6.0 POLLUTION SOURCES, ENVIRONMENTAL IMPACTS

6.1 POLLUTION SOURCES

The proposed project has the potential to generate pollution at the site and its environs.

Pollutants will be generated during the construction and operation phase of the proposed development will be liquid, solid and gaseous in nature. The generation of pollution may be periodic, continuous or accidental. Potential sources of pollutants and their characteristics during the construction and operation phase are shown below in Table 6.1.

Table 6.1: Potential Pollutant sources and Characteristics

Item	Source	Pollutant	Characteristics	Frequency
CONSTRUCTION PHASE				
1	Ground clearing	Air emissions: PM_{10},$PM_{2.5}$, CO, NO_x, SO_2	Dust from construction activities and clearing the site	Temporary during construction phase only-. The site is void of vegetation
		Earth/Solid waste	Solid waste from excavation and construction activity	Periodic
		Noise	Noise generated from construction equipment and machinery	Temporary during initial start up due to the use of generators
2	Workers	Sewage	Sewage generated from workers on site	Temporary in initial construction phase
		Solid Waste	Solid waste generated from labour force	Temporary in initial construction phase
3	Vehicular movement	Air and Noise emissions	Particulates, NO_x, and CO from vehicles	Temporary in initial construction phase
OPERATION PHASE				
1	Vehicular movement	Air emissions	Vehicular exhaust emissions	Continuous /periodic
2	Power Generators	Air emissions	SO_2,NO_x, PM, from fuel burning	Continuous/periodic during power failure
		Noise	Noise from running equipment	Continuous/periodic during power failure

		Hazardous waste	Generation of used oil	Periodic, during oil changes
3	Commercial	Waste water	Waste water containing food matter	continuous
		Domestic solid waste	Garbage/Food waste	continuous
4	Project area including common toilets	Sewage	Domestic waste water-BOD, Pathogens	continuous
		Domestic solid wastes	Bio-degradable and non-biodegradable wastes	Continuous-small quantities
5	Raw water treatment	Waste water	Backwash water discharge	continuous
		Solid waste	Sludge from coagulation process	continuous
6	Sewage Treatment Plant	Solid Waste	Settled and stabilized sludge	continuous
		Treated water	Treated sewage connected to BWA plant	continuous
7	Diesel Storage	Solid waste	Settled sludge during tank cleaning	occasional
		Oil	Oil spillage-Accidental large spills due to pipe rupture and oil spillage due to small leaks	8 Accidental only due to poor housekeeping

8	Maintenance	Waste water	Floor Washing	Continuous
		Solid waste	Used equipment parts and garden wastes	Continuous
9	Vehicle parking Area	Oil Spills	Minor oil leaks in parking lots	Occasional-Small Quantities
10	Storm Water Drains	Waste Water	Contamination discharge from site-Mainly suspended solids	During period of heavy rainfall

6.2 Impact Prediction and Assessment

The primary function of this environmental impact assessment study is to predict and quantify potential impacts, assess and evaluate the magnitude and their importance in order to develop an environmental management plan to mitigate the impacts. Environmental impacts could be positive or negative, direct or indirect, local or regional and also reversible or irreversible. Baseline environmental conditions at the proposed site for various parameters were provided in section 6 whereas Table 6.1provides the various pollution loads and stressors that could impact the environment. This section discusses the incremental environmental impacts on the environmental parameters during the construction and operation phases of the project. The potential impacts have been identified in Table 6.2. The mitigative measures for the adverse impacts, if any, are discussed in section 7 of Environmental Management Plan.

