for the community and key stakeholders consultation exercise EES team sought to:

- ✓ Provide an open and welcoming forum for local people to express their views on the PV Farms Project Proposal;
- ✓ Explain and discuss any issues and concerns raised;
- ✓ Encourage discussion and provide everyone with an opportunity to participate;
- ✓ Accurately record the feedback of the participants of the event.

In order to meet the objectives of a significant feedback from consultation EES team engaged a series of public and main stakeholders scoping meeting as follows in the schedule below.

BARTICA, Cuyuni-Mazaruni (Region 7)

- ✓ Main stakeholder Scooping Meeting: June 4th, 2018 at 10:30 hrs. RDC Boardroom, Bartica.
- ✓ Community Scooping Meeting: June 4th, 2018 at 10:30 hrs. RDC Boardroom, Bartica.

LETHEM, Region Upper Takutu-Upper Essequibo (Region 9)

- ✓ Main stakeholder Scooping Meeting: May 31th, 2018 at 17:00 hrs. RDC Boardroom, Lethem.
- ✓ Community Scooping Meeting: June 1st, 2018 at 17:00 hrs. Amerindian Conference Hall, Lethem.

MAHDIA, Potaro-Siparuni (Region 8)

- ✓ Main stakeholder Scooping Meeting: May 29th, 2018 at 17 hrs. RDC Boardroom, Mahdia.
- ✓ Community Scooping Meeting: May 30th, 2018 at 10:00 hrs. Amerindian Hostel, Campbelltown Village.

5.3 Methodology – Stakeholders and Community Consultation events

5.3.1 Introduction

This section of the CR highlights the consultation events held by EES Team. The feedback, findings and issues discussed are analyzed in the following section 5.4. The findings that influenced the project proposal are also in the section 5.4

During the consultation the residents and the main stakeholders may have different interest and concerns where they had the opportunity to express their views. The consultation was always open and flexible at the event, where they were able to learn and discuss in detail about the Solar Farms for the three proposed sites.

Residents and Stakeholders were able to discuss the details of sites selection, potential social and environmental impact along with the benefits that each Solar Farm represents to each community or region. The presentation was more informative and graphic with the intention to have a simple and practical understanding for the attendees and the feedback and results were very optimistic and positive.

5.3.2 Consultation Event –Bartica, Mahdia and Lethem, Guyana South America

In overall the stakeholders and community consultations were well receive in the dates of the event. And average people attending the consultation scoping meeting were for Bartica 12 people, for Lethem 26 people and for Mahdia 77 people. The aim of this exhibition was to allow

members of public and main stakeholders to discuss the projects and continue the process of engaging with local people and provide information and guidance on both the project itself and how individuals and groups could comment on the projects and get involved in the process.

The key stakeholders and community consultation provided an additional opportunity for engagement with local people and businesses, allowing them to express their particular interest or concern regarding the Projects. The exhibition offered local residents and other interested parties the opportunity to view the layout of the Projects, ask questions and offer comment. Full details of the entire project process were available for attendees. Full details of the entire project process were available for attendees (please see power point presentation in this CR in Annex). EES team present the project in order that specific questions could be answered as required.

Publicity

EES team publicized the event widely to actively inform both the general public and relevant main stakeholders the RDC's office from Bartica, Lethem and Mahdia played an important role during the diffusion of the invitation for consultation forums (scooping meetings). The aim of this publicity was to encourage as many people as possible to attend.

The methods used prior to the event were: Flyer for public invitation, RDC' invitation letter to main stakeholders and community leaders or the area of interest. Also radio ads were sent in the case of Lethem and invitation face to face from EES Team to the community during the social survey prior to the consultation dates for the projects.

The consultation meetings

Presentation in power point was detailed for the projects of Bartica, Lethem and Mahdia. Projects were on display as people entered the consultation meeting. This gave participants the opportunity to view the illustrative presentation and have informal discussions with EES Team staff and with one another regarding any concerns held in respect of the Proposals. The consultation worth in its full objectives the three communities were anxious to support the Projects and emphasized about the timeframe to be completed.

During the presentation a microphone were distributed for comments and questions from attendees. Questionnaires were available for community leaders and were returned and complete interview with EES staff.

During the consultation event attendees were consulted on the three finalized sites for Bartica,

Lethem and Bartica. The projects sites and locations were unanimously approved by local residents.

The general approach of the motion of agenda for the three locations where as follow:

1. To give detail background about the project; presentation of land; project outline (components) environmental substances and compensation policy or consideration.
2. Visit proposed site; environmental data testing (wind speed, wind direction, temperature) and carry out an environmental survey mainly around the environmental perimeters of the proposed site.
3. Feedback from stakeholder; confirmation of land title and ownership.

The main points and issues, presented, discussed and noted from this stage of the stakeholders and community consultation process were, with key comments noted as appropriate:

Environmental

- ✓ The development of the PV Solar Power Farm will lead to a reduction in fossil fuel consumption;
- ✓ “Support for renewable energy and solar farms, to tackle climate change”;
- ✓ “Reduction in Carbon dioxide (CO₂) emission from electricity generation”;
- ✓ Increase in energy security and accessibility;
- ✓ “Incorporating PV solar farm with other forms of natural energy source expanding throughout the region”;
- ✓ “To safeguard the footprint reducing the impact on villages and community development”.

Social

- ✓ Approximately 34,700 residents are expected to benefit from renewable energy supply and clean energy source.
- ✓ Regional Democratic Council and Lands and Survey Commission have confirmed that the proposed land area allocated of land is State Land with zero issues with land ownership and with no issues with Amerindian Land Boundaries or any future extension claim.
- ✓ Beneficial to health sector keeping machines running efficiently with the development of stable, reliable energy source
- ✓ “We are fully supporters of the project that will benefit to schools,, villages hall ,communities, and more”;
- ✓ “I agree with the site”;
- ✓ “I am happy that the project looks ready to start”.

Economics

- ✓ 50 fulltime jobs for local citizens throughout the various phase of this project from construction and installation to training and certification;
- ✓ “Utilizing the nearest and exiting power lines will save more money and the project become more feasible”;
- ✓ “I am so glad that that the project can reduce the electricity rate in the communities”.

It is worth noting that local residents expressed an interest in participating during the tender process for the construction of land clearing, development and foundation for the projects. EES team will endeavour to facilitate the contact information for tendering process and employment during the project cycle

Resolved for the three proposed sites (Bartica, Lethem and Mahdia):

“We have no objection to the project of the development of PV Solar Farms we welcome the Proposals fully and the communities support and agreed with the land needed and the timeframe to be completed. We were waiting the project to start a long time ago”.

5.4 Conclusions and Implementation of Findings

EES team is committed to a communication strategy for stakeholders and community engagement, the output from this consultation exercise add value to the development of the Solar Farms in Bartica, Lethem and Mahdia.

The main stakeholder, the community leaders and the residents (Community residents and Amerindian village residents) supporting in its totality the proposed Solar Farms with local recognition that development of renewable energy project will secure future energy demands.

EES team have confidence that any issue to be a rise can be solve in the best positive way possible maximising the benefits and reducing any minor impact specifically the Social and environmental aspect.

A list of the main material considerations identified during the consultation plant is set out below:

- ✓ Support for the Projects and recognition of the contribution of the Proposals to generating renewable energy;
- ✓ Support of the Site location and the confirmation of no issues with land title, currently all the sites under application for land title through the Guyana Land and Survey Commission since all the proposed site fall under state land ownership;
- ✓ Confirmation of no concerns about the potential impact on the Public Rights of Way in the area;
- ✓ No concern related to the accessibility to the proposed sites.

In overall EES team see the consultation process as successful, providing vital information to local resident and stakeholders about the proposed projects. Also during the sites visit EES team had the opportunity of inspect the proposed sites assuring the technical feasibility for such proposals, ensuring the benefit for the communities and maximising the positives effects.

6 RESETTLEMENT PLAN

A land and population census were carried out at each of the three sites to determine the exact number of persons that would be affected by land acquisition and any related impacts that can occur as a result of the project. This information is critical as it provides the basis on which eligibility for compensation is determined.

Based on the census, it was determined that the three sites being considered for the establishment of the Solar PV Farms are all on state lands. The site in Lethem, which is adjacent to the current Lethem Power Company Inc. has already been acquired by the Company for use under the Project. The sites at South Bartica, which has already been earmarked in the GBDP for the Solar PV Farms, and Mahdia are also currently unoccupied with no human settlements or economic activities. It is therefore evident that there will be no physical displacement of occupants on the land where the Solar PV Farms will be established, no losses, and none of the units or persons, indigenous or otherwise, would be affected by the project. As such, no resettlement plan is required under the project.

6.1 Livelihood Restoration Plan

Given that there is no resettlement that will occur as a result of the project, the preparation of a livelihood restoration plan is not required. However, since lack of employment and poverty were cited as important social considerations for the residents of the area, the project can consider livelihood interventions, such as skills-based training and the provision of short-term employment that could be of benefit to the residents in the three areas.

6.2 Displacement of Physical Assets and Social Services

Based on the surveys, it was determined that none of the facilities and services identified in the Bartica, Mahdia and Lethem area would be displaced or affected by the project, and as such there is no need for resettlement or compensation within the three sites.

7 INSTITUTIONAL AND LEGAL FRAMEWORK

7.1 National Institutional and Legal Framework

The Government of Guyana, through the Ministry of Public Infrastructure., has secured funding from the Inter-American Development Bank (IDB) for the ‘Guyana Hinterland Electrification Programme’s Solar Photovoltaic (PV) Farms Project’. This initiative, which entails the development of grid-connected solar PV systems, aims to promote socio-economic development through the supply of reliable and affordable electricity to six hinterland communities and reduce carbon dioxide emissions from the power sector by utilising an indigenous renewable energy source. The project will be implemented initially in three communities including Lethem (Region 9), Bartica (Region 7), and Mahdia (Region 8). As an important first step in any developmental project, it is necessary that a comprehensive review of the institutional and legislative framework be conducted so as to ensure that the project is consistent and fully compliant with all national and international requirements. With this in mind, the specific institutional and legislative arrangements in Guyana that are of relevance to this project are:

Land-related Provisions

1. State Lands Act 1903
2. National Land Use Plan 2013

Environment-related Provisions

1. Constitution of the Cooperative Republic of Guyana Act 1980
2. Environmental Protection Act 1996
3. Environmental Protection (Authorisation) Regulations 2000
4. Environmental Protection (Water Quality) Regulations 2000
5. Environmental Protection (Air Quality) Regulations 2000
6. Environmental Protection (Hazardous Wastes Management) Regulations 2000
7. Environmental Protection (Noise Management) Regulations 2000
8. Wildlife Conservation and Management Act 2016
9. Forests Act 2009
10. Low Carbon Development Strategy 2009
11. National Biodiversity Strategy and Action Plan 2012
12. Green State Development Strategy Framework 2017

Indigenous-related Provisions

1. Amerindian Act 2006

Energy-related Provisions

1. Guyana Energy Act 1997
2. Electricity Sector Reform Act 1999

7.2 Land-related Provisions

7.2.1 State Lands Act 1903

The Act was enacted to provide for the proper regulation of public lands, rivers and creeks of the state (GoG 1903). The Act was amended in 1929 and 1953, and later consolidated on January 01, 2012. All state lands fall under the jurisdiction of the Guyana Lands and Surveys Commission (GLSC) which is a national-level institution established on June 01, 2001, through the implementation of the Guyana Lands and Surveys Act, 1999. The GLSC is the custodian of all public lands, rivers and creeks of Guyana and oversees the administration of lands for the development and benefit of land owners and the state.

7.2.2 National Land Use Plan 2013

The GLSC has developed a draft National Land Use Plan (NLUP) 2013 which “provides a strategic framework to guide land development in Guyana.” (GL&SC 2013). A draft National Land Use Policy is in existence and provides the policy context for all land uses in the country. Regional land use plans are being developed through a phased process to ensure more localized and contextual land use planning and management.

7.3 Environment-related Provisions

7.3.1 Constitution of the Cooperative Republic of Guyana Act 1980

The Constitution is considered to be the supreme law of the country. Guyana’s commitment to the environment and sustainable development is enshrined in the Constitution which states that “Every citizen has a duty to participate in activities to improve the environment and protect the health of the nation” and “In the interest of the present and future generations the state will protect rational use of its flora and fauna and will take all appropriate measures to conserve and improve the environment” (GoG 1980). Further, the Constitution charges that the wellbeing of the nation depends on preserving clean air, fertile soils, pure water and the rich diversity of plants, animals and ecosystems.

7.3.2 Environmental Protection (EP) Act 1996

The EP Act under which the Environmental Protection Agency (EPA) was established provides for the management, conservation, protection and improvement of the environment (EPA 1996). It also has provisions for the prevention or control of pollution, assessment of the impact of economic development on the environment and the sustainable use of natural resources. The Act mandates the conduct of Environmental Impact Assessments for projects with potential significant impacts on the environment. The EP Act also allows for the development of

regulations to govern environmental protection in Guyana. In 2000, five different regulations were enacted under the Act as follows:

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

7.3.3 Environmental Protection (Authorization) Regulations 2000

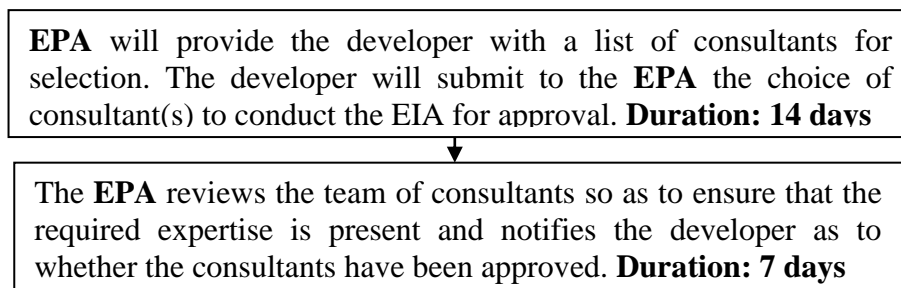
The Regulations outlines the procedure and requirements for issuing Environmental Authorizations (Permit) for any developmental activity which may have adverse impacts on the environment (EPA 2000b). Due to the nature of the proposed project and the potential negative impacts that the installation of transmission lines may have on the environment if not properly managed, the Project may be required to have an Environmental Authorisation which will stipulate permitted conditions for ensuring and maintaining environmental integrity of the area before the commencement of activities and throughout the life of the project.

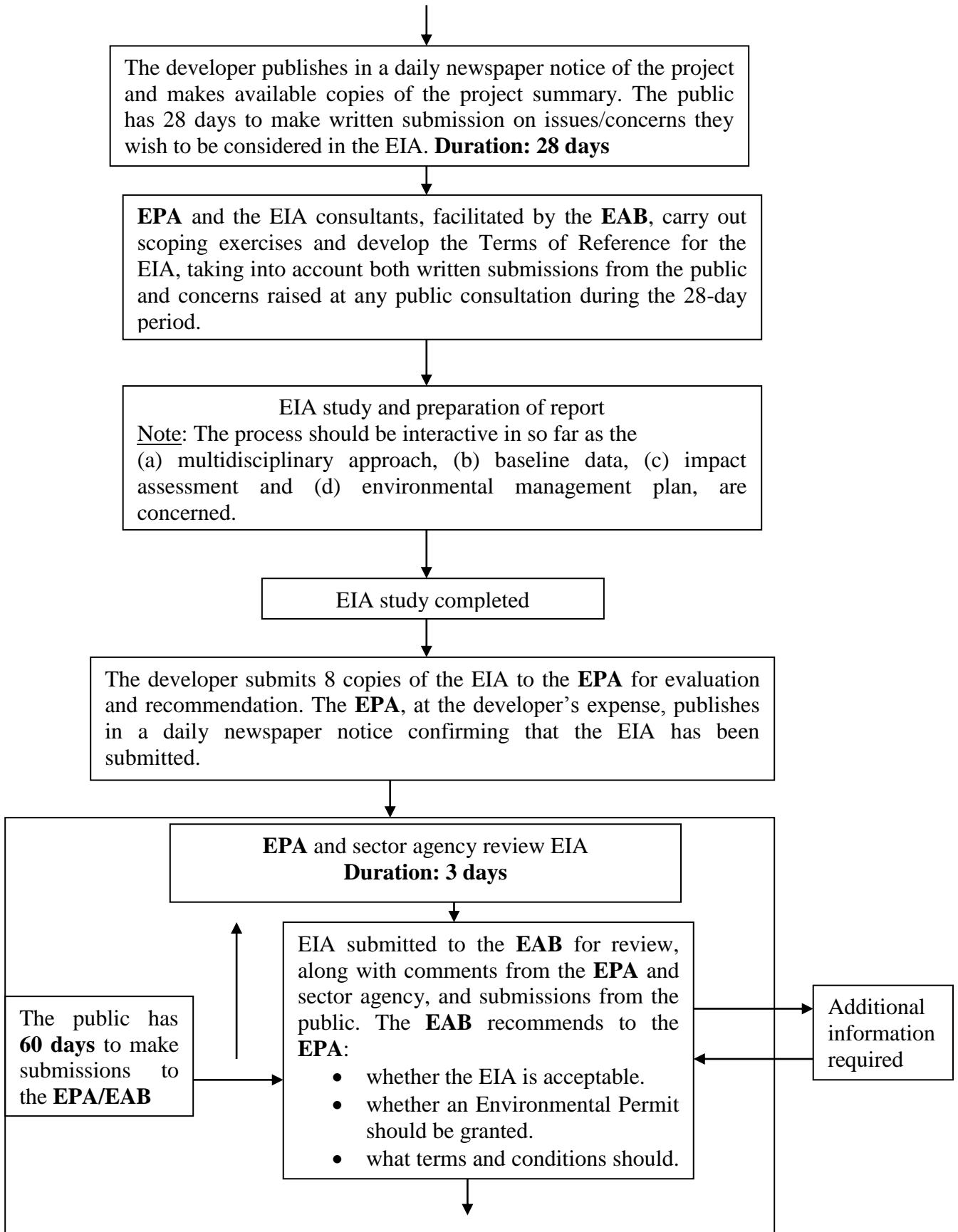
EPA's Role in EIAs

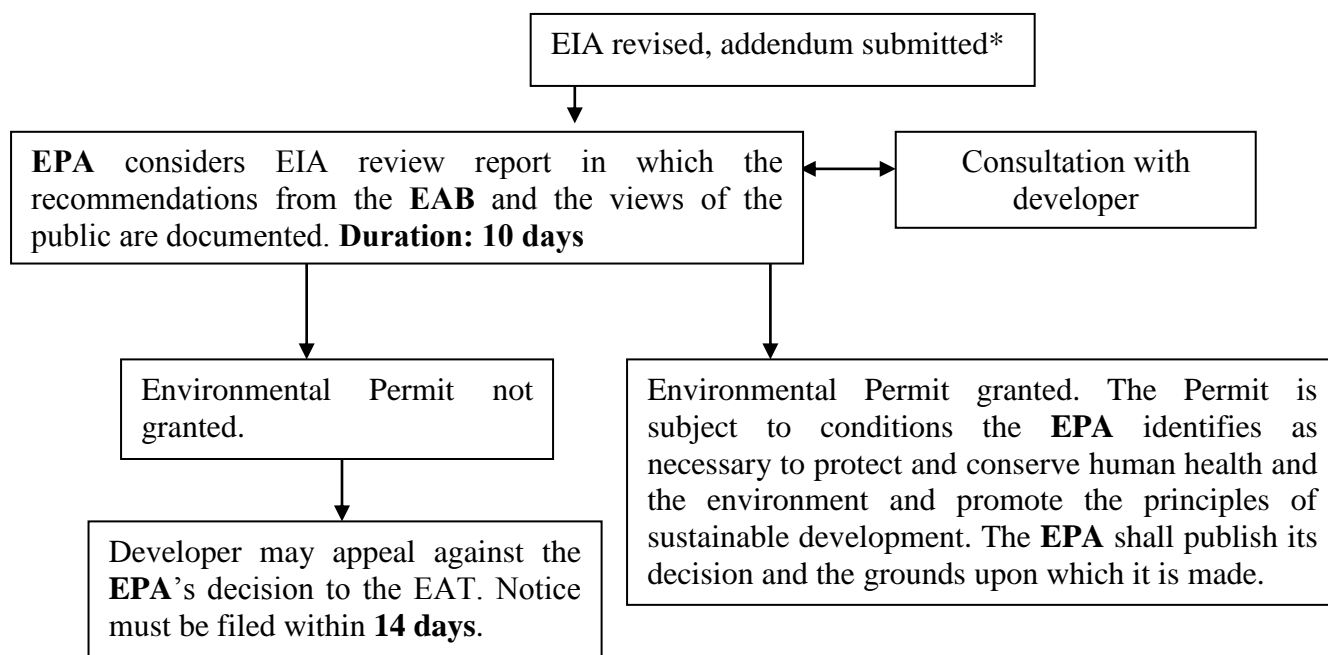
The EP Act mandates four functions of the EPA in relation to environmental assessments. These are:

1. To take such steps as are necessary for the effective management of the natural environment so as to ensure conservation, protection and sustainable use of natural resources.
2. To promote the participation of members of the public in the process of integrating environmental concerns in planning for development on a sustainable basis.
3. To ensure that any development activity which may cause an adverse effect on the natural environment be assessed before such activity is commenced and that such adverse effect is taken into account in deciding whether or not such activity should be authorized.
4. To coordinate environmental management activities of all persons, organizations and activities, including monitoring in accordance with the conditions of the Environmental Authorization.

The EIA process, as described in this section is illustrated in Figure 56 below:







**Depending on the significance of the information requested, the EIA may need to be re-submitted either as a revised document or as an addendum to the EIA.*

Figure 56: Flow Chart of the EIA required process established by the EPA

7.3.4 Environmental Protection (Water Quality) Regulations 2000

The Regulations was established to protect the country's inland and coastal water resources by controlling and managing effluent discharge (EPA 2000e). These regulations require that any developer who is desirous of commencing any operation, construction, modification and/or extension of a facility which discharges or has the potential to discharge effluent must first apply for an Environmental Authorisation. The regulations further state that effluents discharged in inland/ coastal water or land shall not exceed established discharge parameter limits set by the Guyana National Bureau of Standards (GNBS). The provisions reiterate that there must be the establishment of sampling points; effective record keeping, reporting on effluent discharges, water quality and biological integrity; management of spills/accidental discharges and encouragement of proper disposal/treatment of effluents discharge. This project, therefore, will ensure that there is adherence to the water quality regulations, where necessary, to safeguard the environment and ensure that the project activities are conducted in keeping with the legal requirements of the country.

7.3.5 Environmental Protection (Air Quality) Regulations 2000

The Regulations outlines the allowable amount of air pollutants which may be emitted into the atmosphere (EPA 2000a). The regulations require that any developer involved in any construction, installation, operation, modification and/or extension of any facility that emits air

contaminant must apply for an environmental authorization from the EPA. The regulations also include the air contaminants for which parameter limits are to be established.

7.3.6 Environmental Protection (Hazardous Waste Management) Regulations 2000

The Regulations was developed with the primary aim of protecting the environment by controlling the discharge of hazardous waste materials. The regulations require that any Developer involved in any operations that generates, transports, treats, stores or disposes of hazardous waste must submit an application for an Environmental Authorisation (EPA 2000c). The regulations also outline the provisions for reporting, record keeping, emergency preparedness planning and transportation of hazardous waste, while at the same time encouraging that Developers utilise appropriate disposal and/or treatment mechanisms of hazardous waste identified in the regulations.