Table 6.2: Identification of the Potential Impacts during Construction and Operation Phases

Item	Components	Aspect	Potential Impact
CONSTRUCTION PHASE			
1	Ambient Air Quality	Dust emissions from site preparation, material handling and other construction activities at site	Minor negative impact inside the premises. No negative impact outside the project site. Short term

2	Noise	Noise generated from construction activities, operation of construction equipment and traffic	Minor negative impact near sources inside the premises. No significant impact on ambient noise levels at sensitive receptors-short term
3	Water Quality	Surface water from project site. Oil/fuel and waste spills. Improper debris disposal. Discharge of sewage Temporary facilities for workers.	Significant negative impact on nearby seawater, if not properly managed at project site. Short Term
4	Land Uses and Aesthetics	Land Development	No significant impact
5	Topography and Geology	Site Development	No significant impact
6	Soil	Construction activity	No impact-very little or no topsoil coverage
7	Ecology Flora and Fauna	Habitant disturbance during construction activity	Minor negative – Short Term
8	Socio-Economy	Increase job opportunities for locals. Also commercial related to commercial real estate development and material supply and vending	Overall positive impact
9	Traffic Pattern	Haul Truck movement and possibility of traffic congestion outside the site access road	No significant impact
OPERATIONAL PHASE			

1	Ambient Air Quality	Particulate and gaseous emissions from generators and vehicle movement	Minor negative impact
2	Noise	Noise from vehicle movement and operation of generators during power failures	Minor negative impact inside premises. No significant impact at sensitive receptors
Item	Components	Aspect	Potential Impact
3	Water Quality	Oil/fuel and spills. Discharge of sewage. Discharge of contaminated storm water	Significant adverse impact on nearby sea water, if not properly managed inside the premises.
4	Soil	Storage and disposal of solid and hazardous wastes. Discharge of sewage	Minor negative Impact
5	Ecology Flora and Fauna	Land Use change. Discharge of wastewater to sea.	Significant adverse impact on marine ecology and minor impact on terrestrial ecology
6	Socio- economy	Increased job opportunities in the project area for locals	Over all positive impact
7	Traffic Patterns	The proposed project is likely to add to predicted traffic during peak hours.	Moderate Negative Impact

6.3 Impact on Physical Environment

6.3.1 Impact on Physical Environment-Pre Construction Phase

6.3.1.1 Land Use

The proposed site was the site of the Old Harbour police station, the Two Bonds and Tucker Motors was last used as a commercial complex housing a restaurant, businesses and its ancillary services. The proposed project is tourism one which includes restaurants hotel accommodation and the land was previously approved for the construction of a hotel. The surround lands comprises a variety of uses such as a retail store an entertainment centre and a mixture of residential uses in the London Bourne Residential complex. There also exist two major hotels on that stretch of beach namely the Barbados Hilton and the Radisson Hotel.

Therefore the new land use is compatible with the proposed development.

6.3.2 Impact on Physical Environment- Construction Phase

6.3.2.1 Topography

The proposed development will not change the topographic features of the site. The site is relatively flat and will remain so. Therefore there will no significant impact on the topography of the area.

6.3.2.2 Geology

The quarry materials, such as sand earth and stones, for the site will be sourced from government- approved sites hence there will be no negative impact on the local geology of the site. Additionally, a major component of the construction will be done by precast and pre-stress concrete structures that will reduce the 'in situ' works on the site.

6.3.2.3 Climate & Meteorology

The proposed development on the climate and meteorological patterns of the area is not expected to change. There is very little vegetation on site and so there will be no significant loss of vegetation. The Proposed landscape plan for the new facility will increase the vegetation and will help in improving the microclimate of the project area.

6.4 IMPACT ON THE AIR ENVIRONMENT

6.4.1 Impact on Air Environment Pre- construction Phase

6.4.1.1 Air Emissions Sources

Air emissions have no boundaries and can migrate from one place to another place depending upon the wind direction and speed. The sources of air emission can be grouped into three categories of point, area and line sources:

1. A pollutant source that can be treated in a dispersion model as though pollutants were emitted from a single point that is fixed in space. An example of this will be the mouth of a smoke stack.

2. An array of pollutant sources so widely dispersed and uniform in strength that they can be treated in a dispersion model as an aggregate pollutant release from a defined area at a uniform rate. Such sources may include vehicles and other small engines, small businesses and household activities, or biogenic sources, such as a forest, that release hydrocarbons.

3. An array of pollutant sources along a defined path that can be treated in dispersion models as an aggregate uniform release of pollutants along a line. Example: the sum of emissions from individual cars travelling down a highway can be treated as a line source.

6.4.1.2 Fugitive Emissions from site preparation

During the construction phase of the project, the principal source of air pollution will be dust from exposed site areas, stockpiling, and movement of vehicles along unpaved roads, excavation and handling of construction materials.

6.4.2 Impact on Air Environment - Construction Phase

6.4.2.1 Air Quality

During the construction phase, the major sources of air emissions include:

- Suspended Particulate Matter (SPM) associated with the construction activity
- Emissions due to the operation of generators, to be used for supplying power as a backup in case of power loss from BL&P.

In order to quantify the impact of SPM associated with the construction activity, it is planned that the construction activity will be carried out in phases. The emission sources will be distributed throughout the project site and will fall under the category of area source.

Basic Assumptions

In the absence of information regarding the number and type of construction equipment to be deployed at any particular time, overall emission factor for SPM from construction activities has been used. Overall SPM emission has been estimated using the emission factor of 1.2 tons

SPM/month of activity/acre as per AP-42 Section 13.2.3.3 (USEPA, 1995). This emission factor is used for developing emission estimates from construction activities throughout a geographical area and is most applicable for construction operations associated with the proposed project. The derivation of the factor assumes that construction activity occurs 30 days per month, making the above estimate somewhat conservatively high for total suspended particulate (U.S. EPA, 1995).

6.4.2.2 Impact on Air Environment during Operation

The major air emissions expected during the operation phase will be due to running of generators sets during the power failure.

Air Dispersion Model

Air dispersion modelling can be used to predict atmospheric concentrations of pollutants at specific locations (receptors) over specific averaging times (i.e. annual, daily and hourly). An atmospheric dispersion model accounts for emissions from a source; estimates how high into the atmosphere they will go, how widely they will spread and how far they will travel based on temporal meteorological data; and outputs the pattern of concentrations that will occur for various exposure periods, thereby providing the exposure risks for different receptors. Industrial Source Complex Short Term air dispersion model has been used to predict ground level concentrations of the contaminants emitted from area and point sources at the site during both the construction and operational phases.

In order to predict the air pollutants, the model requires the following input parameters:

• Hourly meteorological data;

• The source description including emission rates of the various contaminants, type of source (i.e. area and point) and source emissions characteristics, as described above;

• The receptor locations and grid layout will be based on the site coordinates, receptor locations and nature of sources. With the absence of a computer generated model the following Plume dispersion model is used to calculate the concentration of emissions in g/m^3 at the receptors.

$$C = \frac{Q}{u} \cdot \frac{f}{\sigma_y \sqrt{2\pi}} \cdot \frac{g_1 + g_2 + g_3}{\sigma_z \sqrt{2\pi}}$$

f= crosswind dispersion parameter

= e $[-y^2/(2^{\sigma 2/y})]$

g= vertical dispersion parameter = $g_1+g_2+g_3$

g_1 = vertical dispersion with no reflections

$= e^{(\{-(z-H)2}/2^{\sigma 2/z})\}$

g_2 = vertical dispersion for reflection from the ground

$= e^{(\{-(z+H)2}/2^{\sigma 2/z})\}$

g_3= vertical dispersion for refection aloft

$$= \sum_{m=1}^{\infty} \{ \exp [-(z - H - 2mL)^2 / (2\,\sigma_z^2)\,] $$

C = concentration of emissions in g/m^3 at any receptor located at;