7.3.7 Environmental Protection (Noise Management) Regulations 2000

The Regulations seeks to manage and control noise emission levels within Guyana. According to these regulations, it is required that any Developer involved in any construction, installation, operation, modification and/or extension of a facility that emits noise must apply for an environmental authorisation from the EPA (EPA 2000d). The regulations also stipulate that noise decibel levels are not to be greater than the established permissible noise levels/limits of the GNBS which have been adopted by the EPA.

7.3.8 Wildlife Conservation and Management Act 2016

The Act provides for the protection, conservation, management, sustainable use, and internal and external trade of Guyana's wildlife. It applies to all wildlife species including those that are listed under Appendix I-III of the CITES. The Act establishes the Guyana Wildlife Conservation and Management Commission, a body corporate, designated as the CITES Management Authority of Guyana and a Wildlife General Fund to fund the operations of the Commission.

7.3.9 Forests Act 2009

The Act seeks to repeal and replace the Guyana Forestry Act 1979, re-establish the Guyana Forestry Commission (GFC) and provide for incidental matters relating to forest and forest resources. It focuses on the utilization and conservation of Guyana's forests and mandates the GFC to regulate the harvesting, marketing, export and transportation of timber. The Act also empowers the Minister responsible for the forestry sector to make regulations governing the harvesting of forestry produce, the operation of sawmills, restricting the exploitation of certain species and other matters related to the state forest. Additionally, the GFC is required to consult with the GLSC before issuing any forest concession agreement.

7.3.10 Low Carbon Development Strategy (LCDS) 2009

In 2009, the former President of Guyana set out a vision to forge a new low carbon economy in Guyana. The vision was translated into a national low carbon development strategy, which aims to achieve two goals. These include the transformation of Guyana's economy to deliver greater economic and social development for the people of Guyana by following a low carbon development path; and the provision of a model for the world on how climate change can be addressed through low carbon development in developing countries, if the international community takes the necessary collective actions, especially relating to REDD Plus. Following the election of a new Government in 2015, steps have been taken to develop a Green State Development Strategy which is intended to be a more comprehensive strategy that sets out Guyana's path to achieving a green economy.

7.3.11 National Biodiversity Strategy and Action Plan (NBSAP) 2012

The Government of Guyana adopted its first National Biodiversity Action Plan (NBAP I) in 1999, reviewed it in 2005, and developed its second NBAP in 2007 (NBAP II). The third NBSAP was later developed in 2012 and covers the period 2012-2020. This strategy and action plan which serves as the strategic framework for biodiversity management in the country, has nine strategic objectives. It also outlines key priority actions for implementation including the review of existing legislation and outcomes of EIAs and their roles in protecting biodiversity.

7.3.12 Green State Development Strategy (GSDS) Framework 2017

The draft GSDS Framework provides an overview of the current economic, environmental and social context within Guyana. The document is a consolidation of the relevant goals and targets and an outline of the strategic areas to be developed with expert groups and through broad national multi-stakeholder consultations. The GSDS Framework is built on past strategies and lays out the elements to be examined and consulted upon during the course of the GSDS's development. These include green infrastructural transformation; development of new climate resilient infrastructure, sustainable management of natural resources including establishment of conservation areas, renewable energy transition, capacity building for human development through the acquisition of green skills, and improved institutional governance and international cooperation for green trade and investment. The process for the development of the GSDS is ongoing.

7.4 Indigenous-related Provisions

7.4.1 Amerindian Act 2006

The Act provides for the recognition and protection of the collective rights of Amerindian villages and communities, the granting of land to Amerindian villages and communities and the

promotion of good governance. It establishes the National Toshias Council, which is a body corporate comprising of all Toshias in Guyana and the election of Village Councils for the administration and management of each respective village. The Act also covers entry and access into villages and communities for research and official business, the issuance of leases, and the processes for the conduct of mining and forestry activities on village lands.

7.5 Energy-related Provisions

7.5.1 Guyana Energy Agency Act 1997

This Act came into effect in 1998 and established the Guyana Energy Agency (GEA), which falls under the purview of the Minister of Public Infrastructure (GEA 1997). The GEA has responsibility for advising and recommending to the subject minister methods to secure effective management of energy and sources of energy, and for the development and utilization of alternative sources of energy. The Agency has responsibility for development and implementation of the National Energy Policy and also acts as a consultative body to the minister as it relates to instructions for compliance in energy matters. Additionally, the GEA is responsible for conducting research into more effective sources of energy and utilization of energy.

7.5.2 Electricity Sector Reform Act 1999

This Act established the licensing requirements to be adhered to by a commercial entity supplying electricity to any person, premises or geographical areas (GoG 1999). The Act further sets out the conditions which must be satisfied for the issuance of a license to an Independent Power Producer (IPP) for the generation of electricity for sale to a public supplier.

7.6 International Conventions and Agreements

In addition to the national institutional and legal framework, there are several international conventions and agreements that may be of relevance to the project: These include:

- Rio Declaration
- Agenda 21
- United Nations Framework Convention on Climate Change
- Paris Agreement
- United Nations Convention on Biological Diversity
- United Nations Declaration on the Rights of Indigenous Peoples

7.6.1 Rio Declaration

The Rio Declaration on Environment and Development resulted from the United Nations Conference on Environment and Development (UNCED) held in Rio de Janeiro in 1992 (UN 1992). The Rio Declaration consisted of 27 principles intended to guide future sustainable development around the world. It confirms the responsibilities of all countries including Guyana to among other principles:

- Use the precautionary approach to prevent environmental degradation (Principle 15)
- Undertake activities having environmental impacts with full public participation (Principle 10)
- Include indigenous peoples and their communities in development projects (Principle 22)

7.6.2 Agenda 21

This was also developed from the UNCED and outlines a number of environmental policy and management issues for a more sustainable pattern of development in the 21st century. Four major areas of political action were identified in Agenda 21 – social and economic development, natural resources including fragile ecosystems, major organizations and groups of people, and means of implementation (Selman, 1996). Further, 27 environmental principles for the protection of environmental resources were outlined as the Agenda 21 action programmes. These global principles have since guided the development of a national policy on environmental impact assessment.

The UNCED Conference also initiated global statements on key environmental issues. These include the Framework Convention on Climate Change and the Convention on Biological Diversity to which Guyana is signatory. More recently, Guyana also became one of the first countries to sign on to the landmark Paris Agreement and must therefore consider and comply with these global instruments during environmental impact assessments for development projects.

7.6.3 United Nations Framework Convention on Climate Change (UNFCCC)

The UNFCCC was entered into force on November 27, 1994 to achieve stabilization of greenhouse gas concentrations at a level that would prevent dangerous anthropogenic interference with the climate system. Further, it required that acceptable levels of greenhouse gas be achieved within a timeframe that is sufficient to allow ecosystems to adapt naturally to climate change. In keeping with the provisions of the Convention, a national climate change committee was established, and a national inventory of greenhouse gases was prepared for base-year 1994. Measures related to technology transfer, capacity building requirements, vulnerability assessment and adaptation measures have also been compiled and implemented over the years.

More recently Guyana, through the Office of Climate Change, which is also the National Focal Point for the Convention in Guyana, is working to develop a national climate change policy.

7.6.4 Paris Agreement

The Paris Agreement, the first global legally binding climate Agreement, was entered into force on November 04, 2016, and sets out the framework for parties to take measures to limit the global increase in temperature. As a requirement under the Agreement, Guyana prepared and submitted its Nationally Determined Contributions (NDCs) which outline the actions that it will take in its fight against climate change. Under the Agreement, Guyana has made a commitment to pursue alternative energy sources, and has identified a mix of wind, solar, biomass and hydropower to supply both the demand of the national grid and the energy requirements for towns and villages in Guyana's hinterland. This energy mix is expected to help the country achieve national energy requirements and meet its international targets.

7.6.5 United Nations Convention on Biological Diversity (UNCBD)

The UNCBD was entered into force on November 12, 1997 with the main objectives being the conservation of biological diversity (defined as the variability among living organisms from all sources including interalia, terrestrial, marine and other aquatic ecosystems and the ecological complexities of which they are part including diversity within species, between species and of ecosystems), the sustainable use of its components, and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources.

7.6.6 United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP)

The UNDRIP was established in 2007 with the aim of encouraging countries to collaborate with indigenous peoples to find solutions to global development challenges. The Declaration sets out the individual and collective rights of indigenous peoples, as well as their rights to culture, identity, language, employment, health, education and other issues. It also "emphasizes the rights of indigenous peoples to maintain and strengthen their own institutions, cultures and traditions, and to pursue their development in keeping with their own needs and aspirations". It also "prohibits discrimination against indigenous peoples", and "promotes their full and effective participation in all matters that concern them and their right to remain distinct and to pursue their own visions of economic and social development".

In keeping with the provisions of the legislation described above, a brief overview of the environmental and social studies required under this project, based on the level of socio-environmental risk to ensure compliance with national, provincial, and municipal legislation is presented in Table 13 below.

Table 13: Environmental and Social Studies required based on level of socio-environmental risk to ensure compliance with national, provincial, and municipal legislation

Legislation	Potential Socio-environmental Risk	Level of Risk (High, Medium, Low)	Studies Required
Land-related Provisions	Impacts to Road Use and Safety during installation	Medium	Lands, Livelihood and Living Census
	Potential Impact to vulnerable groups	Low	Population and Vulnerability Census
Environment-related Provisions	Noise and Vibration Impacts from Construction Activities, including transportation of construction equipment	Medium	Noise and Vibration Surveys
	Erosion potential during construction and operation	Low	Geotechnical and Topographic Surveys
	Impacts to threatened species and endangered and ecological communities	Low	Literature Review/Rapid Biological Assessment
	Potential impacts to native vegetation and wildlife habitat	Low	Vegetation Mapping and Analysis
	Impact of dust from construction activities	Low	Air quality Surveys
	Potential impacts from waste during construction	Low	Effluent Site Surveys
Health, Safety and Labour-related Provisions	Transportation, handling and storage of hazardous materials during construction	Low	Assessment of transportation and use techniques, and emergency response schemes
Energy-related Provisions	Energy consumption and greenhouse gas emissions	Low	Energy Consumption Assessment

7.7 Compliance with the Directives of the IDB's Policies and Safeguards

The IDB applies safeguards throughout the life cycle of the project to ensure that its operations are environmentally sustainable. The key requirements for the IDB Environmental and Safeguards Compliance Policy (OP-703) that are relevant to this project are as follows:

- Directive B1: The Bank will only finance operations and activities that comply with the directives of this policy and are consistent with the relevant provisions of other Bank policies.
- Directive B2: The Bank will require the borrower for that operation to ensure that it is designed and carried out in compliance with environmental laws and regulations of the country where the operation is being implemented, including national obligations established under ratified Multilateral Environmental Agreements.
- Directive B3: All operations financed by the Bank will be screened early in the preparation process and classified according to their potential environmental impacts. Any operation that is likely to cause significant negative environmental and associated social impacts, or have profound implications affecting natural resources, will be classified as a Category A. These operations will require an environmental assessment (EA), normally an Environmental Impact Assessment (EIA) for investment operations. Category A operations are considered high safeguard risk. Operations that are likely to cause mostly local and short-term negative environmental and associated social impacts and for which effective mitigation measures are readily available are classified as Category B. These operations will normally require an environmental and/or social analysis according to and focusing on the specific issues identified in the screening process and an environmental and social management plan.
- Directive B4: In addition to risks posed by environmental impacts, the Bank will identify and manage other risk factors that may affect the environmental sustainability of its operations. These risk factors may include elements such as the governance capacity of executing agencies/borrower, sector-related risks, risks associated with highly sensitive environmental and social concerns, and vulnerability to disasters.
- Directive B5: Preparation of Environmental Assessments (EA) and associated management plans and their implementation are the responsibility of the borrower. The Bank will require compliance with specified standards for Environmental Impact Assessments (EIAs) which includes as a minimum screening and scoping for impacts; timely and adequate consultation and information dissemination process; and examination of alternatives including a no project scenario. The EIA should be supported by economic cost benefit assessments of the project's environmental impacts and/or the associated protection measures.

- Directive B6: As part of the environmental assessment process, Category A and B operations will require consultations with affected parties and consideration of their views. Consultations with other interested parties may also be undertaken in order to consider a broader range of expertise and perspectives. Category A operations will be consulted at least twice during project preparation, that is, during the scoping phase of the environmental assessment or due diligence processes and during the review of the assessment reports. For Category B operations, affected parties must be consulted at least once, preferably during the preparation or review of the ESMP as agreed with the borrower.
- Directive B7: The Bank will monitor the executing agency/borrower's compliance with all safeguard requirements stipulated in the loan agreement and project operating or credit regulations.
- Directive B9: The Bank will not support operations, that in its opinion, significantly convert or degrade critical natural habitats or that damage critical cultural sites. Whenever feasible Bank-financed operations will be sited on lands already converted. In addition, the Bank will not support operations involving the significant conversion or degradation of natural habitats unless there are no feasible alternatives acceptable to the Bank; comprehensive analysis demonstrates that overall benefits from the operation substantially outweigh the environmental costs; and mitigation and compensation measures are acceptable to the Bank – that is they are adequately funded, implemented and monitored.
- Directive B10: The production, procurement, use and disposal of hazardous material and substances should be avoided whenever possible and minimised in other cases to avoid adverse impacts to the environment, and human health and safety.
- Directive B11: Bank-financed operations will include, as appropriate, measures to prevent, reduce, or eliminate pollution emanating from their activities.
- Directive B17: Where agreed with the borrower, suitable safeguard provisions for procurement of goods and services in Bank-financed projects may be incorporated into project-specific loan agreements, operating regulations and bidding documents as appropriate to ensure environmentally responsible procurement.

The key requirements for the IDB Disaster Risk Management Policy (OP-704) that are relevant to this project are as follows:

- Directive A2: Bank-financed public and private sector projects will include the necessary measures to reduce disaster risk to acceptable levels as determined by the Bank on the basis of generally accepted standards and practices. The Bank will not finance projects that according to its analysis, would increase the threat of loss of human life, significant

human injuries, severe economic disruption or significant property damage related to natural hazards.

During the project preparation process, project teams will identify if the projects have high exposure to natural hazards or show high potential to exacerbate risk. The findings will be reported to the Bank through the social and environmental project screening and classification process. The risk of exposure to natural hazards will be considered taking into account the projected distribution in frequency, duration and intensity of hazard events in the geographic area affecting the project.

Project Teams will carry out a natural hazard risk assessment for projects that are found to be highly exposed to natural hazards or have a high potential to exacerbate risk. In the analysis of risk and project viability, consideration should be given to both structural and non-structural mitigation measures. This includes specific attention to the capacity of the relevant national institutions to enforce proper design and construction standards, and of the financial provisions for proper maintenance of physical assets commensurate with the foreseen risk.

The key requirements for the IDB Operational Policy on Gender Equality in Development (OP-761) that are relevant to this project are as follows:

- The Bank will support actions aimed at: (1) addressing the specific needs of both women and men, recognizing that, because of gender differences, women and men enjoy different advantages and face different barriers to participating in and benefiting from development; and (2) investment in the empowerment of women as a key factor in accelerating progress toward gender equality, recognizing that inequality affects women to a larger extent.
- The policy recognizes that gender inequalities interact with other inequalities that are based on socio-economic, ethnic and racial factors, exacerbating the barriers and vulnerabilities of poor, indigenous, and Afro-descendant women. For this reason, the Bank will pay particular attention to these groups.
- The Bank will actively seek opportunities to mainstream the gender perspective as a strategic dimension of its development interventions and will incorporate actions to address the issue. Within the context of the policy, gender mainstreaming is the process that seeks to have general equality and the needs of women and men be heard and addressed in the design, implementation, monitoring and evaluation of the Bank's interventions with special emphasis on public- and private sector loan operations given their importance within the institution.
- Gender equality mainstreaming will be applied systematically in all Bank development interventions. The Bank will require an analysis of its interventions' potential contribution to general equality. When the analysis so indicates, the Bank will incorporate specific actions to strengthen that contribution.

- The Bank will conduct its financial operations so as to identify and address adverse impacts and the risk of gender-based exclusion, include women and men in consultation processes, and comply with applicable legislation relating to equality between men and women. Its financial operations must, throughout all phases of the project cycle adhere to the safeguards as set forth in the policy.
- In designing its operations, the Bank will introduce measures to prevent, avoid, or mitigate any adverse impacts and/or risks of gender-based exclusion identified in the project risk analysis. These risks may include introducing unequal requirements for access to project-derived economic opportunities and benefits, including paid work, training, credit or business opportunities. Projects will apply the principles of non-discrimination, equal treatment and equal pay for work.
- In its public consultation processes, the Bank will seek the equitable participation of women and men, as well as the participation of civil society organizations. In its project-related consultations, the Bank will seek the inclusion of the women and men affected in a gender-sensitive and socio-culturally appropriate manner.
- The Bank will recognize, in any cultural or ethnic context, the right to equality between women and men, as well as the specific rights of women, as established in the national legislation of the regional member countries and in applicable international agreements.
- The Bank's support of affirmative action specifically targeted to women or men with the goal of closing existing gender gaps, meeting specific gender-based needs of either group or ensuring the participation of either group in consultations will not constitute discrimination or exclusion.

The key requirements for the IDB Operational Policy on Indigenous Peoples (OP-765) that are relevant to this project are as follows:

- The Bank will seek to support the initiatives of governments and indigenous peoples designed to promote indigenous social, economic, political and organizational development through socio-culturally appropriate activities and operations and innovative mechanisms. To be considered by the Bank, these operations specifically targeting indigenous beneficiaries must have the respective country's support or non-objection and be based on socio-culturally appropriate processes of consultation with indigenous peoples concerned. The consultations will be carried out in a manner appropriate to the circumstances, with a view to reaching agreement or obtaining consent.
- In its efforts to facilitate dialogue and support the mainstreaming of indigenous issues, the Bank will seek to address the various facets of development with identity, as far as feasible and appropriate. Of particular importance is the development of specific initiatives to implement socio-culturally appropriate project alternatives for better access by indigenous peoples to labour, production, and financial markets, technical assistance

and information technology; and support for the participation and leadership by and protection of women, the elderly, youth and children and for the promotion of equal rights.

- The Bank will take into account respect for the rights of indigenous peoples and individuals as established in the applicable legal norms according to their relevance to Bank operations.
- The Bank will conduct its operations in a way that prevents or mitigates direct or indirect adverse impacts on indigenous peoples or their individual and collective rights or assets.

The key requirements for the IDB Operational Policy on Involuntary Resettlement (OP-710) that are relevant to this project are as follows:

- Every effort will be made to avoid or minimize the need for involuntary resettlement. A thorough analysis of project alternatives must be carried out in order to identify solutions that are economically and technically feasible while eliminating or minimizing the need for involuntary resettlement.
- Particular attention must be given to socio-cultural considerations, such as the cultural or religious significance of the land, the vulnerability of the affected population, or the availability of in-kind replacement for assets, especially when they have important intangible implications.

7.8 Additional Provisions Relating Specifically to Indigenous Lands and Land Rights

There are several provisions outlined in the UNDRIP that are directly related to land acquisition, resettlement and compensation as follows:

- Article 8 (2): States shall provide effective mechanisms for prevention of, and redress for any form of forced population transfer which has the aim or effect of violating or undermining any of their rights.
- Article 10: Indigenous people shall not be forcibly removed from their lands or territories. No relocation shall take place without the free, prior and informed consent of the indigenous peoples concerned and after agreement on just and fair compensation, and where possible, with the option of return.
- Article 12: States shall provide redress through effective mechanisms which may include restitution, developed in conjunction with indigenous peoples, with respect to their cultural, intellectual, religious and spiritual property taken without their free, prior and informed consent or in violation of their laws, traditions and customs.
- Article 26 (1): Indigenous peoples have the right to the lands, territories and resources which they have traditionally owned, occupied or otherwise used or acquired.

- Article 26 (2): Indigenous peoples have the right to own, use, develop and control the lands, territories and resources that they possess by reason of traditional ownership or other traditional occupation or use, as well as those which they have otherwise acquired.
- Article 28 (1): Indigenous peoples have the right to redress, be means that can include restitution, or when this is not possible, just, fair and equitable compensation for the lands, territories, and resources which they have traditionally owned or otherwise occupied or used, and which have been confiscated, taken, occupied, used or damaged without their free, prior and informed consent.
- Article 28 (2): Unless otherwise freely agreed upon by the peoples concerned, compensation shall take the form of lands, territories and resources, equal in quality, size and legal status or of monetary compensation or other appropriate redress.
- Article 29 (3): States shall take effective measures to ensure that no storage or disposal of hazardous materials shall take place in the lands or territories of indigenous peoples without their free, prior and informed consent.
- Article 32 (2) States shall consult and cooperate in good faith with the indigenous peoples concerned with their own representative institutions in order to obtain their free, prior and informed consent prior to the approval of any project affecting their lands or territories and other resources, particularly in connection with the development, utilisation or exploitation of mineral water and other resources.
- Article 32 (3) States shall provide effective mechanisms for just and free redress for any such activities, and appropriate measures shall be taken to mitigate adverse environmental, economic, social, cultural or spiritual impact.
- Article 40: Indigenous peoples have the right to access to and prompt decision through just and fair procedures for the resolution of conflicts and disputes with States or other parties, as well as to effective remedies for all infringements of their individual and collective rights. Such a decision shall give due consideration to the customs, traditions, rules and legal systems of the indigenous peoples concerned and international human rights.

In Guyana, the Amerindian Act 2006 is the overarching legal framework for indigenous land titling and management in the country. It establishes the Village Council with overall responsibility for governing the village including, among other things, matters relating to the occupation and use of village lands; the construction and maintenance of roads, bridges, ditches, fences and other local works; and the granting of permission for business or trade on village lands. The Act grants absolute communal title to indigenous communities and does not speak to repossession of lands. Further, the village must be adequately consulted, and its free, prior and informed consent must be acquired before any public works can be conducted on village lands. All of the terms and conditions of the agreement/memorandum of understanding between the

entity executing the public works and the Village Council must be fairly negotiated and agreed prior to the commencement of any development activities.

According to IDB's Operational Policy on Involuntary Resettlement, when displacement is unavoidable, a resettlement plan must be prepared to ensure that the affected people receive fair and adequate compensation and rehabilitation. Based on the field surveys and other on-site assessments, it was determined that the establishment of the Solar PV Farms under this project, does not necessitate involuntary resettlement, and any associated compensation of persons, indigenous or otherwise, in the area. The Lethem Power Company has already allocated lands in Lethem for the purposes of this project, and the lands required in the Bartica and Mahdia area are currently under the management of the state. As Lethem and Bartica have recently been declared as towns, the Ministry of Public Infrastructure will need to formally submit an application to Mayor and City Council as well as the GLSC requesting the land in these two areas for use under this project. Lands for the establishment of the Solar PV Farms in Mahdia, which is currently being considered for township status, will need to be requested from the GLSC.

7.9 Grievance and Redress Mechanism

The IDB has recognized the need for systematic, transparent and meaningful stakeholder consultation processes to improve benefits to local communities and stakeholders and avoid delays in project design and implementation. Meaningful consultations, as a requirement of IDB policies, entail a two-way process of dialogue and engagement, instead of the one-way dissemination of information. One of ten key elements that have been identified by the IDB as critical to any meaningful stakeholder consultation process is the establishment of an appropriate and accessible grievance redress mechanism, which aims to address how stakeholders can seek remedy if they are of the opinion that the project is adversely affecting them or the environment.