X = metres downwind from emission source point,

Y= metres crosswind from emission plume centre line

Z= metres above ground level

Q= source pollutant emission rate in g/s

U= horizontal wind velocity

H= height of emission plume from centre line above ground level in metres

σ_z= vertical standard deviation of the emission distribution in metres

σ_y= horizontal standard deviation of the emission distribution in metres

L= the height from ground level to the bottom of inversion aloft in metres

$\sigma_y(x) = e^{(j_y + {}^{j}_{y}(\ln x) + K_y[\ln(x)]^2}$

$\sigma_z(x) = e^{(l_z + {}^{j}_{z}\ln(x) + K[\ln(x)]^2}$

The six stability cases are A-extremely unstable, B-moderately unstable, C-slightly unstable, D – neutral, E- slightly stable and F- moderately stable. The coefficients in the table measure the atmospheric interference. At the site information was gathered climatic conditions were given from 1982 to 2018 and they suggest that the conditions are moderately stable hence the coefficients at F will be applied.

Table 6.3: Atmospheric Coefficients

Coefficient	A	B	C	D	E	F
R_y	0.443	0.324	0.216	0.141	0.105	0.071
r_y	0.894	0.894	0.894	0.894	0.894	0.894
l_y	-1.104	-1.634	-2.054	-2.555	-2.754	-3.143
J_y	0.9878	1.0350	1.0231	1.0423	1.0106	1.0148
K_y	-0.0076	-0.0096	-0.0076	-0.0087	-0.0064	-0.0070
l_z	4.679	-1.999	-2.341	-3.186	-3.783	-4.490
J_z	-1.7172	0.8752	0.9477	1.1737	1.3010	1.4024
K_z	0.2770	0.0136	-0.0020	-0.0316	-0.0450	-0.0540

It is assumed that 5 diesel generators will be used for backup power. The specifications for the generators are given below in table 6.3.

Table 6.4: Specification of Generators

Item	Particular	Values	
1	Generator Capacity	750KVA(600KW)	
2	Number of stacks	5	
3	Height of stacks	10.71	
4	Diameter of stacks (m)	0.35	
5	Exit velocity of gas(m/s)	35.1	
6	Exit gas temperature (0C)	492	
		PM_{10}	0.38

7	Emission rate for each set(g/s)	NO_x	0.48
		SO_x	0.06
		CO	0.23

The following Tables 6.5-66.8 give the contribution of the generators to the air pollutants.

Table 6.5: Maximum Ground Level (G.L) Concentration NO_x (24hours Average)

Description	Maximum 24 hours concentration	NAAQS196 µg/m^3
SO_2 concentration from site	2.72	
SO_2contribution from baseline (Average)	9.64	
Total $SO_2$from site to maximum	12.36	
% increase	22%	

Table 6.7: Maximum Ground Level (G.L) Concentration SO_2 (24hours Average)

Description	Maximum 24 hours concentration	NAAQS 65 µg/m^3
NO_x concentration from site	21.81	
NO_xcontribution from baseline (Average)	10.96	
Total $NO_x$from site to maximum	32.77	
% increase	66.6 %	

Table 6.8: Maximum Ground Level (G.L) Concentration PM_{10} (24hours Average)

Description	Maximum 24 hours concentration	NAAQS 150 µg/m^3
PM_{10} concentration from site	17.26	
PM_{10} contribution from baseline (Average)	29.94	
Total PM_{10} from site to maximum	47.20	
% increase	36.6 %	

Table 6.9: Maximum Ground Level (G.L) Concentration CO (8hours Average)

Description	Maximum 8 hours concentration	NAAQS 2000 µg/m^3
CO concentration from site	10.45	
COcontribution from baseline(Average)	918	
Total CO from site to maximum	928.45	
% increase	1.1 %	

6.5 IMPACT ON NOISE ENVIRONMENT

6.5.1 Impact on Noise Environment - Pre-construction

The noise generating activity during the mobilization pre construction period is vehicular movement and various noise-generating equipment, which would be used onsite for construction purpose. The majority of the site has already been cleared and noise generation will be negligible.

6.5.2 Impact on Noise Environment - Construction and Operation Phase

6.5.2.1 Noise Quality

The noise emission sources during construction phase will come mainly from construction machineries/equipment to be used at the site. The expected noise levels from the operation of equipment and machineries are provided in Table 6.10 below.

Table 6.10: Noise generation Levels from Construction Equipment

Source of Noise	Noise Level at 15m (50') from source in db(A)
Bach Hoe/ Loader	80
Concrete Mixer	85
Dump Truck	84
Generator	82
Jack Hammer	85
Crane	85

Source: Construction Noise Handbook, Federal Highway Administration

6.5.2.2 Impact due to Generator sets

The major source of noise generation during the construction and operation phase will be due to generator sets used on the project site. The DG sets are proposed to be installed during the construction and operation phase for power back up supply and hence the noise pollution load will be increase. However, the generators will be provided with acoustic enclosures so as to keep the noise level within the prescribed standards. Noise Limit for Generator Sets run with Diesel were notified by Environment (Protection) second Amendment Rules vide GSR 371(E), dated 17th May 2002 at serial no.94 and its subsequent amendments. The maximum permissible sound pressure level for new diesel generator (DG) sets with rated capacity up to 1000 KVA, manufactured on or after the 1st January, 2005 shall be 75 dB (A) at 1 m from the enclosure surface (CPCB). The diesel generator sets will be provided with integral acoustic enclosure at the manufacturing stage itself.

Prediction Model

For an approximate estimation of propagation of noise in the ambient air from the area or point source, a standard mathematical model for sound wave propagation has been used which is as follows:

Noise (Receptor) = Noise (Source) - 20 Log [distance (Receptor) / distance (Source)]

In the worst-case scenario where all the equipment is used at the site simultaneously then the combined noise level is the logarithmic sum is of the individual noise level. In the case where all the equipment and the additional 4 Generators are used in the construction phase then the resultant noise level of all the equipment, as a single point source, is equivalent to 97.21 dB (A) at 15m. The table below is generated using the equation:

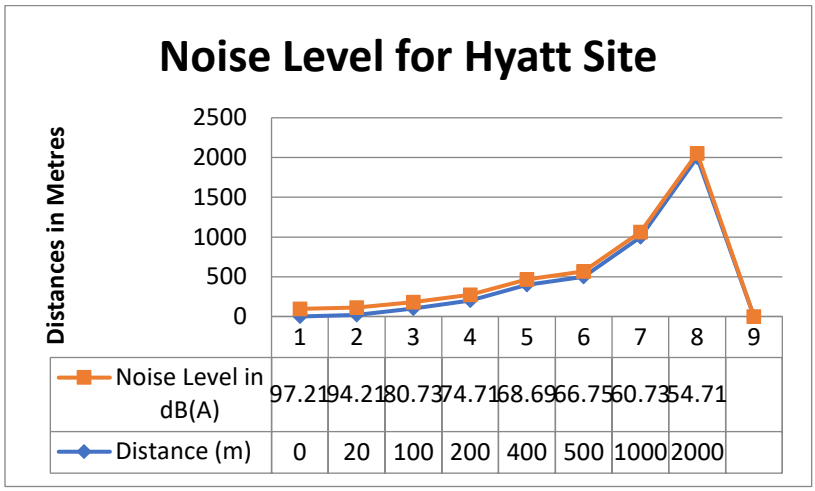
Noise (Receptor) = Noise (Source) - 20 Log [distance (Receptor) / distance (Source)]

Table 6.11: Prediction of Noise Levels emanating from site

Distance (m)	Noise Level in dB(A)
0	97.21
20	94.21
100	80.73

200	74.71
400	68.69
500	66.75
1000	60.73
2000	54.71

Figure 6.1: Noise levels



The graph shows that the noise will reach acceptable level of 55 dB (A) assuming that all the equipment is being use at the same time.

However during the construction Phase it is more than likely that only 3 pieces of equipment will be used at the same time.

Bear in mind that the superstructure will be mainly made from precast concrete components so the traditional block work and concrete batching will be at a minimum.

Therefore the following scenarios are suggested.