Additionally, in areas where indigenous communities are existent, there is need for appropriate measures to ensure that any potential grievances are effectively addressed, and further provisions for redress in keeping with international requirements and best practices. With this in mind, the elements of an effective grievance and redress mechanism as described and illustrated by the IDB are presented below:



Figure 57: Elements of an Effective Grievance and Redress Mechanism. (Source: Meaningful Stakeholder Consultations (IDB, 2017))

Given that the project will be implemented within three different regions in the country, a localized grievance process is considered to be the most appropriate approach. It is proposed that a designated Grievance Officer be identified for each site, prior to the start of the project, to receive all complaints that may come in during the life of the project. Signposts with the contact details of the Grievance Officer should be placed at various prominent positions at the site so as to ensure that the general public can easily access the information. In cases where complainants would prefer to remain anonymous, a grievance box can also be placed at the site to receive complaints.

For complaints that are submitted directly to the Grievance Officer, these can take the form of a letter or in cases where the complainant cannot read or write, particulars of the complainant and the grievance may be documented by the Grievance Officer in a Complaints Form. All of the complaints received by the Grievance Officer should then be logged in a complaint register which should include the date of receipt of the complaint, the complainant's contact information, the subject of the grievance and a description of the grievance. Once the complaints have been documented, these complaints can then be forwarded to the Site Supervisor on a bi-weekly basis for review and action. The complaints box at the site should also be checked at biweekly intervals and any complaints that are deposited in the box should also be logged and forwarded to the Site Supervisor along with other submissions.

Once the complaints have been received by the Site Supervisor, the complaint should be reviewed and assessed within three days of receipt. Depending on the nature of the complaint, the Site Supervisor may need to consult with relevant personnel on site to determine whether the issues can be resolved at the site level. All complaints that can be resolved at the site level should be done within two weeks of receiving the complaint and the decision should be communicated to the complainant through the Grievance Officer. For complaints that cannot be addressed at the

site level, these should be forwarded by the Site Supervisor to the Hinterland Electrification Company Inc. within the Ministry of Public Infrastructure for review and action within two weeks. The decision made by the Hinterland Electrification Company Inc. should be communicated to the complainant at this time.

In cases where the complaint is not addressed to the satisfaction of the complainant, both in terms of the decision or if the complaint is not resolved within the allocated timeframe, the complainant may approach the Regional Democratic Council (RDC) for redress in addressing the matter. Currently, the RDC is the overarching local government body in each region with responsibility for the overall management and administration of the region. The RDC which falls under the Ministry of Communities administers all services required within its boundaries including health, education and public works. Therefore, issues relating to the project can be directly reported to the RDC which can then consult with the Ministry of Public Infrastructure and the Guyana Energy Agency on behalf of the complainant for resolution within three weeks.

As it relates to indigenous complainants, complaints can be directed through their respective Village Councils to the Community Development Officers (CDOs) employed by the Ministry of Indigenous Peoples Affairs. The MOIPA is responsible for enhancing the social, economic and environmental well-being of Indigenous Peoples and their lands and achieves its mandate through the deployment of 13 CDOs in the various sub-regions to monitor all village activities and projects and address certain issues within their jurisdiction and within the purview of their job descriptions. Once these issues have been reported to the CDOs, they can then be forwarded to the Principal Development Officer (PDO) based at the MOIPA for action. The PDO, and other relevant personnel within the Ministry can then consult with the Ministry of Public Infrastructure and the Guyana Energy Agency on behalf of the complainant for resolution within three weeks.

In cases where the complainant is still not satisfied with the outcome of this process, the complainant may seek further redress in the High Court. For cases that require compensation, the affected person is entitled to compensation as determined by agreement between that person and the Government through the Ministry of Public Infrastructure and the Guyana Energy Agency. In the absence of such an agreement, any compensation shall be determined based on the fair market value of the property or right in the nature of the property by the High Court.

For issues relating to the environment, the complainant can direct complaints to the Executive Director of the Environmental Protection Agency. The EP Act mandates the EPA to conduct investigations and inspections to ensure compliance with the Act and its regulations and investigate complaints relating to breaches of their legal provisions. Depending on the nature of the complaint, the EPA may need to conduct site visits in collaboration with other regulatory authorities such as the Regional Authorities, Mayor and City Council and the Central Board of Health (Public Health Officers and Occupational Health and Safety Department), to determine the level of impact, and outline conditions and measures to ensure the expeditious resolution of the complaint and protection of the environment. For indigenous communities, these complaints can be directed to the EPA through the respective regional CDOs and the Ministry of Indigenous

Peoples Affairs. The grievance and redress mechanism as described here is further illustrated in Figure 58 below.

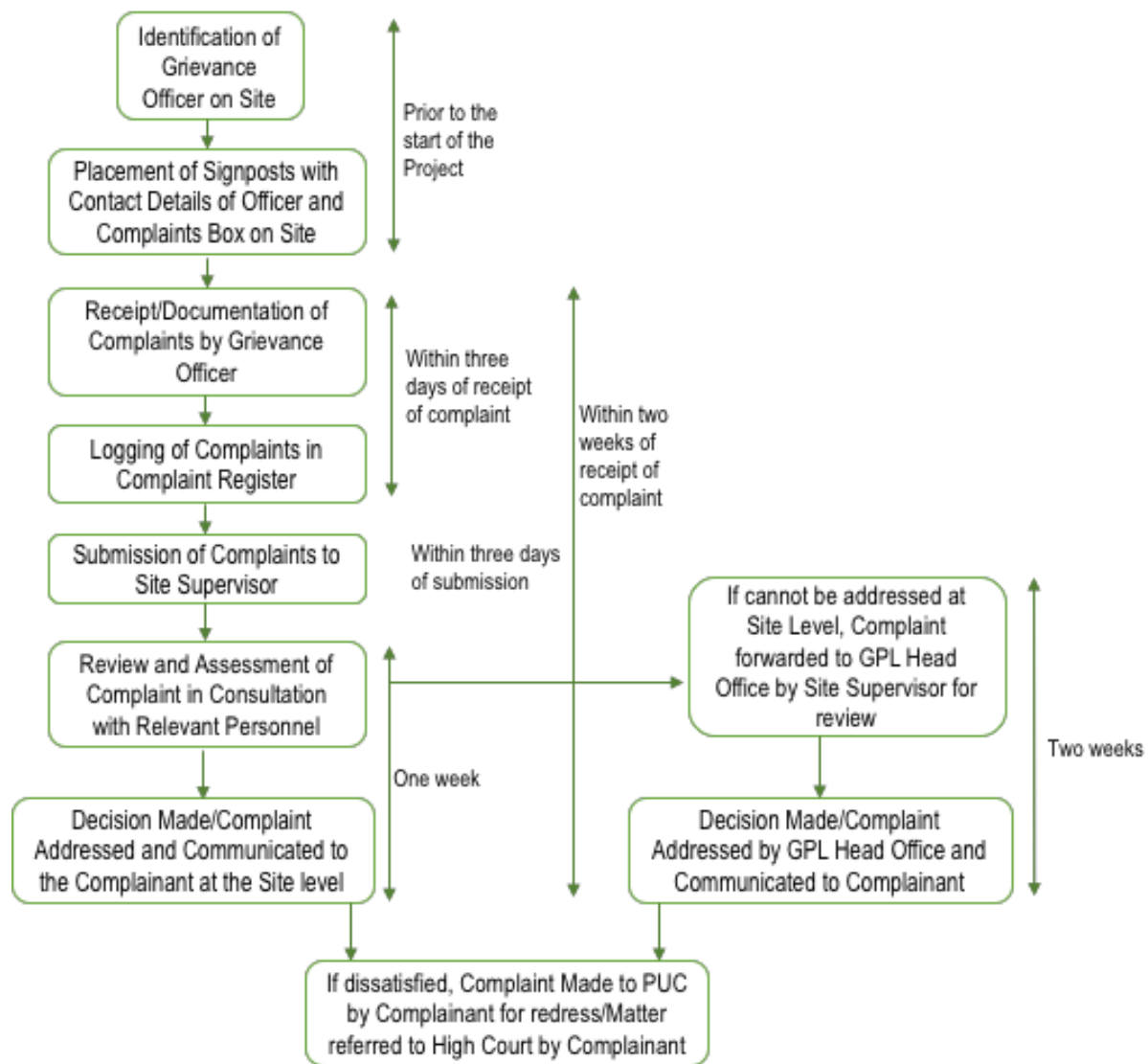


Figure 58: Overview of Grievance and Redress Mechanism Proposed under this Project

8 ENVIRONMENTAL AND SOCIAL IMPACTS ANALYSIS

As described in Chapter 1 of this report, related to the Operation “Diversification of the Energy Matrix and Energy Security (GY-L1066) entails the construction and operation of three solar systems (solar plant, substation, control room, etc.) at Lethem, Bartica, and Madhia. In this section, the Environmental and Social Impacts (ESI) of the proposed activities are identified and analyzed to inform adequate actions of control and measures of prevention of associated environmental and social risks. While the use of Photovoltaic Systems is generally considered to be among the cleaner energy technologies, there are environmental and social impacts during the construction, operation and commissioning phases that need to be identified to ensure adequate measures are implemented for the project to be environmentally and socially viable and sustainable. The analysis of environmental and socioeconomic impacts is presented for each individual site (i.e. Lethem, Bartica, Madhia). The identification and analysis of the environmental and social impacts was based on available information concerning the major activities of the proposed project, identification of potential environmental and social aspects, and analysis of the significance of the environmental and social impacts. Impacts will be assessed considering three factors: duration of the impact, its geographical extent and magnitude. Table 14 introduces the scales and definitions used for this project.

Table 14: Impact Appraisal Criteria

Criteria	Scale	Definition
Duration of effects	1. Short effects	Lasting less than a year
	2. Temporary effects	Lasting less than five years
	3. Long term	Lasting more than five years
Geographical spread	1. Local	Limited to the project site and immediate surroundings
	2. Medium	Up to 2km beyond the project site
	3. High	Up to 5km beyond the project spread
Magnitude	1. Low	Minimal and/or reversible changes to the baseline conditions in immediate surroundings
	2. Moderate	Evident changes to the baseline conditions in the surrounding area
	3. High	Significant changes to the baseline conditions

Based on these three factors the significance of an impact is determined as major; moderate; minor as shown in Table 14. The biophysical and socioeconomic aspects that were considered for the impact analysis of the three sites: Bartica, Mahdia and Lethem. The quantitative ratings of impacts on the biophysical and socioeconomic aspects are included in Chapter 3. The qualitative aspect of the impacts is discussed in subsequent tables.

Table 15: Impact Significance Criteria

Spread	Duration	Magnitude	Rating	Significance
1	1	1	1	Insignificant
1	1	2	2	Minor
1	2	1	2	Minor
2	1	1	2	Minor
1	3	1	3	Minor
1	1	3	3	Moderate
3	1	1	3	Moderate
1	2	2	4	Moderate
2	1	2	4	Moderate
2	2	1	4	Moderate
1	2	3	6	Moderate
1	3	2	6	Moderate
2	1	3	6	Moderate
2	3	1	6	Moderate
3	1	2	6	Moderate
3	2	1	6	Moderate
2	2	2	8	Moderate
3	3	1	9	Moderate
3	1	3	9	Moderate
1	3	3	9	Major
2	2	3	12	Major
2	3	2	12	Major
3	2	2	12	Major
2	3	3	18	Major
3	2	3	18	Major
3	3	2	18	Major
3	3	3	27	Major

Table 16: Biophysical and Socio-economic aspects considered for impact analysis

Biophysical	Socio-economic
Air Quality	Demography
Noise	Displacement
Soil	Employment
Land Use	Livelihood
Landscape and Visual Amenities	Socio-cultural
Solid Waste	Infrastructure
Surface Water	Health and Safety
Groundwater	
Natural Habitat	

Table 17: Air Quality

	Construction Phase	Operation	Decommissioning
Lethem	<p>Dust generation: expected to be brief, frequent, and localized due to preparation of the site and use of heavy machinery (clearing, levelling, excavation, grading). Effects can be minimized with adequate mitigation measures. The impact is considered minor.</p> <p>Nitrogen and Carbon oxides emission: expected to be brief and localized due to the operation of heavy machinery, transportation trucks, generators, compressors and other construction equipment. The impact is considered minor.</p>	<p><u>Reduction of carbon emission (+):</u> There is an expected long-term reduction of greenhouse gases emissions compared to the baseline. Based on the current annual energy production in Lethem (1,554 KWh), it is expected that the operation of the PV system will bring a reduction on CO₂ emissions of 388 tons of CO₂ every year¹. The generation of energy through the PV system will</p> <p>The impact is considered major.</p>	<p>Dust generation: expected to be brief, frequent, and localized due to preparation of the site and use of heavy machinery (clearing, levelling, excavation, grading). Effects can be minimized with adequate mitigation measures. The impact is considered minor.</p> <p>Nitrogen and Carbon oxides emission: expected to be brief and localized due to the operation of heavy machinery, transportation trucks, generators, compressors and other construction equipment. The impact is considered minor.</p>
Bartica	Similar impacts are expected	<p><u>Reduction of carbon emission (+):</u> There is an expected long-term reduction of greenhouse gases emissions compared to the baseline. Based on the current annual energy production in Bartica (2,331 KWh), it is expected that the operation of the PV system will bring a reduction on CO₂ emissions of 582 tons of CO₂ every year¹. The generation of energy</p>	Similar impacts are expected

¹ Carbon dioxide emissions were estimated utilizing the Carbon Dioxide Emissions Coefficients for diesel fuel as reported by the U.S. Energy Information Administration (EIA) at https://www.eia.gov/environment/emissions/co2_vol_mass.php.

	Construction Phase	Operation	Decommissioning
		through the PV system will The impact is considered major.	
Mahdia	Similar impacts are expected	<u>Reduction of carbon emission (+):</u> There is an expected long-term reduction of greenhouse gases emissions compared to the baseline. Based on the current annual energy production in Mahdia (1,000 KWh), it is expected that the operation of the PV system will bring a reduction on CO ₂ emissions of 250 tons of CO ₂ every year ¹ . The generation of energy through the PV system will The impact is considered major.	Similar impacts are expected

Table 18: Noise

	Construction Phase	Operation	Decommissioning
Lethem	<u>Elevated noise levels:</u> Brief, frequent and localized elevated noise levels due to construction activities, increase vehicular traffic, and use of construction equipment. The effects are limited to working hours. The impact is considered minor.	<u>Low noise levels:</u> localized low levels of noise due to operation of electrical components of the PV plant, maintenance activities, and vehicular traffic. The impact is considered minor.	<u>Elevated noise levels:</u> Brief, frequent and localized elevated noise levels due to dismantling of facilities, increased vehicular traffic, and movement of equipment. The impact is considered minor.
Bartica	Similar impacts are expected.	Similar impacts are expected.	Similar impacts are expected.
Mahdia	Similar impacts are expected.	Similar impacts are expected.	Similar impacts are expected.

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Table 19: Soil

	Construction Phase	Operation	Decommissioning
Lethem	<p><u>Loss of top soil:</u> Long-term and localized loss of top soil during site clearing and preparation activities. The impact is considered minor.</p> <p><u>Soil compaction:</u> Long-term and localized soil compaction which may cause soil erosion and surface water runoff and riverbed silting. Effects can be minimized with adequate mitigation measures. The impact is considered minor.</p> <p><u>Soil contamination:</u> Brief and localized soil contamination due to oil spills or other substances. Effects can be avoided with adequate mitigation measures. The impact is considered minor.</p>	<u>No impacts expected.</u>	<u>Soil contamination:</u> Brief and localized soil contamination due to oil spills during dismantling activities. Effects can be avoided with adequate mitigation measures. The impact is considered minor.
Bartica	Similar impacts are expected.	Similar impacts are expected.	Similar impacts are expected.
Mahdia	Similar impacts are expected.	Similar impacts are expected.	Similar impacts are expected.

	Construction Phase	Operation	Decommissioning

Table 20: Land Use

	Construction Phase	Operation	Decommissioning
Lethem	<u>Land use:</u> The site comprises 7.5 acres of land contiguous to a site currently used by LMPC. The current land use of the land can be considered as commercial/industrial. The installation of the PV systems will not significantly impact the economic activities of the area. The impact is considered minor.	<u>Land use:</u> The site will be used for energy generation for the lifetime of the facility. There is no significant change in the land use of the site. The installation of the PV systems will not significantly impact the economic activities of the area. The impact is considered minor.	<u>Land use:</u> The site will be dismantled, and the facilities removed. The future site use shall be in line with the land use of the area or be restored to its initial stage. The impact is considered minor.
Bartica	<u>Land use:</u> The proposed site comprises 5 acres of State-owned land covered by forest. Commercial species of trees have been already exploited, however, there is still a significant coverage of dense forest at the site.. The area is located at South Bartica. The Green Bartica Development Plan (GBDP) identifies Southern Bartica as the area to be industrialized along a green economy pathway. Energy production through solar farms is considered as one of the activities to take place in the eastern	Similar impacts are expected.	Similar impacts are expected.

	Construction Phase	Operation	Decommissioning
	half of Southern Bartica according to the GBDP. Therefore, there are no foreseen conflicts with regards the Land use given that the proposed project is already considered in the GBDP. The impact is considered minor.		
Mahdia	<u>Land use:</u> The proposed site comprises of 3.5 acres of land. The site is cleared of vegetation and is located about 1.6 km from current power generation facilities and with access by current road networks, and thus can be considered disturbed. The land surrounding the site is currently vacant. While there are not yet specific plans for the development of the surrounding area, the project site is state-owned land which has been designated for the development of a solar farm. The installation of the PV systems will not impact the economic activities of the area. The impact is considered minor.	Similar impacts are expected.	Similar impacts are expected.

Table 21: Landscape and Visual Impact

	Construction Phase	Operation	Decommissioning
Lethem	<u>Visual landscape:</u> The installation of the PV system will alter the visual	<u>Visual impact:</u> The PV systems will reflect sunlight and may become a	<u>Visual landscape:</u> The decommissioning of the system will

	Construction Phase	Operation	Decommissioning
	landscape of the project site. The components of the PV system will become a dominant feature of the environment. The effects can be minimized with adequate mitigation measures. The impact is considered moderate.	distraction for motorists and aircrafts. The effects can be minimized with adequate mitigation measures. The impact is considered major.	reverse the visual impacts at the proposed site. The impact is considered minor.
Bartica	<u>Visual landscape</u> : The installation of the PV system will significantly alter the visual landscape due the loss of remain vegetation from deforested land. The components of the PV system will become a dominant feature of the environment. The effects cannot be minimized extensively. The impact is considerate major.	<u>Visual impact</u> : The PV systems will reflect sunlight and may become a distraction for motorists and aircrafts. The effects can be minimized with adequate mitigation measures. The impact is considered major.	<u>Visual landscape</u> : The decommissioning of the system will not completely reverse the visual impacts at the proposed site due to the loss of dense forest. The impact Is considerate moderate.
Mahdia	<u>Visual landscape</u> : The installation of the PV system will alter the visual landscape of the project site. The components of the PV system will become a dominant feature of the environment. The effects can be minimized with adequate mitigation measures. The impact is considered moderate.	<u>Visual impact</u> : The PV systems will reflect sunlight and may become a distraction for motorists and aircrafts. The effects can be minimized with adequate mitigation measures. The impact is considered major.	<u>Visual landscape</u> : The decommissioning of the system will reverse the visual impacts at the proposed site. The impact is considered minor.

Table 22: Solid waste

	Construction Phase	Operation	Decommissioning
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	Construction Phase	Operation	Decommissioning
Lethem	<p><u>Solid waste generation Increased:</u> Waste generation will be significant during the construction phase. Important volume of green waste is expected to be generated due to the clearance of the forest. Construction waste, and domestic waste generation is expected to be temporary and localized but significant in volume. As an indirect impact, it is highly probable that temporal food supply business will increase nearby the project site. These businesses will also be a source of increased generation of solid waste that will need to be considered in the project. Poor solid waste management on site may lead to improper disposal, burning, and pollution of water resources.</p> <p>The effects can be minimized with adequate mitigation measures. The impact is considered moderate.</p>	<p><u>Solid waste generation Increased:</u> Domestic waste generation may be expected during maintenance activities on site. Although the generation will be long-term and localized, the volume generated can be considered low.</p> <p>The effects can be minimized with adequate mitigation measures. The impact is considered minor.</p>	<p><u>Solid waste generation Increased:</u> Solid waste generated is expected to increase in the decommissioning stage. Solid waste generated is expected to be localized, temporary and significant volume of domestic, scrap metal, construction waste, and hazardous waste.</p> <p>The effects can be minimized with adequate mitigation measures. The impact is considered moderate.</p>
Bartica	<p><u>Solid waste generation Increased:</u> Similar impacts are expected. However, for the Bartica site it is expected that a significant amount of green waste will be generated at this site given the vast presence of dense forest at the site (see Land use table).</p>	Similar impacts are expected.	Similar impacts are expected.

	Construction Phase	Operation	Decommissioning
	<p>It must be noted that commercial trees species have already been exploited.</p> <p>The effects can be minimized with adequate mitigation measures. The impact is considered moderate.</p>		
Mahdia	Similar impacts are expected.	Similar impacts are expected.	Similar impacts are expected.

Table 23: Surface water

	Construction Phase	Operation	Decommissioning
Lethem	<p><u>Surface water pollution:</u> Construction activities may result in pollution of nearby surface water due to runoff (increased turbidity, organic load). This is expected to be temporary and controlled with adequate drainage and wastewater management at the site.</p> <p>Potential spills of oil could cause contamination of the nearby surface water through run-off. This aspect is temporary and easily avoidable.</p> <p>Wastewater generation from construction crew living quarters may also cause increased organic load to</p>	<p><u>Surface water pollution:</u> During operation, wastewater will be generated from security/maintenance staff offices and cleaning of the PV cells. The effect is expected to be long term and can be mitigated with adequate collection and management practices.</p> <p>The removal of soil cover might generate moderate impacts due to erosions during operation also.</p> <p>Potential spills of oil could cause contamination of the nearby river. This aspect is very localized,</p>	<p><u>Surface water pollution:</u> Construction activities may result in pollution of Tacatu river due to runoff (increased turbidity, organic load). This is expected to be temporary and controlled with adequate drainage at the site.</p> <p>Potential spills of oil could cause contamination of the nearby river. This aspect is very localized, temporary and easily avoidable.</p> <p>The impact is considered moderate.</p>

	Construction Phase	Operation	Decommissioning
	nearby water bodies if not adequately managed. The impact is considered moderate.	temporary and easily avoidable. The impact is considered moderate.	
Bartica	Similar impacts are expected.	Similar impacts are expected.	Similar impacts are expected.
Mahdia	Similar impacts are expected.	Similar impacts are expected.	Similar impacts are expected.