- Using the three pieces of equipment with highest noise level of 85 dB(A)
- The combined Noise level as a single point source is 89.77 d B(A)

Using the equation:

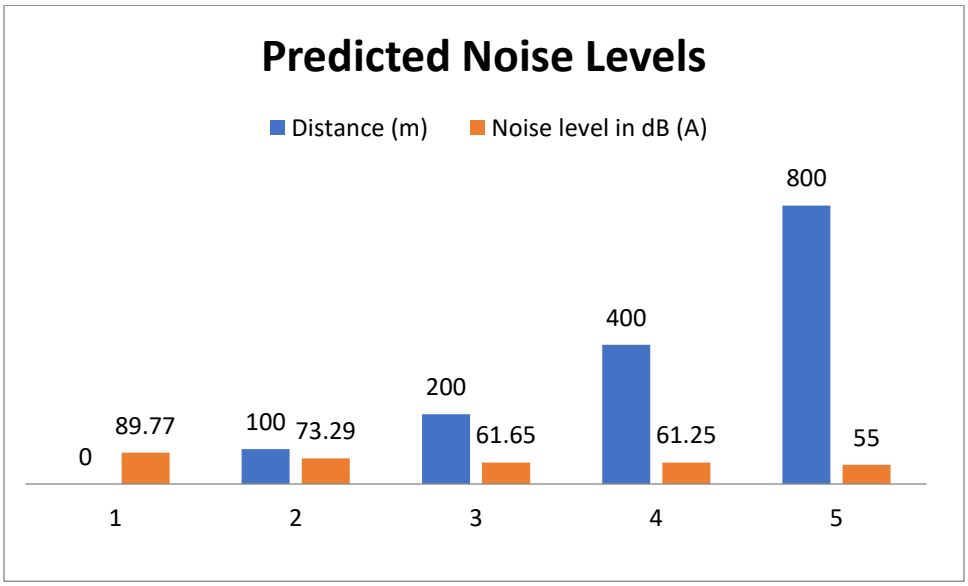
Noise (Receptor) = Noise (Source) - 20 Log [distance (Receptor) / distance (Source)]

The results are as follow:

Table 6.12: Predicted Noise level for three sets of equipment

Distance (m)	Noise level in dB (A)
0	89.77
100	73.29
200	61.65
400	61.25
800	55

Figure 6.2: Predicted Noise level for three sets of equipment



The result shows that without mitigation the acceptable level of 55 dB (A) is achieved at 800 metres. With mitigation measures and scheduling of equipment the noise can contain within the site to acceptable levels.

During the operational phase of the development five back up generations will be used in cases of power failure. The proponent also plans to use Solar Photovoltaic technology to support the essentials services for the project. This will eliminate the need for generators and dependency on fossil fuel for power.

Results and Discussion

6.6 Impact on Land Environment

6.6.1 Impact on Land Environment - Construction Phase

Earthwork

The proposed site is relatively flat and any earthworks will be reduced a very minimum and have a negligible impact on the land environment. However topsoil is required for landscaping purposes that could have a negative impact if not managed properly.

Municipal Waste

The municipal waste generated during the construction phase will comprise of waste generated from the workers on the site. Workers engaged during construction phase will generate municipal solid wastes such as food wastes, packaging and wastepaper. The waste from this activity would be mainly household domestic waste and it is estimated to be 0.05 Ton Per Day (TPD). The construction at the site will be reduced considerably because of the method of construction that will be employed using pre-cast components.

Drainage

The site is located near the seashore and therefore proper care must to be taken to avoid any runoff from the project site into the seawater. The site is relatively flat and every will be made to contain the water on the project site. As expected the proposed project would involve construction of paved areas and thus the runoff from the project site is expected to increase. However, the increased runoff will not cause flooding or water logging because a well-designed storm water network will be provided within the entire site premises which will be stored in a 90,000 gallon tank as water harvesting is a priority for this project.

6.6.2 Impact on Land Environment - Operation Phase

Soil

During the operation phase, carefully designed landscaped areas will be maintained.

No significant impact is expected on the soils on and around the site, due to the following management measures:

1. All solid and hazardous wastes from the project will be properly collected, stored and disposed.
2. An integrated solid waste management plan will be developed as per the details given in section 7
3. Wastewater will be linked to the Bridgetown Sewerage Plan as per BWA recommended standards.
4. Storm water will be stored properly and reused within the premises.

5. Secondary spill containment will be provided in fuel, oil and other material storage areas.

Impacts due to Solid Waste Disposal

During operation phase, solid waste will be generated from various activities, which have been quantified on the basis of the rate in Barbados of 1 kg per person a day (ISWMP) from the estimates from the Barbados Sanitation Service Authority. It is estimated that the population during the operational phase of the project will be 1200 persons which will equate to 1.200kg of waste daily comprising of biodegradable, non biodegradable, hazardous and inert waste. Proper segregation, collection, storage, treatment and disposal facilities for various categories of waste will be provided in accordance with the regulatory requirements.

Municipal Solid Waste (MSW) including horticulture waste will be generated during the operation phase and will be handled as per the Municipal Solid Waste Management & Handling Rules. Segregation at source will be introduced with biodegradable and non recyclable/non-biodegradable waste to be stored and collected separately. The biodegradable waste will be stored, treated on site and then transported to nearest designated waste storage bins; whereas the non recyclable and non biodegradable waste will be disposed off to authorized recyclers.

During this phase of the project, environmental impact from solid waste disposal can typically include contamination of soil, ground water, surface water and air quality. Solid waste, if disposed improperly can cause following impact on the environment:

1. Ground water contamination by leachate generated by non-scientific dumping.
2. Surface water contamination by the runoff from the dumping site
3. Bad odour, Pests, rodents and windblown litter in and around the dumping site.
4. Generation of inflammable gases (e.g. Methane)
5. Fires within the waste dump.
6. Erosion and stability problem relating to slope of the dumping site
7. Epidemic through stray animals
8. Increased concentration of acidity in the surrounding soil
9. Release of green house gases.

Impacts may also result from improper siting, inadequate design and poor operation. However for the proposed project, impacts from waste disposal would not be significant, since waste would be converted to compost at the project site using suitable composting technique and Rejects from compost along with non-recyclable and non-compostable fraction of waste would be disposed as per the SSA Municipal Solid Waste guidelines.

6,7 Impact on Ecological Environmental

6.7.1 Impact on Ecological Environment - Construction Phase

Impact: Potential loss of mature trees located in Zone A, Zone B and Zone C as a result of direct and indirect construction activities. (Short-term & long-term)

Where possible, larger trees, especially in zone (a) and zone(c) will be protected and retained. This would prevent ecological disequilibrium caused by sudden habitat loss. Those trees closest to the high water mark zone(c) will help to hold the sand/soil together and prevent beach erosion.

Impact: Potential Loss and Planned Removal of existing plant species/communities to accommodate new development. (Short-term & long-term)

6.7.2 Impact on Ecological Environment - Operation Phase

The likely impacts of the proposed development during the operation phase include air and noise pollution and disturbance generated due to area lighting and traffic movement. This may affect the mammals and birds in the vicinity. The landscape development will consider the nativity of the species so that local faunal species are supported further. Moreover, landscaping will play a pivotal role in the proposed development in facilitating improved- biodiversity.

6.8 Impact on the Socio- Economic Environment

6.8.1 Impact on Socio-Economic Environment - Construction Phase

Social Impact Assessment involves the processes of analysing, monitoring and managing the intended and unintended social consequences both positive and negative of planned interventions and any social change processes invoked by those interventions. Its primary purpose is to bring about a more sustainable and equitable biophysical and human environment.

This section discusses the proposed development, project activities and the extent of potential impacts anticipated from the proposed development.

During the social consultation process, some issues were raised, which are as follows:

- Priority to the local people for employment during construction and operation phase.
- Increased activity in the area would hamper free movement of the locals and reduce adequate access to the beach.