Table 24: Groundwater

	Construction Phase	Operation	Decommissioning
Lethem	<u>Contamination of groundwater resources:</u> Groundwater resources may be impacted during the construction stage from oil spills and leaks or due to improper storage and handling. Improper solid waste and wastewater management can also impact the groundwater resources. The effects are considered temporary, and medium spread. Adequate measures can minimize potential effects. The impact is considered moderate.	<u>Contamination of groundwater resources:</u> Groundwater resources may be impacted by improper solid waste and wastewater management can also impact the groundwater resources. The effects are considered long term, and medium spread. Adequate measures can minimize potential effects. The impact is considered moderate.	<u>Contamination of groundwater resources:</u> Groundwater resources may be impacted during the decommissioning stage from oil spills and leaks or due to improper storage and handling. Improper solid waste and wastewater management can also impact the groundwater resources. The effects are considered long term, and medium spread. Adequate measures can minimize potential effects. The impact is considered moderate.
Bartica	Similar impacts are expected.	Similar impacts are expected.	Similar impacts are expected.
Mahdia	Similar impacts are expected.	Similar impacts are expected.	Similar impacts are expected.

Table 25: Natural Habitat

	Construction Phase	Operation	Decommissioning
Lethem	<p><u>Loss of natural habitat:</u> The project site is considered highly disturbed with regards its vegetation. There are also low levels of biodiversity with regards to fauna. There is no indication of presence of threatened, or protected flora or fauna species at the proposed site for construction. The impact is localized, long term, with low intensity due to the disturbed conditions of the site.</p> <p>The impact is considered minor.</p> <p><u>Noise levels:</u> Noise generated by construction workers and machinery is more likely to impact any wildlife in the surrounding area of the site. The effects are limited to the project site and immediate surroundings. Due to the low fauna biodiversity of the area the impact is considered minor.</p>	<p><u>Visual effects:</u> Solar panels reflection may affect wildlife, and transmission lines may affect bird mortality. The effects will be long term and localized.</p> <p>The impact can be considered moderate.</p>	<p><u>Noise levels:</u> Noise generated by decommissioning activities is more likely to impact any wildlife in the surrounding area of the site. The effects are limited to the project site and immediate surroundings. Due to the low fauna biodiversity of the area the impact is considered minor.</p>
Bartica	<p><u>Loss of natural habitat:</u> The project site is considered dense forest and natural habitat to a variety of fauna species. Commercial species of trees at the site have already been exploited. It is estimated that only 25% of the project site has been</p>	<p><u>Visual effects:</u> Solar panels reflection may affect wildlife. The effects will be long term and localized.</p> <p>The impact is considered major.</p>	<p><u>Noise levels:</u> Noise generated by decommissioning activities is more likely to impact any wildlife in the surrounding area of the site. The effects are limited to the project site and immediate surroundings. Due to the low fauna biodiversity of the area</p>

	Construction Phase	Operation	Decommissioning
	<p>cleared (commercial trees species). There is no indication of presence of threatened, or protected flora or fauna species at the proposed site for construction. The construction activities will result in permanent loss of natural habitat present at the site. Fauna species likely to be present at the proposed site can migrate away of the area where the effects occur. Also, it can be considered these species have relative wide habitat preferences and suitable habitat is available in the immediate surrounding area to the proposed site.</p> <p>The impact is considered major.</p> <p><u>Noise levels:</u> Noise generated by construction workers and machinery is more likely to impact any wildlife in the surrounding area of the site. Fauna species likely to be present at the proposed site can migrate away of the area where the effects occur. Also, it can be considered these species have relative wide habitat preferences and suitable habitat is available in the immediate surrounding area to the proposed site.</p>		<p>the impact is considered moderate.</p>

	Construction Phase	Operation	Decommissioning
	The impact is considered moderate.		
Mahdia	<p><u>Loss of natural habitat:</u> The project site is expected to be located about 1.6 km from current power generation facilities/utilities and within access by current road networks, and thus can be considered disturbed. Faunal diversity within Mahdia is lower compared to intact, forested areas beyond because of its level of disturbance. In such areas, the most common species are those considered generalists and those that are not disturbance sensitive. There is no indication of presence of threatened or protected flora or fauna species at the proposed site for construction. The proposed site looks clear of vegetation almost in its totality. The impact is localized, long term, with low intensity due to the disturbed conditions of the site.</p> <p>The impact is considered minor.</p>	<p><u>Visual effects:</u> Solar panels reflection may affect wildlife, and transmission lines may affect bird mortality. The effects will be long term and localized.</p> <p>The impact can be considered minor.</p>	<p><u>Noise levels:</u> Noise generated by decommissioning activities is more likely to impact any wildlife in the surrounding area of the site. The effects are limited to the project site and immediate surroundings. Due to the low fauna biodiversity of the area the impact is considered minor.</p>

Table 26: Demography

	Construction Phase	Operation	Decommissioning
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	Construction Phase	Operation	Decommissioning
Lethem	<p><u>Demography:</u> During the construction phase an increase of population is expected in the area. While residents are expected to take part in some construction activities, there may also be the need for influx of workers with specific skills. The effects are considered temporary, and localized. In general, this will bring a positive socio-economic impact to the area. However, demographics are not expected to be significantly impacted during this stage.</p> <p>The impact can be considered as minor.</p>	<p><u>Demography:</u> Operation of the PV systems doesn't require a large group of staff. Additionally, maintenance and operational activities are expected to be carried out by LMPC staff already living in the area. The effects will be long term, localized but insignificant with regards population increase due to system operation. The impact is considered minor.</p> <p><u>Socio-economic activities:</u></p> <p>An expected indirect impact of the operation of the PV systems is the increase of population in the area. The expected improvement on the reliability of the LMPC service, will naturally promote an expansion of socio-economic activities in the area thus impacting also the demography. This effect is considered high spread, long term and significant for the community.</p> <p>The impact is considered major.</p>	<p><u>Demography:</u> Decommissioning activities will need to ensure the quality of the LPCM service is not affected negatively. In such case, the removal of the system is more likely to have an impact in the socio-economic activities of the area and its demography. For the purpose of this assessment it is assumed that LMPC service after decommissioning will be maintained, therefore, decommissioning of the system is not considered to have a significant impact.</p>
Bartica	Similar impacts are expected.	Similar impacts are expected.	Similar impacts are expected.
Mahdia	Similar impacts are expected.	Similar impacts are expected.	Similar impacts are expected.

Table 27: Employment

	Construction Phase	Operation	Decommissioning
Lethem	<p><u>Employment:</u> During the construction phase employment opportunities will be generated for local skilled and unskilled labor. There will also be a demand for local goods and services which will have an impact on the earning capacity of local businesses. These impacts while positive are expected to be only temporary and localized.</p> <p>The impact is considered minor.</p>	<p><u>Employment:</u> The operation of the PV systems will be managed by LMPC staff. Therefore, a direct impact on employment generation is not expected during this phase.</p> <p><u>Socio-economic activities:</u></p> <p>An expected indirect impact of the operation of the PV systems is the increase of employment in the area. The expected improvement on the reliability of the LMPC service, will naturally promote an expansion of socio-economic activities in the area thus impacting employment opportunities. This effect is considered high spread, long term and significant for the community.</p> <p>The impact is considered major.</p>	<p><u>Employment:</u> Similarly, than the construction phase, there may be employment opportunities during the dismantling of the plant. However, this is expected to be in a much lesser extent than in the construction phase.</p> <p>The impact is considered minor.</p>
Bartica	Similar impacts are expected.	Similar impacts are expected.	Similar impacts are expected.
Mahdia	Similar impacts are expected.	Similar impacts are expected.	Similar impacts are expected.

Table 28: Displacement

	Construction Phase	Operation	Decommissioning
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	Construction Phase	Operation	Decommissioning
Lethem	<u>Displacement</u> : The proposed site is State-owned land, adjacent to LMPC Lethem power plant. There are no human settlements or economic activities currently at the proposed site. Therefore, the project will not cause any type of displacement. The process for the LPC to obtain the Land Title has begun through a request to the Guyana Lands and Surveys Commission. There are no foreseen issues for LPC to obtain the land title.	No impacts expected on the operation phase.	No impacts expected in decommissioning phase.
Bartica	<u>Displacement</u> : The proposed site is State-owned land, located at South Bartica and it is State Land. The use of the land is already considered in the GBDP to be that for solar farm. There are no human settlements or economic activities currently at the proposed site. Therefore, the project will not cause any type of displacement. The process for the LPC to obtain the Land Title has begun through a request to the Guyana Lands and Surveys Commission. There are no foreseen issues for LPC to obtain the land title.	No impacts expected on the operation phase.	No impacts expected in decommissioning phase.
Mahdia	<u>Displacement</u> : The proposed site is State-owned land, located about 1.6	No impacts expected on the operation phase.	No impacts expected in decommissioning phase.

	Construction Phase	Operation	Decommissioning
	km from current power generation facilities and with access by current road networks. There are no human settlements or economic activities currently at the proposed site. Therefore, the project will not cause any type of displacement. The process for the LPC to obtain the Land Title has begun through a request to the Guyana Lands and Surveys Commission. There are no foreseen issues for LPC to obtain the land title.		

Table 29: Livelihood

	Construction Phase	Operation	Decommissioning
Lethem	<u>Livelihood:</u> The proposed site is adjacent to the current LMPC power plant at Lethem. As discussed in the land use table, the designated land use for the site is in line with the proposed project. Therefore, the construction of the PV system is not expected to affect means of livelihood for persons in the area.	<u>Livelihood:</u> The operation of the PV system will increase energy security and access in the area and will support the development of a greener economy. It is highly likely that because of the project economic activities will expand and diversify bringing new employment opportunities and improving also the quality of life in the community. The effects will be spread at the community level and will be long term. There is also an anticipated positive effect on income generation opportunities for women.	<u>Livelihood:</u> For the purpose of this assessment it is assumed that LMPC service after decommissioning will be maintained, therefore, decommissioning of the system is not considered to have a significant impact.

		The impact is considered major.	
Bartica	<u>Livelihood:</u> There are no known economic activities currently developed on or near the site. The Bartica Green Development Plan considers the development of this area. Therefore, the construction of the PV system is not expected to affect means of livelihood for persons in the area.	Similar impacts are expected.	Similar impacts are expected.
Mahdia	<u>Livelihood:</u> The proposed site is vacant land. There are no known economic activities currently at the proposed site. Therefore, the construction of the PV system is not expected to affect means of livelihood for persons in the area.	Similar impacts are expected.	Similar impacts are expected.

Table 30: Socio-cultural

	Construction Phase	Operation	Decommissioning
Lethem	<u>Socio-cultural:</u> While there may be a temporary increase of construction workers in the area, the local customs, cultures, and social relations are not expected to be significantly impacted. There are no cultural sites on the project site.	<u>Socio-cultural:</u> The operation of the PV systems is expected to be performed by local LMPC staff. There are no expected impacts on local customs, culture, and social relations directly related to the operation of the PV systems.	<u>Socio-cultural:</u> There are no expected impacts on local customs, culture, and social relations directly related to the decommissioning of the PV systems.

	Construction Phase	Operation	Decommissioning
	Indigenous Peoples: There are no direct negative impacts expected to the Amerindian community of St. Ignatius during the construction phase. Amerindian descendants residing in the town of Lethem will benefit also from impacts considered in other section applicable to the Lethem town.	Indigenous Peoples: The Amerindian community of St. Ignatius and Amerindian descendants living in the Lethem town are expected to benefit from a reliable and efficient provision of energy through the operation of the PV farm.	
Bartica	Similar impacts are expected.	Similar impacts are expected.	Similar impacts are expected.
Mahdia	Similar impacts are expected.	Similar impacts are expected.	Similar impacts are expected.

Table 31: Infrastructure

	Construction Phase	Operation	Decommissioning
Lethem	<p><u>Infrastructure</u>: There is no expected disruption of energy or other services during construction activities. Unexpected events would have a brief and wide spread effect. However, effects can be minimized with adequate planning.</p> <p>The impact is considered minor.</p>	<p><u>Infrastructure</u>: During the operation of the PV system, the energy service is expected to be reliable. Modular PV systems are resilient to disruptive events. Even if a module is damaged, the system would remain operational. This will benefit the customers and will minimize black-outs in the area. Water supply service is expected to be impacted positively, since power disruptions to the distribution system will also be minimized.</p> <p>Effects will be long term and spread</p>	<p><u>Infrastructure</u>: For the purpose of this assessment it is assumed that LMPC service after decommissioning will be maintained, therefore, decommissioning of the system is not considered to have a significant impact.</p>

	Construction Phase	Operation	Decommissioning
		at the community level. The impact is considered major.	
Bartica	Similar impacts are expected.	Similar impacts are expected.	Similar impacts are expected.
Mahdia	Similar impacts are expected.	Similar impacts are expected.	Similar impacts are expected.

Table 32: Public Health and Safety

	Construction Phase	Operation	Decommissioning
Lethem	<p><u>Health and Safety:</u> During the construction phase there will be health and safety hazards on site and in areas surrounding the site due to increase vehicular traffic, heavy machinery operation, excavation, and other construction activities. The effects will be localized and temporary. However, the effects can be minimized by strict adherence of the Contractor to approved safety procedures.</p> <p>Influx of construction workers may lead to increase in the prevalence of sexually transmitted diseases among the local population. Considering that local labor is expected to play a major role, this concern can be regarded as low. However, health and awareness campaigns can minimize any effect.</p>	<p><u>Health and Safety:</u> workers will be exposed to occupational hazards. The probability of occurrence can be minimized by strict adherence to occupational safety procedures.</p> <p>The impact is considered minor.</p>	<p>Health and safety: Similarly than in the construction phase, exposures to hazards are expected from the decommissioning activities. Health and safety procedures shall be observed to minimize the effects.</p> <p>The impact is considered moderate.</p>

	Construction Phase	Operation	Decommissioning
	The impact is considered moderate.		
Bartica	Similar impacts are expected.	Similar impacts are expected.	Similar impacts are expected.
Mahdia	Similar impacts are expected.	Similar impacts are expected.	Similar impacts are expected.

In general, it can be concluded that the project will bring major positive impacts to the communities. While there are several impacts that are likely to cause a major or moderate negative effect, these can be minimized or avoided by implementing adequate mitigation measures.

8.1 Indigenous Peoples

The proposed project is not expected to negatively affect indigenous communities near Lethem, Bartica and Mahdia. The proposed sites do not infringe any designated lands for Amerindians and the execution of the project will not affect negatively their rights or customs. The proposed sites are and have been State-owned land; Indigenous peoples do not have any known legal rights on the proposed sites lands. There are some Amerindian communities currently receiving energy from the current power plants. . These communities will benefit from the project through a reliable provision of electricity which is likely to have an impact in the diversification and expansion of local economic activities and improved opportunities for income generation.

8.2 Other potential risks identified for the proposed project

The initial Social Environment Household Survey for the project indicates that there is an opportunity to increase the level of understanding about the benefits of the use of solar system for energy generation. There is also a perception of low local employment opportunities in the communities.

In this line, it is important for the project to maintain the community involved and informed throughout the lifetime of the project to adequately inform the expected benefits and to manage expectations. Lack of understanding of the project and the perception that the local community will not directly benefit from the project can generate community resistance to project implementation.

However, this risk can be minimized. There Community Consultation should be maintained during project execution, particularly during the construction phase to ensure the ESMP and mitigation measures are been effective and to receive feedback about the community's specific concerns and perceived risks. Furthermore, the project can be a source of employment for local skilled and non-skilled persons during the construction phase. The project should consider engaging contractors and including a requirement for local labour force in the contract documents, measures to ensure compliance is maintained should be sought. This action will foster community involvement and ownership not only during the construction but also during the operation of the facility.

8.3 Conclusion and Summary of Impacts

1. Expected social and environmental benefits.

In general, positive socio-economic impacts are expected to benefit the utilities' customers in all three sites (Lethem, Bartica and Mahdia) through reliable provision of electricity. In addition, significant reduction of operational costs in the three sites is expected to contribute to the improvement of the financial performance of the electricity provider and is supportive to the establishment of a sustainable green economy framework in Guyana. Government subsidies are

also anticipated to be significantly reduced, making valuable resources available for other developmental activities in the country. As a result of the improved and reliable provision of electricity other indirect impacts are also predictable, such as: (i) increase and diversification of economic activities in the area; (ii) improved efficiency in the health, education, water, and public safety sectors; (iii) contribution to mitigation of global climate change by reduced emissions of greenhouse gases compared to the baseline (stand-alone diesel supply), and (iv) increased income generation opportunities for women.

2. Potential negative impacts.

It is concluded that the main impacts of the project are related to the construction and permanent presence of the installations in the physical environment. The significance of these impacts depends on the type of installations and the specific site. Given that the areas for installation in Lethem and Mahdia are developed and main access roads already exist, there is in general a low level of bio-physical impacts expected and limited predominantly in the construction phase (for example, clearing of vegetation, land preparation, compaction from the transport of materials). As for the Bartica site, the major negative impacts are related to the loss of forest given the location of the project site and potential effects to surrounding fauna due the presence and operation of the facilities. However, the development of the southern Bartica area is already considered in the GBDP, and in general there is a positive balance between the negative impacts and the positive effects of the project.

Most of the analyzed impacts are considered minor or moderate for the three sites. The effects of these impacts can be significantly reduced or minimized by the implementation of mitigation measures. The mitigation measures for the construction, operation and decommissioning phases are presented in the next Section and are contained in the Environmental and Social Management Plan for each of the sites.

9 ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

The Environmental and Social Management Plan (ESMP) is an important tool to monitor the effectiveness of the identified mitigation measures and project commitments with regards environmental and social aspects to ensure sustainability of the project. The ESMP may be used to comply with requirements set in the Environmental Permit issued by the Environmental Protection Agency in Guyana (EPA).

In this section the proposed ESMP is presented to be used throughout the life of the proposed project. The ESMP will aid the management of environmental and social factors associated with the proposed project and will provide recommendations to help prevent, minimize or avoid the potential negative impacts that may occur in the project's construction, operation and decommissioning phases.

The objective of the ESMP is to (i) clearly outline the proposed mitigation measures to avoid, reduce, or minimize the effects of project impact's; and (ii) monitor project compliance with legal requirements.

The following tables describe the mitigation measures recommended for the adverse impacts that were identified, it also identified the monitoring indicators for the proposed action, and the parties involved in the implementation and monitoring of the ESMP implementation. The ESMP includes mitigation measures for the construction, operation and decommissioning phases.

Table 33: Lethem Environmental Management Plan

Construction Phase

	Issue/ Impact	Mitigation Measures	Monitoring Indicators	Responsibility for Implementation	Responsibility for Monitoring
Air Quality	Dust generation	<ul style="list-style-type: none"> ▪ Covering of stockpiles to minimize dust generation. ▪ Suppress dust from construction, stock piles and increased vehicular traffic by sprinkling water. ▪ Consider wind direction when stockpiling construction materials. Orientation shall avoid downwind residences or sensitive locations. 	<ul style="list-style-type: none"> ▪ PM monitoring. ▪ Dust generation observation. ▪ Complaints register. 	All contractors on site.	Site Supervisor.
	NO _x and CO _x emissions	<ul style="list-style-type: none"> ▪ Regular maintenance of vehicles and on-site construction equipment 	<ul style="list-style-type: none"> ▪ Equipment maintenance records according to schedule. ▪ Vehicle fitness certificates. 	All contractors on site.	Site Supervisor.
	Noise	<ul style="list-style-type: none"> ▪ Use of padding/noise isolators for construction equipment and machinery. ▪ Fixed noise sources or activities to be carried out away from site boundaries, particularly boundaries close to sensitive environments. ▪ Adequate maintenance of construction vehicles and machinery. ▪ Use of ear plugs or ear muffs for specific activities by workers. ▪ Stakeholders consultation (immediate surroundings of site) to 	<ul style="list-style-type: none"> ▪ Monitoring of dB. ▪ Complaints register. ▪ Equipment maintenance records according to schedule. ▪ Workers compliance to H&S procedures. ▪ Consultation records. 	All contractors on site.	Site Supervisor.

Table 33: Lethem Environmental Management Plan

Construction Phase

	Issue/ Impact	Mitigation Measures	Monitoring Indicators	Responsibility for Implementation	Responsibility for Monitoring
		plan activities accordingly.			
Soil	Top soil loss	<ul style="list-style-type: none"> ▪ Limit the removal of vegetation to the site footprint. ▪ Whenever possible, removed top soil should be conserved and used for remediation of affected areas. 	<ul style="list-style-type: none"> ▪ ESMP Compliance records. 	All contractors on site.	Site Supervisor.
	Soil compaction and erosion	<ul style="list-style-type: none"> ▪ Adequate drainage will be developed for the site. ▪ Planting grass or use of rocks under the solar panels is also recommended. 	<ul style="list-style-type: none"> ▪ ESMP Compliance records. 	All contractors on site.	Site Supervisor.
	Soil contamination	<ul style="list-style-type: none"> ▪ Adequate disposal of waste materials. ▪ Provision of bunded areas or secondary containment for storage of oil/fuel with 115% capacity of the stored material. ▪ Provision of spill kits at relevant locations. ▪ Construction vehicles and machinery will be serviced regularly and off-site or at impervious surfaces to avoid soil contamination. 	<ul style="list-style-type: none"> ▪ Complaints register. ▪ ESMP Compliance records. 	All contractors on site.	Site Supervisor.
	Landscape and visual impact	<ul style="list-style-type: none"> ▪ It is recommended to landscape the boundaries with adequate trees to provide a visual screen. ▪ Consultation meetings with 	<ul style="list-style-type: none"> ▪ ESMP Compliance records. ▪ Consultation meeting records. 	All contractors on site.	Site Supervisor.

Table 33: Lethem Environmental Management Plan

Construction Phase

	Issue/ Impact	Mitigation Measures	Monitoring Indicators	Responsibility for Implementation	Responsibility for Monitoring
		aeronautical authorities with regards positioning and direction of solar panels to avoid conflicts with flying airplanes.			
	Solid waste generation	<ul style="list-style-type: none"> ▪ Waste will be disposed in the community dumpsite. ▪ Adequate planning and coordination will be done with the dumpsite management to manage the increased volume expected to be generated from the site. ▪ The site will be provided with an adequate number of bins for the disposal of domestic waste. ▪ Hazardous waste management plan will be developed by contractor. Hazardous waste such as spent oil, oily rags, etc. will be stored on site and disposed of according to an approved plan and in line with EPA recommendations. ▪ Burning of waste on-site will be prohibited. ▪ Adequate arrangements will be done for the frequent collection of domestic, construction and hazardous waste. 	<ul style="list-style-type: none"> ▪ ESMP Compliance records. ▪ Consultation records with solid waste management authorities. ▪ Compliance with Hazardous waste management plan. ▪ Complaints records. ▪ Valid contract with solid waste collection contractor. ▪ Existence of at least one container bin outside the project site where food services providers are located (if necessary). 	All contractors on site.	Site Supervisor.

Table 33: Lethem Environmental Management Plan

Construction Phase

	Issue/ Impact	Mitigation Measures	Monitoring Indicators	Responsibility for Implementation	Responsibility for Monitoring
		<ul style="list-style-type: none"> ▪ The project will facilitate bins outside the site to food supply entrepreneurs and will arrange for the collection of such waste. ▪ Site and immediate surroundings cleanliness will be maintained always. 			
	Surface water pollution	<ul style="list-style-type: none"> ▪ Adequate drainage will be designed for the site to minimize run-off. ▪ Drainage system will be monitored and frequently maintained. ▪ Adequate temporary sanitary facilities will be provided for workers on-site while permanent facilities are constructed. ▪ Frequent collection of waste generated by sanitary facilities will be done by an EPA approved contractor. ▪ Provision of bunded areas or secondary containment for storage of oil/fuel with 115% capacity of the stored material. 	<ul style="list-style-type: none"> ▪ ESMP compliance records. ▪ Existence of temporary sanitary facilities. ▪ Valid contract with waste collection contractor. 	All contractors on site.	Site Supervisor.
	Groundwater pollution	<ul style="list-style-type: none"> ▪ Oil spills, fuel spill and other site contaminants will be rapidly cleaned. ▪ Adequate temporary sanitary 	<ul style="list-style-type: none"> ▪ ESMP compliance records. ▪ Existence of temporary sanitary facilities. 	All contractors on site.	Site Supervisor.

Table 33: Lethem Environmental Management Plan

Construction Phase

	Issue/ Impact	Mitigation Measures	Monitoring Indicators	Responsibility for Implementation	Responsibility for Monitoring
		<p>facilities will be provided for workers on-site while permanent facilities are constructed.</p> <ul style="list-style-type: none"> ▪ Frequent collection of waste generated by sanitary facilities will be done by an EPA approved contractor. ▪ Provision of bunded areas or secondary containment for storage of oil/fuel with 115% capacity of the stored material. 	<ul style="list-style-type: none"> ▪ Valid contract with waste collection contractor. 		
	Loss of natural habitat	<ul style="list-style-type: none"> ▪ For the Lethem site the loss of natural habitat impact is considered minor and no mitigation measures are foreseen. ▪ Noise levels will be monitored and controlled as described above to minimize additional effects to fauna in the surrounding areas. ▪ Flora and Fauna rescue campaign will be carried out before construction start. 	<ul style="list-style-type: none"> ▪ dB monitoring. 	All contractors on site.	Site Supervisor.
	Demography and Employment	<ul style="list-style-type: none"> ▪ Employment of local laborer should be maximized. ▪ Transparent recruitment process will take place. 	<ul style="list-style-type: none"> ▪ Employment records. ▪ Number of local labor employed at the site. 	All contractors on site.	Site Supervisor.
	Socio-cultural	<ul style="list-style-type: none"> ▪ Regular community consultation 	<ul style="list-style-type: none"> ▪ Monthly community 	All contractors	Site Supervisor.

Table 33: Lethem Environmental Management Plan

Construction Phase

	Issue/ Impact	Mitigation Measures	Monitoring Indicators	Responsibility for Implementation	Responsibility for Monitoring
		meetings will take place. <ul style="list-style-type: none"> ▪ A chance find procedure will be implemented by the contractor 	consultation records. <ul style="list-style-type: none"> ▪ Chance Find Procedure 	on site.	
	Infrastructure	<ul style="list-style-type: none"> ▪ Timely and adequate public announcements with regards any service interruption due to the project. 	<ul style="list-style-type: none"> ▪ Service interruption records. ▪ Duration of service interruption. 	All contractors on site.	Site Supervisor.
	Health and Safety	<ul style="list-style-type: none"> ▪ Health and Safety plan will be implemented by contractor on site. ▪ Workers awareness sessions on health and safety issues will be carried out regularly. ▪ All persons on site will use personal protective equipment (PPE). ▪ Site emergency response plans will be developed. Including Fire Safety Plan. ▪ Adequate fire-fighting equipment will be provided on site. ▪ Adequate signage on site and in surrounding areas should be visible and properly maintained. ▪ Traffic control and speed limits will be observed. ▪ Working hours will be limited to day-light, unless otherwise agreed with relevant stakeholders. 	<ul style="list-style-type: none"> ▪ H&S Plan compliance records. ▪ H&S awareness sessions attendance records. ▪ Site emergency response and Fire Safety plans developed and implemented. ▪ ESMP compliance records. ▪ Visible traffic and speed signage. 	All contractors on site.	Site Supervisor.

Table 33: Lethem Environmental Management Plan					
Construction Phase					
	Issue/ Impact	Mitigation Measures	Monitoring Indicators	Responsibility for Implementation	Responsibility for Monitoring
		<ul style="list-style-type: none"> Occupational hazards should be marked on site and staff trained on hazard recognition. Cleanliness of the site will be maintained at all times. 			

Table 34: Lethem Environmental Management Plan

Operation Phase

	Issue/ Impact	Mitigation Measures	Monitoring Indicators	Responsibility for Implementation	Responsibility for Monitoring
Air Quality	Noise	<ul style="list-style-type: none"> ▪ Use of padding/noise isolators for equipment. ▪ Adequate maintenance of vehicles and machinery. 	<ul style="list-style-type: none"> ▪ Monitoring of dB. ▪ Complaints register. ▪ Equipment maintenance records according to schedule. 	LMPC on-site staff	LMPC Regional Supervisor.
Soil	Soil contamination	<ul style="list-style-type: none"> ▪ Adequate disposal of waste materials. ▪ Provision of bunded areas for storage of oil/fuel with 115% capacity of the stored material. ▪ Provision of spill kits at relevant locations. 	<ul style="list-style-type: none"> ▪ ESMP Compliance records. 	LMPC on-site staff	LMPC Regional Supervisor.
Soil	Soil Erosion	<ul style="list-style-type: none"> ▪ Proper drainage will be maintained also for the operation phase 	<ul style="list-style-type: none"> ▪ ESMP Compliance records. 	LMPC on-site staff	LMPC Regional Supervisor.
	Visual Impact	<ul style="list-style-type: none"> ▪ Adequate landscaping of facilities. ▪ Solar panels will be installed at low distance from ground. ▪ Solar panel modules will be installed in visually aesthetical arrays. 	<ul style="list-style-type: none"> ▪ ESMP Compliance records. ▪ Complaints records. 	LMPC on-site staff	LMPC Regional Supervisor.
	Solid waste generation	<ul style="list-style-type: none"> ▪ Waste generated will be disposed in the community dumpsite. ▪ The site will be provided with an adequate number of bins for the disposal of domestic waste. ▪ Hazardous waste management plan 	<ul style="list-style-type: none"> ▪ ESMP Compliance records. ▪ Compliance with Hazardous waste management plan. ▪ Complaints records. 	LMPC on-site staff	LMPC Regional Supervisor.

Table 34: Lethem Environmental Management Plan

Operation Phase

	Issue/ Impact	Mitigation Measures	Monitoring Indicators	Responsibility for Implementation	Responsibility for Monitoring
		<p>will be developed by contractor. Hazardous waste such as spent oil, oily rags, etc. will be stored on site and disposed of according to an approved plan and in line with EPA recommendations.</p> <ul style="list-style-type: none"> ▪ Burning of waste on-site will be prohibited. ▪ Adequate arrangements will be done for the frequent collection of domestic, and other waste. ▪ Site and immediate surroundings cleanliness will be maintained at all times. 	<ul style="list-style-type: none"> ▪ Valid contract with solid waste collection contractor. 		
	Surface water pollution	<ul style="list-style-type: none"> ▪ Adequate maintenance of drainage system. ▪ Adequate operation and management of sanitary facilities /septic tank. ▪ Collection of septage by EPA approved contractor. 	<ul style="list-style-type: none"> ▪ ESMP compliance records. ▪ Valid contract with waste collection contractor. 	LMPC on-site staff	LMPC Regional Supervisor.
	Groundwater pollution	<ul style="list-style-type: none"> ▪ Oil spills, fuel spill and other site contaminants will be rapidly cleaned. ▪ Adequate operation and management of sanitary facilities /septic tank. ▪ Collection of septage by EPA approved contractor. 	<ul style="list-style-type: none"> ▪ ESMP compliance records. ▪ Valid contract with waste collection contractor. 	LMPC on-site staff	LMPC Regional Supervisor.

Table 34: Lethem Environmental Management Plan

Operation Phase

	Issue/ Impact	Mitigation Measures	Monitoring Indicators	Responsibility for Implementation	Responsibility for Monitoring
Natural Habitat	Noise levels	<ul style="list-style-type: none"> Noise levels will be monitored and controlled as described above to minimize additional effects to fauna in the surrounding areas. 	<ul style="list-style-type: none"> dB monitoring. 	LMPC on-site staff	LMPC Regional Supervisor.
	Health and Safety	<ul style="list-style-type: none"> Health and Safety plan will be implemented by operator on site. Workers awareness sessions on health and safety issues will be carried out regularly. All persons on site will use personal protective equipment (PPE). Site emergency response plans will be developed. Including Fire Safety Plan. Adequate fire-fighting equipment will be provided on site. Adequate hazards signage on site should be visible and properly maintained. Traffic control and speed limits will be observed. Cleanliness of the site will be maintained at all times. 	<ul style="list-style-type: none"> H&S Plan compliance records. H&S awareness sessions attendance records. Site emergency response and Fire Safety plans developed and implemented. ESMP compliance records. Visible traffic and speed signage. 	LMPC on-site staff	LMPC Regional Supervisor.

Table 35: Lethem Environmental Management Plan

Decommissioning Phase

	Issue/ Impact	Mitigation Measures	Monitoring Indicators	Responsibility for Implementation	Responsibility for Monitoring
Air Quality	NO _x and CO _x emissions	<ul style="list-style-type: none"> Regular maintenance of vehicles and on-site equipment 	<ul style="list-style-type: none"> Equipment maintenance records according to schedule. Vehicle fitness certificates. 	All contractors on site.	Site Supervisor.
	Noise	<ul style="list-style-type: none"> Use of padding/noise isolators for equipment and machinery. Use of ear plugs or ear muffs for specific activities by workers. Stakeholders consultation (immediate surroundings of site) to plan activities accordingly. 	<ul style="list-style-type: none"> Monitoring of dB. Complaints register. Equipment maintenance records according to schedule. Workers compliance to H&S procedures. Consultation records. 	All contractors on site.	Site Supervisor.
Soil	Soil contamination	<ul style="list-style-type: none"> Adequate disposal of waste materials. Provision of bunded areas for storage of oil/fuel with 115% capacity of the stored material. Provision of spill kits at relevant locations. Vehicles and machinery will be serviced regularly and off-site or at impervious surfaces to avoid soil contamination. 	<ul style="list-style-type: none"> Complaints register. ESMP Compliance records. 	All contractors on site.	Site Supervisor.
	Solid waste generation	<ul style="list-style-type: none"> Waste will be disposed in the community dumpsite. 	<ul style="list-style-type: none"> ESMP Compliance records. 	All contractors on site.	Site Supervisor.

Table 35: Lethem Environmental Management Plan

Decommissioning Phase

	Issue/ Impact	Mitigation Measures	Monitoring Indicators	Responsibility for Implementation	Responsibility for Monitoring
		<ul style="list-style-type: none"> ▪ Adequate planning and coordination will be done with the dumpsite management to manage the increased volume expected to be generated from the site. ▪ The site will be provided with an adequate number of bins for the disposal of domestic waste. ▪ Hazardous waste management plan will be developed by contractor. Hazardous waste such as spent oil, oily rags, etc. will be stored on site and disposed of according to an approved plan and in line with EPA recommendations. ▪ Specific provisions for the disposal of the solar panels and electrical equipment will be developed and followed by the contractor. The process will comply with International Standards and Good Practice. ▪ Burning of waste on-site will be prohibited. ▪ Adequate arrangements will be done for the frequent collection of domestic, construction and 	<ul style="list-style-type: none"> ▪ Consultation records with solid waste management authorities. ▪ Compliance with Hazardous waste management plan. ▪ Complaints records. ▪ Valid contract with solid waste collection contractor. ▪ Compliant disposal strategy for solar panels and electrical equipment. ▪ Existence of at least one container bin outside the project site where food services providers are located (if necessary). 		

Table 35: Lethem Environmental Management Plan

Decommissioning Phase

	Issue/ Impact	Mitigation Measures	Monitoring Indicators	Responsibility for Implementation	Responsibility for Monitoring
		<p>hazardous waste.</p> <ul style="list-style-type: none"> ▪ The project will facilitate bins outside the site to food supply entrepreneurs and will arrange for the collection of such waste. ▪ Site and immediate surroundings cleanliness will be maintained at all times. 			
	Surface water pollution	<ul style="list-style-type: none"> ▪ Drainage system will be monitored and frequently maintained. ▪ Adequate temporary sanitary facilities will be provided for workers on-site. ▪ Frequent collection of waste generated by sanitary facilities will be done by an EPA approved contractor. 	<ul style="list-style-type: none"> ▪ ESMP compliance records. ▪ Existence of temporary sanitary facilities. ▪ Valid contract with waste collection contractor. 	All contractors on site.	Site Supervisor.
	Groundwater pollution	<ul style="list-style-type: none"> ▪ Oil spills, fuel spill and other site contaminants will be rapidly cleaned. ▪ Adequate temporary sanitary facilities will be provided for workers on-site. ▪ Frequent collection of waste generated by sanitary facilities will be done by an EPA approved contractor. 	<ul style="list-style-type: none"> ▪ ESMP compliance records. ▪ Existence of temporary sanitary facilities. ▪ Valid contract with waste collection contractor. 	All contractors on site.	Site Supervisor.

Table 35: Lethem Environmental Management Plan					
Decommissioning Phase					
	Issue/ Impact	Mitigation Measures	Monitoring Indicators	Responsibility for Implementation	Responsibility for Monitoring
	Demography and Employment	<ul style="list-style-type: none"> ▪ Employment of local laborer should be maximized. ▪ Transparent recruitment process will take place. 	<ul style="list-style-type: none"> ▪ Employment records. ▪ Number of local labor employed at the site. 	All contractors on site.	Site Supervisor.
	Health and Safety	<ul style="list-style-type: none"> ▪ Health and Safety plan will be implemented by contractor on site. ▪ Workers awareness sessions on health and safety issues will be carried out regularly. ▪ All persons on site will use personal protective equipment (PPE). ▪ Site emergency response plans will be developed. Including Fire Safety Plan. ▪ Adequate fire-fighting equipment will be provided on site. ▪ Adequate signage on site and in surrounding areas should be visible and properly maintained. ▪ Traffic control and speed limits will be observed. ▪ Working hours will be limited to day-light, unless otherwise agreed with relevant stakeholders. ▪ Occupational hazards should be marked on site and staff trained on hazard recognition. 	<ul style="list-style-type: none"> ▪ H&S Plan compliance records. ▪ H&S awareness sessions attendance records. ▪ Site emergency response and Fire Safety plans developed and implemented. ▪ ESMP compliance records. ▪ Visible traffic and speed signage. 	All contractors on site.	Site Supervisor.

Table 35: Lethem Environmental Management Plan Decommissioning Phase					
	Issue/ Impact	Mitigation Measures	Monitoring Indicators	Responsibility for Implementation	Responsibility for Monitoring
		<ul style="list-style-type: none"> Cleanliness of the site will be maintained at all times. 			

Table 36: Bartica Environmental Management Plan
Construction Phase

	Issue/ Impact	Mitigation Measures	Monitoring Indicators	Responsibility for Implementation	Responsibility for Monitoring
Air Quality	Dust generation	<ul style="list-style-type: none"> ▪ Covering of stockpiles to minimize dust generation. ▪ Suppress dust from construction, stock piles and increased vehicular traffic by sprinkling water. ▪ Consider wind direction when stockpiling construction materials. Orientation shall avoid downwind sensitive locations. 	<ul style="list-style-type: none"> ▪ PM monitoring. ▪ Dust generation observation. ▪ Complaints register. 	All contractors on site.	Site Supervisor.
	NO _x and CO _x emissions	<ul style="list-style-type: none"> ▪ Regular maintenance of vehicles and on-site construction equipment 	<ul style="list-style-type: none"> ▪ Equipment maintenance records according to schedule. ▪ Vehicle fitness certificates. 	All contractors on site.	Site Supervisor.
	Noise	<ul style="list-style-type: none"> ▪ Use of padding/noise isolators for construction equipment and machinery. ▪ Fixed noise sources or activities to be carried out away from site boundaries, particularly boundaries close to sensitive environments. ▪ Adequate maintenance of construction vehicles and machinery. ▪ Use of ear plugs or ear muffs for 	<ul style="list-style-type: none"> ▪ Monitoring of dB. ▪ Complaints register. ▪ Equipment maintenance records according to schedule. ▪ Workers compliance to H&S procedures. ▪ Consultation records. 	All contractors on site.	Site Supervisor.

Table 36: Bartica Environmental Management Plan

Construction Phase

	Issue/ Impact	Mitigation Measures	Monitoring Indicators	Responsibility for Implementation	Responsibility for Monitoring
		specific activities by workers. <ul style="list-style-type: none"> Stakeholders consultation (immediate surroundings of site) to plan activities accordingly. 			
Soil	Top soil loss	<ul style="list-style-type: none"> Limit the removal of vegetation to the site footprint. Whenever possible, removed top soil should be conserved and used for remediation of affected areas. 	<ul style="list-style-type: none"> ESMP Compliance records. 	All contractors on site.	Site Supervisor.
	Soil compaction and erosion	<ul style="list-style-type: none"> Adequate drainage will be developed for the site. Planting grass or use of rocks under the solar panels is also recommended. 	<ul style="list-style-type: none"> ESMP Compliance records. 	All contractors on site.	Site Supervisor.
	Soil contamination	<ul style="list-style-type: none"> Adequate disposal of waste materials. Provision of bunded areas for storage of oil/fuel with 115% capacity of the stored material. Provision of spill kits at relevant locations. Construction vehicles and machinery will be serviced regularly and off-site or at impervious surfaces to avoid soil contamination. 	<ul style="list-style-type: none"> Complaints register. ESMP Compliance records. 	All contractors on site.	Site Supervisor.
	Landscape and visual	<ul style="list-style-type: none"> It is recommended to landscape the boundaries with adequate trees to 	<ul style="list-style-type: none"> ESMP Compliance records. 	All contractors on site.	Site Supervisor.

Table 36: Bartica Environmental Management Plan

Construction Phase

	Issue/ Impact	Mitigation Measures	Monitoring Indicators	Responsibility for Implementation	Responsibility for Monitoring
	impact	<p>provide a visual screen.</p> <ul style="list-style-type: none"> ▪ Consultation meetings with aeronautical authorities with regards positioning and direction of solar panels to avoid conflicts with airplanes. 	<ul style="list-style-type: none"> ▪ Consultation meeting records. 		
	Solid waste generation	<ul style="list-style-type: none"> ▪ Waste will be disposed in the community dumpsite. ▪ Adequate planning and coordination will be done with the dumpsite management to manage the increased volume expected to be generated from the site. ▪ The site will be provided with an adequate number of bins for the disposal of domestic waste. ▪ Hazardous waste management plan will be developed by contractor. Hazardous waste such as spent oil, oily rags, etc. will be stored on site and disposed of according to an approved plan and in line with EPA recommendations. ▪ Burning of waste on-site will be prohibited. ▪ Adequate arrangements will be done for the frequent collection of 	<ul style="list-style-type: none"> ▪ ESMP Compliance records. ▪ Consultation records with solid waste management authorities. ▪ Compliance with Hazardous waste management plan. ▪ Complaints records. ▪ Valid contract with solid waste collection contractor. ▪ Existence of at least one container bin outside the project site where food services providers are located (if necessary). 	All contractors on site.	Site Supervisor.

Table 36: Bartica Environmental Management Plan

Construction Phase

	Issue/ Impact	Mitigation Measures	Monitoring Indicators	Responsibility for Implementation	Responsibility for Monitoring
		<p>domestic, construction and hazardous waste.</p> <ul style="list-style-type: none"> ▪ The project will facilitate bins outside the site to food supply entrepreneurs and will arrange for the collection of such waste. ▪ Site and immediate surroundings cleanliness will be maintained at all times. 			
	Surface water pollution	<ul style="list-style-type: none"> ▪ Adequate drainage will be designed for the site to minimize run-off. ▪ Drainage system will be monitored and frequently maintained. ▪ Adequate temporary sanitary facilities will be provided for workers on-site while permanent facilities are constructed. ▪ Frequent collection of waste generated by sanitary facilities will be done by an EPA approved contractor. 	<ul style="list-style-type: none"> ▪ ESMP compliance records. ▪ Existence of temporary sanitary facilities. ▪ Valid contract with waste collection contractor. 	All contractors on site.	Site Supervisor.
	Groundwater pollution	<ul style="list-style-type: none"> ▪ Oil spills, fuel spill and other site contaminants will be rapidly cleaned. ▪ Adequate temporary sanitary facilities will be provided for workers on-site while permanent 	<ul style="list-style-type: none"> ▪ ESMP compliance records. ▪ Existence of temporary sanitary facilities. ▪ Valid contract with waste collection 	All contractors on site.	Site Supervisor.

Table 36: Bartica Environmental Management Plan

Construction Phase

	Issue/ Impact	Mitigation Measures	Monitoring Indicators	Responsibility for Implementation	Responsibility for Monitoring
		facilities are constructed. <ul style="list-style-type: none"> ▪ Frequent collection of waste generated by sanitary facilities will be done by an EPA approved contractor. 	contractor.		
	Loss of natural habitat	<ul style="list-style-type: none"> ▪ Remediation by planting of specific trees/shrubs to offset unavoidable loss of vegetation is recommended. ▪ Noise levels will be monitored and controlled as described above to minimize additional effects to fauna in the surrounding areas. 	<ul style="list-style-type: none"> ▪ dB monitoring. 	All contractors on site.	Site Supervisor.
	Demography and Employment	<ul style="list-style-type: none"> ▪ Employment of local laborer should be maximized. ▪ Transparent recruitment process will take place. 	<ul style="list-style-type: none"> ▪ Employment records. ▪ Number of local labor employed at the site. 	All contractors on site.	Site Supervisor.
	Socio-cultural	<ul style="list-style-type: none"> ▪ Regular community consultation meetings will take place. ▪ A chance find procedure will be implemented by the contractor 	<ul style="list-style-type: none"> ▪ Monthly community consultation records. ▪ Chance Find Procedure 	All contractors on site.	Site Supervisor.
	Infrastructure	<ul style="list-style-type: none"> ▪ Timely and adequate public announcements with regards any service interruption due to the project. 	<ul style="list-style-type: none"> ▪ Service interruption records. ▪ Duration of service interruption. 	All contractors on site.	Site Supervisor.
	Health and Safety	<ul style="list-style-type: none"> ▪ Health and Safety plan will be implemented by contractor on site. ▪ Workers awareness sessions on 	<ul style="list-style-type: none"> ▪ H&S Plan compliance records. ▪ H&S awareness 	All contractors on site.	Site Supervisor.

Table 36: Bartica Environmental Management Plan

Construction Phase

	Issue/ Impact	Mitigation Measures	Monitoring Indicators	Responsibility for Implementation	Responsibility for Monitoring
		<p>health and safety issues will be carried out regularly.</p> <ul style="list-style-type: none"> ▪ All persons on site will use personal protective equipment (PPE). ▪ Site emergency response plans will be developed. Including Fire Safety Plan. ▪ Adequate fire-fighting equipment will be provided on site. ▪ Adequate signage on site and in surrounding areas should be visible and properly maintained. ▪ Traffic control and speed limits will be observed. ▪ Working hours will be limited to day-light, unless otherwise agreed with relevant stakeholders. ▪ Occupational hazards should be marked on site and staff trained on hazard recognition. ▪ Cleanliness of the site will be maintained at all times. 	<p>sessions attendance records.</p> <ul style="list-style-type: none"> ▪ Site emergency response and Fire Safety plans developed and implemented. ▪ ESMP compliance records. ▪ Visible traffic and speed signage. 		

Table 37: Bartica Environmental Management Plan

Operation Phase

	Issue/ Impact	Mitigation Measures	Monitoring Indicators	Responsibility for Implementation	Responsibility for Monitoring
Air Quality	Noise	<ul style="list-style-type: none"> ▪ Use of padding/noise isolators for equipment. ▪ Adequate maintenance of vehicles and machinery. 	<ul style="list-style-type: none"> ▪ Monitoring of dB. ▪ Complaints register. ▪ Equipment maintenance records according to schedule. 	GPL on-site staff	GPL Regional Supervisor.
Soil	Soil contamination	<ul style="list-style-type: none"> ▪ Adequate disposal of waste materials. ▪ Provision of bunded areas for storage of oil/fuel with 115% capacity of the stored material. ▪ Provision of spill kits at relevant locations. 	<ul style="list-style-type: none"> ▪ ESMP Compliance records. 	GPL on-site staff	GPL Regional Supervisor.
Soil	Soil Erosion	<ul style="list-style-type: none"> ▪ Proper drainage will be maintained also for the operation phase 	<ul style="list-style-type: none"> ▪ ESMP Compliance records. 	LMPC on-site staff	LMPC Regional Supervisor.
	Visual Impact	<ul style="list-style-type: none"> ▪ Adequate landscaping of facilities. ▪ Solar panels will be installed at low distance from ground. ▪ Solar panel modules will be installed in visually aesthetical arrays. 	<ul style="list-style-type: none"> ▪ ESMP Compliance records. ▪ Complaints records. 	GPL on-site staff	GPL Regional Supervisor.
	Solid waste generation	<ul style="list-style-type: none"> ▪ Waste generated will be disposed in the community dumpsite. ▪ The site will be provided with an adequate number of bins for the disposal of domestic waste. ▪ Hazardous waste management plan 	<ul style="list-style-type: none"> ▪ ESMP Compliance records. ▪ Compliance with Hazardous waste management plan. ▪ Complaints records. 	GPL on-site staff	GPL Regional Supervisor.

Table 37: Bartica Environmental Management Plan

Operation Phase

	Issue/ Impact	Mitigation Measures	Monitoring Indicators	Responsibility for Implementation	Responsibility for Monitoring
		<p>will be developed by contractor. Hazardous waste such as spent oil, oily rags, etc. will be stored on site and disposed of according to an approved plan and in line with EPA recommendations.</p> <ul style="list-style-type: none"> ▪ Burning of waste on-site will be prohibited. ▪ Adequate arrangements will be done for the frequent collection of domestic, and other waste. ▪ Site and immediate surroundings cleanliness will be maintained at all times. 	<ul style="list-style-type: none"> ▪ Valid contract with solid waste collection contractor. 		
	Surface water pollution	<ul style="list-style-type: none"> ▪ Adequate maintenance of drainage system. ▪ Adequate operation and management of sanitary facilities /septic tank. ▪ Collection of septage by EPA approved contractor. 	<ul style="list-style-type: none"> ▪ ESMP compliance records. ▪ Valid contract with waste collection contractor. 	GPL on-site staff	GPL Regional Supervisor.
	Groundwater pollution	<ul style="list-style-type: none"> ▪ Oil spills, fuel spill and other site contaminants will be rapidly cleaned. ▪ Adequate operation and management of sanitary facilities /septic tank. ▪ Collection of septage by EPA approved contractor. 	<ul style="list-style-type: none"> ▪ ESMP compliance records. ▪ Valid contract with waste collection contractor. 	GPL on-site staff	GPL Regional Supervisor.

Table 37: Bartica Environmental Management Plan

Operation Phase

	Issue/ Impact	Mitigation Measures	Monitoring Indicators	Responsibility for Implementation	Responsibility for Monitoring
Natural Habitat	Noise levels	<ul style="list-style-type: none"> Noise levels will be monitored and controlled as described above to minimize additional effects to fauna in the surrounding areas. 	<ul style="list-style-type: none"> dB monitoring. 	GPL on-site staff	GPL Regional Supervisor.
	Health and Safety	<ul style="list-style-type: none"> Health and Safety plan will be implemented by operator on site. Workers awareness sessions on health and safety issues will be carried out regularly. All persons on site will use personal protective equipment (PPE). Site emergency response plans will be developed. Including Fire Safety Plan. Adequate fire-fighting equipment will be provided on site. Adequate hazards signage on site should be visible and properly maintained. Traffic control and speed limits will be observed. Cleanliness of the site will be maintained at all times. 	<ul style="list-style-type: none"> H&S Plan compliance records. H&S awareness sessions attendance records. Site emergency response and Fire Safety plans developed and implemented. ESMP compliance records. Visible traffic and speed signage. 	GPL on-site staff	GPL Regional Supervisor.

Table 38: Bartica Environmental Management Plan

Decommissioning Phase

	Issue/ Impact	Mitigation Measures	Monitoring Indicators	Responsibility for Implementation	Responsibility for Monitoring
Air Quality	NO _x and CO _x emissions	<ul style="list-style-type: none"> Regular maintenance of vehicles and on-site equipment 	<ul style="list-style-type: none"> Equipment maintenance records according to schedule. Vehicle fitness certificates. 	All contractors on site.	Site Supervisor.
	Noise	<ul style="list-style-type: none"> Use of padding/noise isolators for equipment and machinery. Use of ear plugs or ear muffs for specific activities by workers. Stakeholders consultation (immediate surroundings of site) to plan activities accordingly. 	<ul style="list-style-type: none"> Monitoring of dB. Complaints register. Equipment maintenance records according to schedule. Workers compliance to H&S procedures. Consultation records. 	All contractors on site.	Site Supervisor.
Soil	Soil contamination	<ul style="list-style-type: none"> Adequate disposal of waste materials. Provision of bunded areas for storage of oil/fuel with 115% capacity of the stored material. Provision of spill kits at relevant locations. Vehicles and machinery will be serviced regularly and off-site or at impervious surfaces to avoid soil contamination. 	<ul style="list-style-type: none"> Complaints register. ESMP Compliance records. 	All contractors on site.	Site Supervisor.
	Solid waste generation	<ul style="list-style-type: none"> Waste will be disposed in the community dumpsite. 	<ul style="list-style-type: none"> ESMP Compliance records. 	All contractors on site.	Site Supervisor.

Table 38: Bartica Environmental Management Plan

Decommissioning Phase

	Issue/ Impact	Mitigation Measures	Monitoring Indicators	Responsibility for Implementation	Responsibility for Monitoring
		<ul style="list-style-type: none"> ▪ Adequate planning and coordination will be done with the dumpsite management to manage the increased volume expected to be generated from the site. ▪ The site will be provided with an adequate number of bins for the disposal of domestic waste. ▪ Hazardous waste management plan will be developed by contractor. Hazardous waste such as spent oil, oily rags, etc. will be stored on site and disposed of according to an approved plan and in line with EPA recommendations. ▪ Specific provisions for the disposal of the solar panels and electrical equipment will be developed and followed by the contractor. The process will comply with International Standards and Good Practice. ▪ Burning of waste on-site will be prohibited. ▪ Adequate arrangements will be done for the frequent collection of domestic, construction and 	<ul style="list-style-type: none"> ▪ Consultation records with solid waste management authorities. ▪ Compliance with Hazardous waste management plan. ▪ Complaints records. ▪ Valid contract with solid waste collection contractor. ▪ Compliant disposal strategy for solar panels and electrical equipment. ▪ Existence of at least one container bin outside the project site where food services providers are located (if necessary). 		

Table 38: Bartica Environmental Management Plan

Decommissioning Phase

	Issue/ Impact	Mitigation Measures	Monitoring Indicators	Responsibility for Implementation	Responsibility for Monitoring
		<p>hazardous waste.</p> <ul style="list-style-type: none"> ▪ The project will facilitate bins outside the site to food supply entrepreneurs and will arrange for the collection of such waste. ▪ Site and immediate surroundings cleanliness will be maintained at all times. 			
	Surface water pollution	<ul style="list-style-type: none"> ▪ Drainage system will be monitored and frequently maintained. ▪ Adequate temporary sanitary facilities will be provided for workers on-site. ▪ Frequent collection of waste generated by sanitary facilities will be done by an EPA approved contractor. 	<ul style="list-style-type: none"> ▪ ESMP compliance records. ▪ Existence of temporary sanitary facilities. ▪ Valid contract with waste collection contractor. 	All contractors on site.	Site Supervisor.
	Groundwater pollution	<ul style="list-style-type: none"> ▪ Oil spills, fuel spill and other site contaminants will be rapidly cleaned. ▪ Adequate temporary sanitary facilities will be provided for workers on-site. ▪ Frequent collection of waste generated by sanitary facilities will be done by an EPA approved contractor. 	<ul style="list-style-type: none"> ▪ ESMP compliance records. ▪ Existence of temporary sanitary facilities. ▪ Valid contract with waste collection contractor. 	All contractors on site.	Site Supervisor.

Table 38: Bartica Environmental Management Plan

Decommissioning Phase

	Issue/ Impact	Mitigation Measures	Monitoring Indicators	Responsibility for Implementation	Responsibility for Monitoring
	Demography and Employment	<ul style="list-style-type: none"> ▪ Employment of local laborer should be maximized. ▪ Transparent recruitment process will take place. 	<ul style="list-style-type: none"> ▪ Employment records. ▪ Number of local labor employed at the site. 	All contractors on site.	Site Supervisor.
	Health and Safety	<ul style="list-style-type: none"> ▪ Health and Safety plan will be implemented by contractor on site. ▪ Workers awareness sessions on health and safety issues will be carried out regularly. ▪ All persons on site will use personal protective equipment (PPE). ▪ Site emergency response plans will be developed. Including Fire Safety Plan. ▪ Adequate fire-fighting equipment will be provided on site. ▪ Adequate signage on site and in surrounding areas should be visible and properly maintained. ▪ Traffic control and speed limits will be observed. ▪ Working hours will be limited to day-light, unless otherwise agreed with relevant stakeholders. ▪ Occupational hazards should be marked on site and staff trained on hazard recognition. 	<ul style="list-style-type: none"> ▪ H&S Plan compliance records. ▪ H&S awareness sessions attendance records. ▪ Site emergency response and Fire Safety plans developed and implemented. ▪ ESMP compliance records. ▪ Visible traffic and speed signage. 	All contractors on site.	Site Supervisor.

Table 38: Bartica Environmental Management Plan Decommissioning Phase					
	Issue/ Impact	Mitigation Measures	Monitoring Indicators	Responsibility for Implementation	Responsibility for Monitoring
		<ul style="list-style-type: none"> Cleanliness of the site will be maintained at all times. 			

Table 39: Mahdia Environmental Management Plan

Construction Phase

	Issue/ Impact	Mitigation Measures	Monitoring Indicators	Responsibility for Implementation	Responsibility for Monitoring
Air Quality	Dust generation	<ul style="list-style-type: none"> ▪ Covering of stockpiles to minimize dust generation. ▪ Suppress dust from construction, stock piles and increased vehicular traffic by sprinkling water. ▪ Consider wind direction when stockpiling construction materials. Orientation shall avoid downwind sensitive locations. 	<ul style="list-style-type: none"> ▪ PM monitoring. ▪ Dust generation observation. ▪ Complaints register. 	All contractors on site.	Site Supervisor.
	NO _x and CO _x emissions	<ul style="list-style-type: none"> ▪ Regular maintenance of vehicles and on-site construction equipment 	<ul style="list-style-type: none"> ▪ Equipment maintenance records according to schedule. ▪ Vehicle fitness certificates. 	All contractors on site.	Site Supervisor.
	Noise	<ul style="list-style-type: none"> ▪ Use of padding/noise isolators for construction equipment and machinery. ▪ Fixed noise sources or activities to be carried out away from site boundaries, particularly boundaries close to sensitive environments. ▪ Adequate maintenance of construction vehicles and machinery. ▪ Use of ear plugs or ear muffs for specific activities by workers. 	<ul style="list-style-type: none"> ▪ Monitoring of dB. ▪ Complaints register. ▪ Equipment maintenance records according to schedule. ▪ Workers compliance to H&S procedures. ▪ Consultation records. 	All contractors on site.	Site Supervisor.

Table 39: Mahdia Environmental Management Plan

Construction Phase

	Issue/ Impact	Mitigation Measures	Monitoring Indicators	Responsibility for Implementation	Responsibility for Monitoring
		<ul style="list-style-type: none"> Stakeholders consultation (immediate surroundings of site) to plan activities accordingly. 			
Soil	Top soil loss	<ul style="list-style-type: none"> Limit the removal of forest to the site footprint. Whenever possible, removed top soil should be conserved and used for remediation of affected areas. 	<ul style="list-style-type: none"> ESMP Compliance records. 	All contractors on site.	Site Supervisor.
	Soil compaction and erosion	<ul style="list-style-type: none"> Adequate drainage will be developed for the site. Planting grass or use of rocks under the solar panels is also recommended. 	<ul style="list-style-type: none"> ESMP Compliance records. 	All contractors on site.	Site Supervisor.
	Soil contamination	<ul style="list-style-type: none"> Adequate disposal of waste materials. Provision of bunded areas for storage of oil/fuel with 115% capacity of the stored material. Provision of spill kits at relevant locations. Construction vehicles and machinery will be serviced regularly and off-site or at impervious surfaces to avoid soil contamination. 	<ul style="list-style-type: none"> Complaints register. ESMP Compliance records. 	All contractors on site.	Site Supervisor.
	Landscape and visual impact	<ul style="list-style-type: none"> It is recommended to landscape the boundaries with adequate trees to provide a visual screen. 	<ul style="list-style-type: none"> ESMP Compliance records. Consultation meeting 	All contractors on site.	Site Supervisor.

Table 39: Mahdia Environmental Management Plan

Construction Phase

	Issue/ Impact	Mitigation Measures	Monitoring Indicators	Responsibility for Implementation	Responsibility for Monitoring
		<ul style="list-style-type: none"> ▪ Consultation meetings with aeronautical authorities with regards positioning and direction of solar panels to avoid conflicts with airplanes. 	records.		
	Solid waste generation	<ul style="list-style-type: none"> ▪ Waste will be disposed in the community dumpsite. ▪ Adequate planning and coordination will be done with the dumpsite management to manage the increased volume expected to be generated from the site. ▪ The site will be provided with an adequate number of bins for the disposal of domestic waste. ▪ Hazardous waste management plan will be developed by contractor. Hazardous waste such as spent oil, oily rags, etc. will be stored on site and disposed of according to an approved plan and in line with EPA recommendations. ▪ Burning of waste on-site will be prohibited. ▪ Adequate arrangements will be done for the frequent collection of domestic, construction and 	<ul style="list-style-type: none"> ▪ ESMP Compliance records. ▪ Consultation records with solid waste management authorities. ▪ Compliance with Hazardous waste management plan. ▪ Complaints records. ▪ Valid contract with solid waste collection contractor. ▪ Existence of at least one container bin outside the project site where food services providers are located (if necessary). 	All contractors on site.	Site Supervisor.

Table 39: Mahdia Environmental Management Plan

Construction Phase

	Issue/ Impact	Mitigation Measures	Monitoring Indicators	Responsibility for Implementation	Responsibility for Monitoring
		<p>hazardous waste.</p> <ul style="list-style-type: none"> ▪ The project will facilitate bins outside the site to food supply entrepreneurs and will arrange for the collection of such waste. ▪ Site and immediate surroundings cleanliness will be maintained at all times. 			
	Surface water pollution	<ul style="list-style-type: none"> ▪ Adequate drainage will be designed for the site to minimize run-off. ▪ Drainage system will be monitored and frequently maintained. ▪ Adequate temporary sanitary facilities will be provided for workers on-site while permanent facilities are constructed. ▪ Frequent collection of waste generated by sanitary facilities will be done by an EPA approved contractor. 	<ul style="list-style-type: none"> ▪ ESMP compliance records. ▪ Existence of temporary sanitary facilities. ▪ Valid contract with waste collection contractor. 	All contractors on site.	Site Supervisor.
	Groundwater pollution	<ul style="list-style-type: none"> ▪ Oil spills, fuel spill and other site contaminants will be rapidly cleaned. ▪ Adequate temporary sanitary facilities will be provided for workers on-site while permanent facilities are constructed. 	<ul style="list-style-type: none"> ▪ ESMP compliance records. ▪ Existence of temporary sanitary facilities. ▪ Valid contract with waste collection contractor. 	All contractors on site.	Site Supervisor.

Table 39: Mahdia Environmental Management Plan

Construction Phase

	Issue/ Impact	Mitigation Measures	Monitoring Indicators	Responsibility for Implementation	Responsibility for Monitoring
		<ul style="list-style-type: none"> Frequent collection of waste generated by sanitary facilities will be done by an EPA approved contractor. 			
	Loss of natural habitat	<ul style="list-style-type: none"> Noise levels will be monitored and controlled as described above to minimize additional effects to fauna in the surrounding areas. 	<ul style="list-style-type: none"> dB monitoring. 	All contractors on site.	Site Supervisor.
	Demography and Employment	<ul style="list-style-type: none"> Employment of local laborer should be maximized. Transparent recruitment process will take place. 	<ul style="list-style-type: none"> Employment records. Number of local labor employed at the site. 	All contractors on site.	Site Supervisor.
	Socio-cultural	<ul style="list-style-type: none"> Regular community consultation meetings will take place. A chance find procedure will be implemented by the contractor 	<ul style="list-style-type: none"> Monthly community consultation records. Chance Find Procedure 	All contractors on site.	Site Supervisor.
	Infrastructure	<ul style="list-style-type: none"> Timely and adequate public announcements with regards any service interruption due to the project. 	<ul style="list-style-type: none"> Service interruption records. Duration of service interruption. 	All contractors on site.	Site Supervisor.
	Health and Safety	<ul style="list-style-type: none"> Health and Safety plan will be implemented by contractor on site. Workers awareness sessions on health and safety issues will be carried out regularly. All persons on site will use personal protective equipment (PPE). 	<ul style="list-style-type: none"> H&S Plan compliance records. H&S awareness sessions attendance records. Site emergency response and Fire 	All contractors on site.	Site Supervisor.

Table 39: Mahdia Environmental Management Plan

Construction Phase

	Issue/ Impact	Mitigation Measures	Monitoring Indicators	Responsibility for Implementation	Responsibility for Monitoring
		<ul style="list-style-type: none"> ▪ Site emergency response plans will be developed. Including Fire Safety Plan. ▪ Adequate fire-fighting equipment will be provided on site. ▪ Adequate signage on site and in surrounding areas should be visible and properly maintained. ▪ Traffic control and speed limits will be observed. ▪ Working hours will be limited to day-light, unless otherwise agreed with relevant stakeholders. ▪ Occupational hazards should be marked on site and staff trained on hazard recognition. ▪ Cleanliness of the site will be maintained at all times. 	<p>Safety plans developed and implemented.</p> <ul style="list-style-type: none"> ▪ ESMP compliance records. ▪ Visible traffic and speed signage. 		

Table 40: Mahdia Environmental Management Plan

Operation Phase

	Issue/ Impact	Mitigation Measures	Monitoring Indicators	Responsibility for Implementation	Responsibility for Monitoring
Air Quality	Noise	<ul style="list-style-type: none"> ▪ Use of padding/noise isolators for equipment. ▪ Adequate maintenance of vehicles and machinery. 	<ul style="list-style-type: none"> ▪ Monitoring of dB. ▪ Complaints register. ▪ Equipment maintenance records according to schedule. 	MPLMPL on-site staff	MPLLMPC Regional Supervisor.
Soil	Soil contamination	<ul style="list-style-type: none"> ▪ Adequate disposal of waste materials. ▪ Provision of bunded areas for storage of oil/fuel with 115% capacity of the stored material. ▪ Provision of spill kits at relevant locations. 	<ul style="list-style-type: none"> ▪ ESMP Compliance records. 	MPL on-site staff	MPL Regional Supervisor.
Soil	Soil Erosion	<ul style="list-style-type: none"> ▪ Proper drainage will be maintained also for the operation phase 	<ul style="list-style-type: none"> ▪ ESMP Compliance records. 	LMPC on-site staff	LMPC Regional Supervisor.
	Visual Impact	<ul style="list-style-type: none"> ▪ Adequate landscaping of facilities. ▪ Solar panels will be installed at low distance from ground. ▪ Solar panel modules will be installed in visually aesthetical arrays. 	<ul style="list-style-type: none"> ▪ ESMP Compliance records. ▪ Complaints records. 	MPL on-site staff	MPL Regional Supervisor.
	Solid waste generation	<ul style="list-style-type: none"> ▪ Waste generated will be disposed in the community dumpsite. ▪ The site will be provided with an adequate number of bins for the disposal of domestic waste. ▪ Hazardous waste management plan 	<ul style="list-style-type: none"> ▪ ESMP Compliance records. ▪ Compliance with Hazardous waste management plan. ▪ Complaints records. 	MPL on-site staff	MPL Regional Supervisor.

Table 40: Mahdia Environmental Management Plan

Operation Phase

	Issue/ Impact	Mitigation Measures	Monitoring Indicators	Responsibility for Implementation	Responsibility for Monitoring
		<p>will be developed by contractor. Hazardous waste such as spent oil, oily rags, etc. will be stored on site and disposed of according to an approved plan and in line with EPA recommendations.</p> <ul style="list-style-type: none"> ▪ Burning of waste on-site will be prohibited. ▪ Adequate arrangements will be done for the frequent collection of domestic, and other waste. ▪ Site and immediate surroundings cleanliness will be maintained at all times. 	<ul style="list-style-type: none"> ▪ Valid contract with solid waste collection contractor. 		
	Surface water pollution	<ul style="list-style-type: none"> ▪ Adequate maintenance of drainage system. ▪ Adequate operation and management of sanitary facilities /septic tank. ▪ Collection of septage by EPA approved contractor. 	<ul style="list-style-type: none"> ▪ ESMP compliance records. ▪ Valid contract with waste collection contractor. 	MPL on-site staff	MPL Regional Supervisor.
	Groundwater pollution	<ul style="list-style-type: none"> ▪ Oil spills, fuel spill and other site contaminants will be rapidly cleaned. ▪ Adequate operation and management of sanitary facilities /septic tank. ▪ Collection of septage by EPA approved contractor. 	<ul style="list-style-type: none"> ▪ ESMP compliance records. ▪ Valid contract with waste collection contractor. 	MPL on-site staff	MPL Regional Supervisor.

Table 40: Mahdia Environmental Management Plan

Operation Phase

	Issue/ Impact	Mitigation Measures	Monitoring Indicators	Responsibility for Implementation	Responsibility for Monitoring
Natural Habitat	Noise levels	<ul style="list-style-type: none"> Noise levels will be monitored and controlled as described above to minimize additional effects to fauna in the surrounding areas. 	<ul style="list-style-type: none"> dB monitoring. 	MPL on-site staff	MPL Regional Supervisor.
	Health and Safety	<ul style="list-style-type: none"> Health and Safety plan will be implemented by operator on site. Workers awareness sessions on health and safety issues will be carried out regularly. All persons on site will use personal protective equipment (PPE). Site emergency response plans will be developed. Including Fire Safety Plan. Adequate fire-fighting equipment will be provided on site. Adequate hazards signage on site should be visible and properly maintained. Traffic control and speed limits will be observed. Cleanliness of the site will be maintained at all times. 	<ul style="list-style-type: none"> H&S Plan compliance records. H&S awareness sessions attendance records. Site emergency response and Fire Safety plans developed and implemented. ESMP compliance records. Visible traffic and speed signage. 	MPL on-site staff	MPL Regional Supervisor.

Table 41: Mahdia Environmental Management Plan

Decommissioning Phase

	Issue/ Impact	Mitigation Measures	Monitoring Indicators	Responsibility for Implementation	Responsibility for Monitoring
Air Quality	NO _x and CO _x emissions	<ul style="list-style-type: none"> Regular maintenance of vehicles and on-site equipment 	<ul style="list-style-type: none"> Equipment maintenance records according to schedule. Vehicle fitness certificates. 	All contractors on site.	Site Supervisor.
	Noise	<ul style="list-style-type: none"> Use of padding/noise isolators for equipment and machinery. Use of ear plugs or ear muffs for specific activities by workers. Stakeholders consultation (immediate surroundings of site) to plan activities accordingly. 	<ul style="list-style-type: none"> Monitoring of dB. Complaints register. Equipment maintenance records according to schedule. Workers compliance to H&S procedures. Consultation records. 	All contractors on site.	Site Supervisor.
Soil	Soil contamination	<ul style="list-style-type: none"> Adequate disposal of waste materials. Provision of bunded areas for storage of oil/fuel with 115% capacity of the stored material. Provision of spill kits at relevant locations. Vehicles and machinery will be serviced regularly and off-site or at impervious surfaces to avoid soil contamination. 	<ul style="list-style-type: none"> Complaints register. ESMP Compliance records. 	All contractors on site.	Site Supervisor.
	Solid waste generation	<ul style="list-style-type: none"> Waste will be disposed in the community dumpsite. 	<ul style="list-style-type: none"> ESMP Compliance records. 	All contractors on site.	Site Supervisor.

Table 41: Mahdia Environmental Management Plan

Decommissioning Phase

	Issue/ Impact	Mitigation Measures	Monitoring Indicators	Responsibility for Implementation	Responsibility for Monitoring
		<ul style="list-style-type: none"> ▪ Adequate planning and coordination will be done with the dumpsite management to manage the increased volume expected to be generated from the site. ▪ The site will be provided with an adequate number of bins for the disposal of domestic waste. ▪ Hazardous waste management plan will be developed by contractor. Hazardous waste such as spent oil, oily rags, etc. will be stored on site and disposed of according to an approved plan and in line with EPA recommendations. ▪ Specific provisions for the disposal of the solar panels and electrical equipment will be developed and followed by the contractor. The process will comply with International Standards and Good Practice. ▪ Burning of waste on-site will be prohibited. ▪ Adequate arrangements will be done for the frequent collection of domestic, construction and 	<ul style="list-style-type: none"> ▪ Consultation records with solid waste management authorities. ▪ Compliance with Hazardous waste management plan. ▪ Complaints records. ▪ Valid contract with solid waste collection contractor. ▪ Compliant disposal strategy for solar panels and electrical equipment. ▪ Existence of at least one container bin outside the project site where food services providers are located (if necessary). 		

Table 41: Mahdia Environmental Management Plan

Decommissioning Phase

	Issue/ Impact	Mitigation Measures	Monitoring Indicators	Responsibility for Implementation	Responsibility for Monitoring
		<p>hazardous waste.</p> <ul style="list-style-type: none"> ▪ The project will facilitate bins outside the site to food supply entrepreneurs and will arrange for the collection of such waste. ▪ Site and immediate surroundings cleanliness will be maintained at all times. 			
	Surface water pollution	<ul style="list-style-type: none"> ▪ Drainage system will be monitored and frequently maintained. ▪ Adequate temporary sanitary facilities will be provided for workers on-site. ▪ Frequent collection of waste generated by sanitary facilities will be done by an EPA approved contractor. 	<ul style="list-style-type: none"> ▪ ESMP compliance records. ▪ Existence of temporary sanitary facilities. ▪ Valid contract with waste collection contractor. 	All contractors on site.	Site Supervisor.
	Groundwater pollution	<ul style="list-style-type: none"> ▪ Oil spills, fuel spill and other site contaminants will be rapidly cleaned. ▪ Adequate temporary sanitary facilities will be provided for workers on-site. ▪ Frequent collection of waste generated by sanitary facilities will be done by an EPA approved contractor. 	<ul style="list-style-type: none"> ▪ ESMP compliance records. ▪ Existence of temporary sanitary facilities. ▪ Valid contract with waste collection contractor. 	All contractors on site.	Site Supervisor.

Table 41: Mahdia Environmental Management Plan Decommissioning Phase					
	Issue/ Impact	Mitigation Measures	Monitoring Indicators	Responsibility for Implementation	Responsibility for Monitoring
	Demography and Employment	<ul style="list-style-type: none"> ▪ Employment of local laborer should be maximized. ▪ Transparent recruitment process will take place. 	<ul style="list-style-type: none"> ▪ Employment records. ▪ Number of local labor employed at the site. 	All contractors on site.	Site Supervisor.
	Health and Safety	<ul style="list-style-type: none"> ▪ Health and Safety plan will be implemented by contractor on site. ▪ Workers awareness sessions on health and safety issues will be carried regularly. ▪ All persons on site will use personal protective equipment (PPE). ▪ Site emergency response plans will be developed. Including Fire Safety Plan. ▪ Adequate fire-fighting equipment will be provided on site. ▪ Adequate signage on site and in surrounding areas should be visible and properly maintained. ▪ Traffic control and speed limits will be observed. ▪ Working hours will be limited to day-light, unless otherwise agreed with relevant stakeholders. ▪ Occupational hazards should be marked on site and staff trained on hazard recognition. 	<ul style="list-style-type: none"> ▪ H&S Plan compliance records. ▪ H&S awareness sessions attendance records. ▪ Site emergency response and Fire Safety plans developed and implemented. ▪ ESMP compliance records. ▪ Visible traffic and speed signage. 	All contractors on site.	Site Supervisor.

Table 41: Mahdia Environmental Management Plan Decommissioning Phase					
	Issue/ Impact	Mitigation Measures	Monitoring Indicators	Responsibility for Implementation	Responsibility for Monitoring
		<ul style="list-style-type: none"> Cleanliness of the site will be maintained at all times. 			

10 MONITORING REQUIREMENTS

10.1 Environmental requirements

Environmental monitoring is a process needed to measure the accuracy of predicted impacts of the project as well as measuring the efficacy of recommended mitigation measures. It serves as an early-warning tool to take actions for any residual/new impacts and improvement of mitigation measures. For the proposed project, the focus of the environmental monitoring shall be on ambient air quality and noise level management as there would be no effluent discharge from the facility.

The baseline for the environmental monitoring shall be the database contained in chapter 2 of this report while standards shall be in accordance the EPA Permit issued for the construction and operation of the facility. The environmental monitoring schedule and requirements for the proposed project is presented in the following table.

Table 42: Environmental Monitoring Schedule

Environmental Attribute	Schedule	Parameters	Location	Frequency	Method
Air Quality	Construction and operation phase	TSP	Middle of site and the four boundaries of the site.	Monthly for the construction phase and quarterly for the operation phase.	Portable air monitoring equipment.
Noise	Construction and operation phase	Noise levels	Middle of site and the four boundaries of the site.	Monthly for the construction phase and quarterly for the operation phase.	Portable sound level equipment.

10.2 Monitoring of ESMP indicators

Other aspects of the ESPM should also be monitored regularly to inform the effectiveness of the mitigation measures or the need for improvement of such. The ESMP monitoring report should be included in the Progress Report of the contractor and/or the Supervision report and should report on the proposed indicators included in the ESMP.

11 EMERGENCY RESPONSE PLAN

The Emergency Response Plan has been prepared to provide employees at TPC (The Power Company) for the locations of Bartica, Lethem and Mahdia with the necessary information to

respond to potential emergency situations in an expedient and safe manner to prevent harm/impairment to employees, local residents, or the natural environment. This plan provides response procedures to incidents that may be encountered during operations at the TPC substations in Sophia and Kingston. The procedures were developed to ensure that personal safety is not compromised, responsibilities are assigned, the emergency is mitigated, the public and environment are protected, and that follow-up monitoring and reporting are performed when incidents occur at the TPC sites. Incident response contacts and telephone numbers, both on-site and off-site are presented at the beginning of this plan to facilitate a rapid response to incidents. Detailed incident response procedures are presented and emergency contact information will be updated as needed on all copies of this plan and at all posted locations to ensure rapid response to incidents. Posted locations of plans will include:

- Main Office
- Maintenance Department
- Security Department
- Workers Quarters/Change Room

The Emergency Response and Incident Management Plan will define the methods of intervention and required resources to be implemented by TPC in the event of an accident to protect staff and property and to prevent harmful effects on the local population and the environment. As part of the plan, GPL will facilitate the alert of rescue services and inform the competent relevant authorities. As such, the detailed Emergency Response Plan includes:

- Emergency Contact Details;
- Emergency Procedures;
- Description of an Emergency;
- Authority of Control;
- Scenario Description and Response;
- Materials Inventory; and
- Incident Reporting Formats

11.1 Emergency Response Principles

The emergency response procedures involve the following priorities for action:

- Protection of human health and safety;
- Contain the threat/hazard;
- Neutralize and render safe any noxious or hazardous materials; and
- Commence clean-up activities and site remediation efforts.

Emergency response procedures manage events that are not anticipated, almost totally unlikely to occur or reasonably anticipated. It is therefore imperative to plan for worst case scenarios or adopt general procedures. It is also important to recognize that although highly unlikely, an emergency can have serious impacts well beyond the individual or the operation involved.

11.2 Identification of an Environmental Emergency

According to the UNEP's Governing Council, an environmental emergency is defined as, "sudden-onset disasters or accidents resulting from natural, technological or human-induced factors, or a combination of these, that causes or threatens to cause severe environmental damage as well as loss of human lives and property." (UNEP 2002). Therefore, in event of occurrence this would call for immediate action. Some examples of events that would require the initiation of an emergency response procedure and reporting at GPL include:

1. A fire.
2. Electrocution.
3. A fuel spill or releases of hazardous chemicals or wastes to the groundwater or surface water;
4. Transmission Lines structural damages;
5. Medical emergencies; and
6. Minor and major accidents.

11.3 Authority of Control

The Manager of the substation has the overall authority to take control of any incident within any department of the operation, and they can also, depending on the severity of the situation will decide to cease all or any part of the operation following an incident. The Manager will also decide on the category and level of response required for a particular emergency incident.

11.4 Minor or Major Incident/Accident

Prompt and effective communication after the occurrence of an accident or emergency to personnel within the operation is vital to reduce the amount loss/damage that is observed as a result. Additionally, prompt notification of an emergency will allow for adequate time for the Manager to execute corrective systems, mitigate the hazard or, in extreme cases, evacuate the premises. In the event of a major incident/accident, the Manager of the TPC site will be immediately informed. In case of an injury, the Manager will ensure first aid treatment is applied. In the case of a bone fracture or if the employee or person is in an unconscious state the Georgetown Public Hospital will be alerted and the Manager will arrange transportation to the Hospital, which is some less than 2 km distance from the Kingston substation and less than 5 km from the Sophia substation.

In the event of a minor accident or emergency, the Manager will be notified verbally. Manager will be notified for emergencies pertaining to personnel related accidents/emergencies, the Operations Department will be consulted for equipment or machinery malfunctions and the Manager will be contacted for emergencies threatening environmental systems. The project site will have a clearly displayed directory located in a location which contains the contact details for the Manager and Operation Department. Therefore, they can be alerted via telephone if an emergency occurs. The relevant personnel, when notified, would take responsibility for on-site response to the event utilizing available tools, equipment and/or mechanisms. Importantly, each emergency which occurs at the TPC sites will be documented in an Accident and Emergency Record Book, which would be useful in monitoring as well as emergency systems enhancement. Bells, whistles or blow horns will be used for emergency communication, the employees should also be made aware of this.

11.5 Internal and External Emergency Contact Details

TPC in an effort to ensure a safe work environment for all employees and visitors of the substations will disseminate and post on the Notice Boards at the Security entrance of the Mill, the list of External Emergency Contacts alongside the Internal Company emergency contact list. In the event of a serious emergency at the operation, key officials of TPC, who may not necessarily be based at the site, must be contacted and duly informed of the situation. The external emergency contact list will consist of a list of emergency contact numbers for the relevant external agencies. These agencies are to be contacted in the event of an emergency when the said emergency has gone beyond the control of the Managerial staff. Henceforth, in an event when an emergency has gone beyond the control of internal company emergency response actions; or requires further attention. The Manager will contact the following relevant key agencies and institutions whose mandates are relevant to the operations at the TPC's substations and that may need to be contacted in the event of an emergency. These institutions and their respective contact details are listed below:

Table 43: Emergency Plan Contact Information

Organization	Telephone Number
GPL Main Office	+(592) 231-4144
GPL Bartica	+(592) 455-2315
Mahdia Power & Light Inc. (MPL)	+(592) 618-4305
Lethem Power Company Inc. (LMPC)	+(592) 772-2140
Lethem Hospital	+592 772-2206
Georgetown Public Hospital	+(592) 227-8204
Emergency Fire Station	912
Environmental Protection Agency	(592) 225-5467-69, 225-5471-72,

	225-6044/48, 225-0506
Guyana Police Force G/town	(592) 227-2128
Air Services Ltd	(592) 222-4368

11.6 Emergency Equipment

TPC will have several key equipment on site that will be utilised in the event of an emergency, these equipment are fire extinguishers, spill kits and first aid kits.

Fire Extinguishers and Sand Buckets

TPC will ensure that the Kingston and Sophia substations will be equipped with functional fire extinguishers. These extinguishers will be located at strategic points within the following departments and will be clearly labelled for easy identification: i.e. Electrical, Maintenance, Mechanical, Office, the Security and the Kitchen. These strategic points will be clearly marked and accessible to employees who will have knowledge of their position. Fire extinguishers will be inspected monthly by the Manager of the site. Moreover, the extinguishers will undergo an official inspection by an officer of the Guyana Fire Service (GFS), on a bi-annual (six months) basis to ensure that they are functioning effectively and are in accordance with recommendations of the GFS with regards to the maintenance of fire extinguishers. Additionally, all employees of TPC are required to undergo basic training in the utilisation of a fire extinguisher. Further, sand buckets will be located at strategic locations throughout the site. These will be used to supplement the extinguishing actions in the event of a fire, especially if a fire extinguisher is not immediately available at the point. Moreover, in the event of a fire, employees will initiate the following procedure as a result of fire drills:

- Sound alarm to immediately notify all employees to evacuate building or area and organize first aid equipment.
- Contact the site Managers.
- Address the fire hazard with provided fire fighting equipment if practicable to do so, without taking personal risks.
- If not practicable alert the Fire Station and evacuate the premises.
- Make entry into the Accident and Emergency Record book.

Spill Kits

Fuel secondary containment bonds that will have 115% containment capacity in event of a spill. TPC has recognised that spills - relating to fuel, oil and other lubricants - may emanate from the operation. If this occurs it can pose a great threat and cause adverse impacts, especially since the Complex is in such close proximity to watercourses. In this regard, the company will acquire spill kits to be used for remedial actions against any spills occurring onsite.

Clearly labelled kits will be strategically placed in the fuel tank refuelling points and the Mechanical Department each where oil, fuel, or any other lubricants are utilised. Key personnel whose duties include constant contact with these materials (such as drivers etc.) will be identified and trained in the use of these kits. In the unlikely event of a spill beyond or outside the containment area the following action will be taken:

- Provide specific training guidelines and procedures for personnel to ensure a safe and effective response to potential spill events.
- Provide training guidelines for recovery and disposal of all materials contaminated in the event of a spill.
- Alert the Mill Managers.
- If practical employees should utilise Spill Kits to address the spill.
- Treat spill with absorbent materials such as sand or paddy husk and if possibly create a bund to prevent the spread of the spill and contaminating the waterways and soil.
- Make entry into the Accident and Emergency Record book.
- Inform EPA.

First Aid Kits

By definition First Aid is the immediate and temporary care/help given to the victim of an accident and sudden illness until professional medical treatment and help can be obtained. First aid response is important in an emergency because quick first aid response:

- Could mean the difference between life and death.
- Can reduce the severity of a particular injury obtained/or illness.

The Kingston and Sophia substations will have equipment which can sometimes be dangerous and cause harm, especially if carelessness and/or negligence on the part of employees occur. As such, the sites will have numerous well-stocked First Aid Kits on site within the departments. The company will ensure that each kit is clearly labelled and easily identifiable. There should also be instruction guidelines on the utilisation of the kit's contents. GPL Management will be responsible for the establishment, maintenance, and to visibly post all information regarding adequate first aid supplies, providers, equipment and location in the event of an onsite injury.

The Company will take all necessary precautions to designate first aid attendants or Medics. The name and contact number of the trained first aid attendants will be posted alongside the first aid kits sufficient for the number of employees within the operation. The first aid kits will be regularly inspected and replenished as need requires by Managers and Supervisors. Records will be kept by Managers and Supervisor on what has been used from the first aid kit at each point

location, by whom, and the reason for its use. This will be done in order to keep an inventory record of the first aid supplies.

It is the responsibility of all managers, supervisors and staff to be familiar with the contents of the first aid kit and have basic first aid knowledge to assess an injured person and provide any immediate medical assistance; such as CPR (if qualified), maintain open airways if breathing is an issue, prevent heavy blood loss; while awaiting a trained first aid attendant. Hence, in the event of an accident or emergency, staff must immediately alert and summon the first aid attendant or Medic and provide as much information as possible. The injured party must not be moved unless it is of necessity to protect their lives or to prevent further injury from occurring.

First aid attendants or Medics will be qualified health care professionals trained in first aid for:

- Respiratory arrest, cardiac arrest (CPR), haemorrhage, lacerations/abrasions,
- Amputations, musculoskeletal injuries, shock, eye injuries, burns,
- Loss of consciousness, extreme temperature exposure (hypothermia/hyperthermia),
- Paralysis, poisoning, loss of mental functioning, and drug overdose.
- Application of dressings and slings.
- Treatment of strains, sprains, fractures, bites, stings, contact with poisonous plants/animals/ material.
- Immobilization, handling and transporting injured persons.
- First Aid Content

The acceptable quantity of first aid kits/materials to number of workers will be determined by the Environmental/Occupational Safety and Health Department. The Environmental Department will also be responsible through the first aid attendants/supervisors to maintain the contents of each first aid kit/materials. The first aid kit and materials should be stored in a dust/water proof appropriate container. Each first aid kit shall contain but not limited to the following items:

- | | |
|---|---|
| • Gauze pads | • Tweezers |
| • Large gauze pads (at least 8" x 10") | • Adhesive tapes |
| • Box adhesive bandages (Band-Aids) | • Latex gloves |
| • Package gauze roller bandage at least 2" wide | • Resuscitation equipment such as resuscitation bag, airway, or protective facemask |
| • Triangular bandages | • Elastic wraps |
| • Rubbing alcohol / alcohol wipes | • Splint |
| • Scissors | • Directions for requesting emergency assistance |
| • Burn cream | • Snake bite kit |
| • Ammonia inhalants | • Cold packs |
| • Butterfly closures | • Eye wash kit |
| • Hand mirror | • Cotton balls |
| • Limacol | • Anti-diarrhoeal Medicine |
| • Ibuprofen, Panadol (Pain tablets) | • Hand Sanitizer |

- Antiseptic Cream
- Antibiotic Ointment

Additional first aid materials needed but not limited to the following are:

- Two (2) clean acceptable Blankets
- Rigid stretcher

11.7 Training

TPC has recognised the great need for personnel employed at the substations to be knowledgeable and adequately prepared to respond to incidents that may have adverse impacts on human health and safety, infrastructure, equipment, environmental resources, or a combination of these. As such, the company will ensure that staff is provided with a Manual that will provide guidance and direction for the implementation and operation of the Complex to all personnel. Regular drills and exercises to test the response procedures to emergencies, and to enhance the preparedness and capacity of workers to effectively respond to the above mentioned situations if/when they do occur will be organized.

11.8 Emergency Evacuation Routes

Evacuation route maps will be posted in each Department. The following information will be marked on evacuation maps:

- Emergency exits
- Primary and secondary evacuation routes
- Locations of fire extinguishers
- Fire alarm pull stations' location
- Assembly points
- Site personnel should know at least two evacuation routes.

11.9 Incident Reporting Document Formats

After every incident/accident a report will be required. The Manager of the site will have direct responsibility for the preparation of such a report. The following formats will be applied for various incidents:

EMERGENCY PERSONNEL NAMES AND PHONE NUMBERS

DESIGNATED RESPONSIBLE OFFICIAL (Highest Ranking Manager at

_____ site, such as _____, _____, or _____):

Name:

Phone: (_____)

EMERGENCY COORDINATOR:

Name:

Phone: (_____)

AREA/FLOOR/ROOM MONITORS (If applicable):

Area/Floor:

Name:

Phone: (_____)

Area/Floor:

Name:

Phone: (_____)

ASSISTANTS TO PHYSICALLY CHALLENGED (If applicable):

Name:

Phone: (_____)

Name:

Phone: (_____)

Date ____/____/____

MEDICAL EMERGENCY

Call medical emergency phone number (check applicable):

- ☐ Paramedics
- ☐ Ambulance
- ☐ Fire Department
- ☐ Other

Provide the following information:

- a) Nature of medical emergency,
 - b) Location of the emergency (building, room number), and
-
- Do not move victim unless absolutely necessary.
 - Call the following personnel trained in CPR and First Aid to provide the required assistance prior to the arrival of the professional medical help:

Name: _____ Phone: _____

Name: _____ Phone: _____

If personnel trained in First Aid are not available, as a minimum, attempt to provide the following assistance:

1. Stop the bleeding with firm pressure on the wounds (note: avoid contact with blood or other bodily fluids).
2. Clear the air passages using the Heimlich maneuver in case of choking.

In case of rendering assistance to personnel exposed to hazardous materials, wear the appropriate personal protective equipment. Attempt first aid ONLY if trained and qualified.

Date ____/____/____

FIRE EMERGENCY

When fire is discovered:

- Activate the nearest fire alarm (if installed)
- Notify the local Fire Department by calling 912.
- If the fire alarm is not available, notify the Managers/Supervisors about the fire emergency.

Fight the fire ONLY if:

- The Fire Department has been notified.
- The fire is small and is not spreading to other areas.
- Escaping the area is possible by backing up to the nearest exit.
- The fire extinguisher is in working condition and personnel are trained to use it.

Upon being notified about the fire emergency, occupants must:

- Leave the building using the designated escape routes.
- Assemble in the designated area (specify location)
- Remain outside until the competent authority (Managers) announces that it is safe to re-enter.

Managers or Supervisors must (underline one):

- Disconnect utilities and equipment unless doing so jeopardizes his/her safety.
- Coordinate an orderly evacuation of personnel.
- Perform an accurate head count of personnel reported to the designated area.
- Determine a rescue method to locate missing personnel.
- Provide the Fire Department personnel with the necessary information about the facility.

Area/Floor Monitors must:

- Ensure that all employees have evacuated the area/floor.
- Report any problems to the Managers or Supervisors at the assembly area
- Assistants to Physically Challenged: Assist all physically challenged employees in emergency evacuation.

Date___/___/___

CHEMICAL SPILL

The following are the locations of:

Spill Containment and Security Equipment: _____

Personal Protective Equipment (PPE): _____

When a Large Chemical Spill has occurred:

- Immediately notify the Managers or Supervisors.
- Contain the spill with available equipment (e.g., pads, booms, absorbent powder, etc.).
- Secure the area and alert other site personnel.
- Do not attempt to clean the spill unless trained to do so.
- Attend to injured personnel and call the medical emergency number, if required.
- Call a local spill cleanup company or the Fire Department (if arrangement has been made) to perform a large chemical spill cleanup.

Name of Spill Cleanup Company: _____

Phone Number: _____

- Evacuate building/area as necessary

When a Small Chemical Spill has occurred:

- Notify the Managers and/or supervisors.
- If toxic fumes are present, secure the area (with caution tapes or cones) to prevent other personnel from entering.
- Small spills must be handled in a safe manner, while wearing the proper PPE.
- Review the general spill cleanup procedures.

Date ____/____/____

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13 ANNEX

Consultation Report Activities:

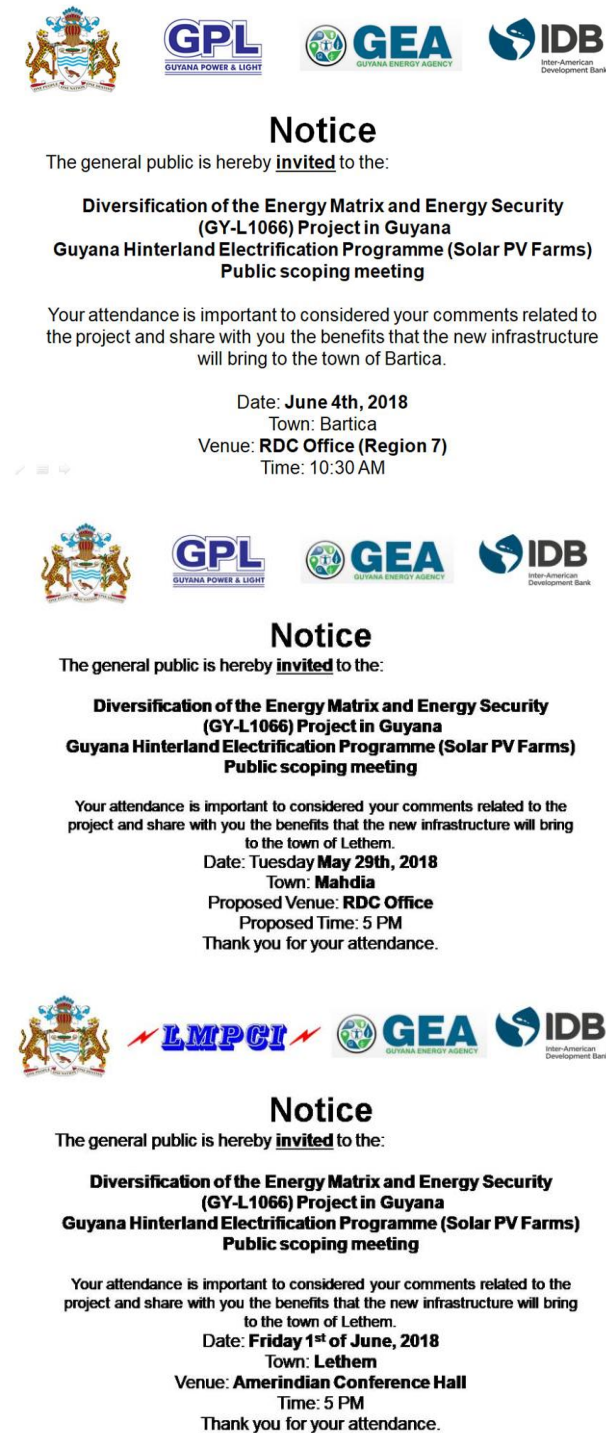


Figure 59: Flyers Scoping Meetings.



Stakeholder Meeting

Diversification of the Energy Matrix and Energy Security
(GY-L1066) Project in Guyana
Guyana Hinterland Electrification Programme (Solar PV Farms)
Public scoping meeting

MAHDIA
MAY 29th, 2018

Presentation Outline

1. Introduction
 - 1.1 Purpose of the Project
 - 1.2 Implementation Structure
 - 1.3 Law and Regulation
 - 1.4 Purpose of the Meeting
2. Project Outline
 - 2.1 Component
 - 2.2 Location
 - 2.3 Schedule
3. Environmental, Social, Compensation Consideration
 - 3.1 Perceived Project Benefits
 - 3.2 Adverse Environmental Effects and Mitigation Measures
 - 3.3 Social Environment Survey
 - 3.4 Compensation Policy
4. Opportunities for Public Comments

1. Introduction

1.1 Purpose of the Project

Background

Guyana has remained 99% dependent on imports of fossil fuel for its energy needs. High fuel costs have historically constrained the pace of the country's development while creating balance of payments challenges. It has also affected the country's competitiveness on the local and international markets, limiting the opportunities for expansion of the productive sectors.

1. Introduction

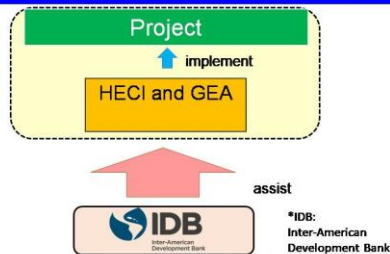
1.1 Purpose of the Project

- About 200 km away from capital
- Lack of continuous fuel supply
- Interruption of electricity service to the overall community
- electricity cost US\$ 0.55 per kWh (US\$0.50 per kWh)
- subsidised price of US\$ 0.50 per kWh
- subventions from Government of about US\$125,000.00 annually

Improve
The Project

1. Introduction

1.2 Implementation Structure



1. Introduction

1.3 Law and Regulation

Environmental and Social Consideration to Study in line with the followings;

- ◆ Guyana Law and Regulation System
- ◆ IDB Guideline for Environmental and Social Consideration

1. Introduction

1.4 Purpose of the Meeting

- ◆ Provide information about the Diversification of the Energy Matrix and Energy Security (GY-L1066) Project in Guyana
- ◆ Solicit community input on Environmental issues to be studied in ESA report

2. Project Outline

2.1 Component (1)

SITE	INSTALLED CAPACITY (MW)	ANNUAL GENERATION (MWh)	INVESTMENT COST (US\$)
Bartica	1.50	2,331	3,876,047.20
Lethem	1.00	1,554	2,591,614.00
Mahdia	0.65	1,000	1,767,299.80
Port Kaituma	0.65	1,024	1,767,299.80
Matthew's Ridge	0.40	596	1,895,053.00
Kwakwani	1.00	1,428	2,591,614.00
TOTAL	5.20	7,933	14,488,927.80

Table 1: Installed Capacity, Annual Generation and Investment Cost

Figure 60: Presentation Scoping Meetings.

2. Project Outline

2.1 Component (1)

With a total investment cost of US\$14,486,927.80, the project is expected to generate approximately 7,933 MWh of electricity annually at an average cost (weighted average LCOE) of US\$0.14 per kWh.

Site	Size of PV systems (MW)	Size of Battery (MWh)	Annual Expected Generation (MWh)	Estimated Land requirement (acres)
Barica	1.50	0.75	2,331	7.50
Lethem	1.00	0.50	1,554	5.00
Mahdia	0.65	0.325	1,000	3.25
Port Kaituma	0.65	0.325	1,024	3.25
Matthew's Ridge	0.40	0.20	596	2.00
Kwakwani	1.00	0.50	1,428	5.00
TOTAL	5.20	2.60	7,933	26.00

Table 2: Installed Capacity, Battery Storage, Generation and Land Requirement

2. Project Outline

2.2 Location (1)

The proposed site for the solar PV system is approximately 1.09 km by road from the Mahdia Power Station.



2. Project Outline

2.2 Location (2)

The site could be accessed by a vehicle as indicated in blue in figure 1. The yellow rectangle represents the proposed site for the 300 kW solar power system which is located at latitude 5.281422° and longitude -59.143785°. The area is approximately 1.5 acres, but up to 3 acres of lands are available at the location.



2. Project Outline

2.2 Location (3)



2. Project Outline

2.3 Schedule (Draft)

The project timeline is expected to be a 15-month period with continued monitoring for another 12 months following commissioning to ensure grid stability and regulation.

Following a 3-month tendering process from January to March 2019, construction of the project is estimated to commence in April 2019, with estimated project operations anticipated to commence in March 2020.

3. Environmental Issues

3.1 Perceived Project Benefits

The Project will bring the following benefits;

The main objectives of the project are to:

- reduce fossil fuel consumption and CO₂ emissions for electricity generation,
- increase energy security and access for hinterland utilities, and
- support of Government's renewable energy drive for a greener economy.

Figure 61: Presentation Scoping Meetings.

3. Environmental Issues

3.1 Perceived Project Benefits

- 50 jobs to be created and potential transfer of skills to other residents;
- to stimulate the local cottage industries and improve operations for existing local businesses;
- an estimated total of 34,700 residents in the Hinterland are expected to benefit from more reliable electricity supply from a clean energy source;
- to improve services at schools and the medical facilities

3. Environmental Issues

3.2 Expected Adverse Impacts and Mitigation Measures

Period	Expected Adverse Impacts	Mitigation Measures
During Construction	Air Pollution	- Use of low emission vehicles - Water sprinkling
	Noise/ Vibration	- Use of noise reduction machine
	Land Acquisition	Avoidance of land acquisition as much as possible. If impossible, it will be compensated.
	Removal of Trees	Avoidance of cutting trees as much as possible. If impossible, it will be compensated.
	Obstruction of Passage	Installation of warning signs.

3. Environmental Issues

3.3 Social Environment Survey

Environmental situation around the site:

Existing social conditions such as population, number of households, ethnicity, income, livelihood and employment, agricultural activity, education, public health, poverty, gender, children issue.

Situation of community infrastructures and services in medical and educational facilities.

Land use (mining, forest, home garden etc.), structures such as houses, facilities, public utilities.

3. Environmental Issues

3.4 Resettlement Action Plan (RAP) Compensation Policy

Specific Measures of Compensation and Support

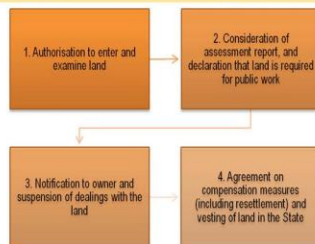
1. Legal framework:
State Lands Act 1903
Acquisition of Land for Public Purposes Act 1914
Electricity and Reform Act 1999

3. Environmental Issues

3.4 Resettlement Action Plan (RAP) Compensation Policy

Specific Measures of Compensation and Support

Procedure for Land Acquisition and Resettlement



3. Environmental Issues

3.4 Compensation Policy

Specific Measures of Compensation and Support

1. Compensation and Support
Loss compensation
Livelihood Restoration Plan
Entitlement Matrix
2. Grievance Mechanism
3. Implementation System

4. Opportunities for Public Comments

Provide comments during meeting.

For further comments contact:

EES: Environmental Engineering Solutions - Guyana
Contact number: (592) 6500373
E-mail comments: eesguyana@gmail.com

Figure 62: Presentation Scoping Meetings.



**Diversification of the Energy Matrix and Energy Security
(GY-L1066) Project in Guyana
Guyana Hinterland Electrification Programme (Solar PV Farms)**

Stakeholders Meeting

Date: June 4th, 2018
Town: Bartica
Venue: RDC Office (Region 7)
Time: 10:30 AM

No.	Name	Position/Institution	Address	Contact Number	Signature
①	Georgina Davis	ASP Prison Service	Muganani Prison	652 0096	<i>[Signature]</i>
②	Sonita SAKH	SUPERVISOR REG. B-HOUSE		615 8540 455-0238	<i>[Signature]</i>
③	Calvin Young	Regional Council	483 Ave B/la	684 2385 455-2702	<i>[Signature]</i>
④	DR. EDWARD SAGALA	Regional Health Officer	Bartica Hospital	455-2846 686-7074	<i>[Signature]</i>
⑤	Cramit Khan	Operations And Maintenance Superintendent	Bartica Power Station	455-0210 623-5012	<i>[Signature]</i>
⑥	Thomas M Adams	Senior Network Technician	G.P.L Inc 19D Bartica	623 4013 455 3091	<i>[Signature]</i>
⑦	Glenroy Nurse	Civil Clerk-od-works	G.P.L Inc Bartica	624-0982	<i>[Signature]</i>
⑧	Debbie Allen	ABRED/7	Bartica	686-1267	<i>[Signature]</i>
⑨	Magaiva Gonsalves	Clerk III (G)	Bydumb Rd.	686-5145	<i>[Signature]</i>
⑩	FOREMAN BRADFORD	Reg-cpman	B/la-	602-1029	<i>[Signature]</i>
11	Lennox Erickson	Electrical Inspector	B/la	6831324	<i>[Signature]</i>
12	OLINDA KYENHOFF-GRIFFITH	R.V.C.	ACATASH	603 6037	<i>[Signature]</i>

Bartica 1/2

Figure 63: Bartica Scoping Meeting- Attendance list.



Date holder meeting

Scoping Meeting Attendance List



**Diversification of the Energy Matrix and Energy Security
(GY-L1066) Project in Guyana
Guyana Hinterland Electrification Programme (Solar PV Farms)
Public scoping meeting**

LETHEM

Date: May 31th, 2018

Town: Lethem

Proposed Venue: RDC Office

Proposed Time: 5 PM

No.	Name	Position/ Institution	Address	Contact Number	Signature
1	Thurston Sample	Lethem Power Com. C.E.O.	R14 Le-them.	699 0780	J. Sample
2	JOHN MACEDO	DIRECTOR LMPCI	LeTh	600 5375	J. Macedo
3.	Karl Singh	R.N.C	RDC Region #9	604-1160	K. Singh
4	ALLISON CAMACHO	President RCCJ	Lethem	600-4679	A. Camacho
5.	Michelle Joseph	Regional Housing officer	Lethem	675-9957	M. Joseph
6.	Jannica Andrie	Secretary LMPCI	Lethem	699-0786	J. Andrie
7.	Brenda Cornelius	Commercial Supervisor Lethem Power Company	St Ignatius village	659-0411	B. Cornelius
8	LINDEN GRAY	SENIOR LAND ADMIN OFFICER Guyana Lands & Survey Commission	Lethem	772-2016 624-0478	L. Gray
9	Keisha Vincent	Town Clerk	Lethem	772-2028 667-1926	K. Vincent

LETHEM 1/2

Figure 64: Lethem Scoping Meeting- Attendance list.

ENVIRONMENTAL ENGINEERING SOLUTIONS (EES)



10	Izvestia Wilson	Lethem Town Councils Secretary	Lethem	660-7131	Izvestia Wilson
11	GEORGE HENRY	LETHEM TOWN CO-OP	LETHEM	604-3462	George Henry
12	Richard Rennie	Admin Manager Lethem Paper	Lethem	699-0787	Richard Rennie
13	Paul Hanique	Plant Maintenance Officer LDC	Lethem	699-0783	Paul Hanique
	Emerick Williams	T&D Supervisor	Lethem	699-0781	Emerick Williams
15	Glenn Vianet	Lethem Power Corp	Lethem	699-0785	Glenn Vianet
16	Muani Barretto	St. Ignace Village		662-0912	Muani Barretto
17	WILLIAM TONE	Lethem C&S	LETHEM	628-4608	William Tone
18	Candace Phillips	Board Secretary LMPCI	Lethem	677-2941	CPhillips
19	Kerry Jarvis	LTC	Lethem	690-4927	Kerry Jarvis
20	Paule Marshall	Regional Engineer	"	662-9702	Paule Marshall
1st JUNE 2018			1st JUNE 2018		
1	Candace Phillips	LMPCI	Lethem	677-2941	CPhillips
2	Baptist Marco	LMPCI	Lethem	677-2941	Baptist Marco
3	Paul Hanique	LDC	Lethem	699-0783	Paul Hanique
4	Jatmilo Andres	LMPCI	Lethem	699-0786	J. Andres
5	Geeta Singh	Robbed Arson Trust	Takatu Hotel	651-2545	geetadsingh@gmail.com
6	Kawathi Soaring				Indu Soaring a
7					
8					
9					
10					
11					

LETHEM 2/2

Figure 65: Lethem Scoping Meeting- Attendance list.

LMPGI LETHEM POWER COMPANY INC.

208 Barrack Retreat Drive
Lethem, Rupununi, Region # 9
Telephone/ Fax: 772-2140

18th, October, 2016

Mr. Trevor L. Benn
Commissioner/ Chief Executive Officer
Guyana Lands and Surveys Commission
22 Upper Hadfield St
D'Urban Backlands
Georgetown

Dear Mr. Benn,

Request for land-Solar Farm

Request is hereby made for twenty (20) acres of land to accommodate a solar farm for the supply of reliable electricity to Lethem and its environs.

The Government is pursuing the establishment of a four megawatts solar farm in Lethem. This is based on the expected demand growth and rapid development. Twenty (20) acres is estimated to be the required space for four megawatt farm hence the reason for our request.

Our preferred area for this project would be close to the new power station at Bon Success since it would provide relatively easy connection to our network/ grid.

Thanking you in advance for considering our request and looking forward for a favourable response.

Sincerely yours,


.....
Thurston Semple (Mr.)
Chief Executive Officer
Lethem Power Company Inc.

LETHEM
POWER COMPANY
Tel: 772-2140

CC: Ms. – Hon. Minister of Public Infrastructure

Ms. Annette Ferguson – Hon. Minister within the Ministry of Public Infrastructure

Mr. Kenneth Jordan – Advisor to the Hon. Minister of Public Infrastructure

Mr. Horace Williams – CEO – Hinterland Electrification Company Inc. (HECI)

Figure 66: Lethem Application Letter for Solar Farm

Mahdia

MAHDIA SKL-1/2
SPM - 29-05-2018

DIVERSIFICATION OF THE ENERGY MATRIX AND ENERGY SECURITY
(64-11066)

NAME	ORGANIZATION	CONTACT NUMBER
Oreia Cooper	MPLCI	Oreia Cooper MPLCI@gmail.com
Rodwell Albert	MPLCI	6972332
Boez Biddle	MPL	6959776
Shawn Deane	MPL	6652397
Bernadette Dine	Buisness	6683637
Gravin Grounge	RDC	6797907
Courtney Hardy	MPL	6804023
Marshall Thomas	MPL	6758107
M. Naïem Gafar	RDC	6815600
Benaventure Fredericks	R.C 8	630-6162
Alfred Duncan	resident	6757472
Molly Jones	resident	663-9361
Cleopatra Evans	Resident	6663955
Prima Wether	RDC Councilor	6790813
Julian Melville	Information Officer RDC	660-1297
Julian Butte	Electionsman	6002025
Karl Williams	Electionsman	674-9965
TRECIAMARC HUBBARD	Campbelltown Village	6020557
Wennesha Evans	MAHDIA DISTRICT Hospital	664-4670
Melene Runder	MCCI	691-8898
RICHARD SINCLAIR	RDC Resident	657-9505, 683-9032
Carl Parker	Teacher	679-0845
	RDC	

Figure 67: Mahdia Scoping Meeting- Attendance list.

<div> <div>DISPERSIFICATION OF THE ENERGY MATRIX AND ENERGY SECURITY</div> <div>(GY-L 1066)</div> <div>SPM-29-05-2018 MAHDIA SM-3/2</div> </div>		
NAME	ORGANISATION	contact Number
M. Freeman	A.C.S	670-9505
A. Remus		670-9505
Rev. Aubrey Skete	Assemblies of God / Mahdia Chamber of Commerce.	6724480
	Foy Weber	66680117
- - -	- - -	- - -

Figure 68: Mahdia Scoping Meeting- Attendance list.

2018/05/30		
Daniel Roberts	Village Council	602-2929
Denver Roberts		677-2533
Samantha Edwards	Village Council	6895573
Jacy Wilson	Villager	6896697
Ron Williams	Villager	676-7954
Winston Baird	"	6876613
J. Gabriel	Manager	
Julian Butts	99 Headley St Plaisance	6002025
ELVIS Williams	Electrician	
Sutton Smith	Village Council	674-3319
Gen Alfred	Villager	694-3216
Lutina Anderson	Villager	679-4788
Jessa Cheeks	!!!	6672656
Deona Thomas	Villager	6783551
DeLa Jonas	Villager	667-6900
Rosella Marcello	Villager	697-2694
		MAHDIA PC- 1/3

Figure 69: Mahdia Public Meeting- Attendance list.

DIVERSIFICATION OF THE ENERGY MATRIX AND ENERGY SECURITY (Guy - L1066)		
NAME	ORGANIZATION	Contact Number
Lillian Gouveia Henny	Teacher	681 7888
Marilyn Gouveia	Resident	678 2041
Elwood Daniels	"	6037105
Maurice Thomas	"	673-7715
Minerva Isaacs	"	661-7577
Orville Gouveia	Resident	672-9240
Carol Rosine	Resident	664-5724
Minnie Andrew	Resident	697-3192
Angelita Joseph	"	6969089
Rev. Aubrey Skeete	Pastor / Vice Pres Mahdia Chamber of Commerce	672 4490
NIGEL PROTMAN	YOUTH NEIGHBOURHOOD (YNDM) PRESIDENTS	615 4830
Balthazew mores	Resident	694-8560
Leron Sandwell	Resident	674-9567
Adrian Benedict	"	603 1612
Tyran Williams	" "	660 9559
Sharmila Williams	" "	" " "
Karl Williams	"	674-9965
Arca Roberts	"	690-6251
Eric Roberts	Resident	630-5856
Mackinson Caravio	"	692-8833
Avebo Peticio	Resident	6034031
Urline Skybar		

MAHDIA-PC-73

Figure 70: Mahdia Public Meeting- Attendance list.

NAME	ORGANISATION	CONTACT Numb
Gheryl La Cruz	Residence (Campbelltown)	6758580
Marbell Thomas	Campbelltown Village Council	6758107
Kevin Thomas	Residence Campbelltown	676-2063
Margaret John	Campbelltown Village	675-4973
Andrew Matthews	7 MILES PATAO ROAD	688-9305
Marie Gomes	Campbelltown Village	604 9723
Melinda Charles	Campbelltown	6808935
Abanis George	" "	
Frank Abraham	Campbell Village	685-7865
Rufina Berchman	Campbelltown Village	672-9037
Juliette Gouveia	Campbelltown Village	659-4682
Lawrence Charles	MAHDIA	671 6497
Jude Nurse	Centre Mahdia	692-5874
Camalalai La Cruz	Campbelltown	688-8958

MAHDIA-PL-3/3

Figure 71: Mahdia Public Meeting- Attendance list.

May 30, 2018

To Whom It May Concern

This correspondence serves to inform you that a Public Scoping meeting was held at the Campbelltown Benab on Wednesday, May 30, 2018, by members of the Environmental Engineering Solutions (EES) consultancy firm, to discuss the proposed establishment of a Solar Photovoltaic (PV) Farm Project at the 111 Miles Mahdia, Region 8.

I would therefore like to express that there is No Objection to the establishment of the above-mentioned Project and would also like to thank the Government of Guyana for the proposed initiative.

Kind Regards,

A handwritten signature in blue ink, appearing to read "Marbell Thomas", is written over a horizontal dotted line.

Ms. Marbell Thomas

Campbelltown Deputy Toshao

Figure 72: Mahdia, Campbelltown Amerindian Village, Thosao Letter of no objection to the project.