The above concerns of the local community are addressed in the impact assessment and management plan.

6.8.2 Impact on Socio-Economic Environment - Operation Phase

Positive Impacts

Local Development: The proposed project will have a positive effect in creation of job opportunities for the people in the project area as well as other parts of the island. The social surveys have shown a high unemployment rate among the villages. In fact the rate stands at 26.2 %, which is astronomically high when compared to the national rate of 10.4%. There will be a need for employing technical, nontechnical, administrative and support staff during this phase, for which due preference will be given to the locals based on their skill sets. The improvement in the physical infrastructure and land use change will lead to significant appreciation of the land value. Scope will be widened for other investors and developers also to invest in the area.

Employment and Job opportunity: The proposed development will generate employment for all sectors of the society with the type of opportunity vary from technical, non-technical, administrative, support staff etc. Other potential developers would also be interested in investing in this area thereby opening more employment opportunities for the people in the whole area.

Accessing prevailing utilities: The resources being utilized by the locals will not be affected in any way as all the resources and infrastructure in the proposed development is self-contained. Adequate sewerage facility, solid waste disposal, water harvesting system, drainage etc. will be developed within the project premises.

Ancillary activities: The proposed development is beach resort, which will trigger ancillary commercial activities in the nearby area and will have a positive impact on the social environment.

Benefits to women: During the construction phase, the proposed project will provide opportunity of employment related to construction activities. During the operation phase there will be considerable opportunities of employment due to demand of domestic help and other such requirements of the habitants of the project. The proximity of the project site to nearby village will benefit local women in getting involved in such jobs.

Negative Impacts

Traffic and Transport: During the construction phase, truck movement due to construction activities will take place. In order to minimize any inconvenience that may arise, the movement of trucks would be allowed during night and non-peak hours. During the operation phase, the traffic in the area is likely to increase. This may lead to traffic congestion and inconvenience for pedestrians and residents accessing the localities. The traffic study and Transportation Management Plan being developed for the project will mitigate these impacts.

Transit Labour population: Labourers for the project would be from surrounding areas. About 1500 labourers would be working on the site and most of them would be on contract or from the neighbouring settlements.

Negligible Impacts

Demography: During construction and operation phase, some of the work force is likely to be nonlocal. It is highly unlikely that this will affect or alter the existing demographic profile and population density.

6.9 Impact on historical, Cultural & architectural sites

The site is part of the Bridgetown UNESCO heritage site and every effort must be made to maintain the historical, cultural and architectural integrity of the area. Several facets are taken into consideration in the design of the proposed project. These included the likely impacts the project could have on the Marine Carlisle Park and the associated underground resources, Public Park and open spaces, beach access, recreation opportunities and visual access to both locals and visitors, the livelihood of residents and beach users in the study area and the architectural design of the streetscape of the project site. As a result no negative impact in this regard is anticipated.

6.10 Summary of Impacts

A summary of likely impacts due to proposed project is noted in Table 6.13.

Table 6.13. A summary of likely impacts due to proposed project

Item	Components	Activities	Predicted Impacts	Extent of impacts
CONSTRUCTION PHASE				
1	Ambient Air Quality	Dust emissions from ground clearing, material handling and other construction activities	Minor negative impact inside the premises. No negative impact outside site	Impacts are temporary during construction phase. Impacts will be confined to short term distances, as course particles will settle within the next short distance from activities
2	Noise	Noise generated from construction activities and operation of construction equipment	Minor negative impact near noise generation sources inside the premises. No significant impact on ambient noise levels at sensitive receptors	Temporary impacts during construction phase. No blasting or other high intensity noise activities envisaged. Contribution of noise during the operational phase will be confined to in time & space
3	Water Quality	Surface water runoff from project site, oil /fuel spills, improper debris disposal, Discharge of sewage from workers	Minimal due to effective EPM proposal	Impact will be temporary. Local labour will be employed. Workers shall be provided potable water for drinking. Proper mitigation measures will be taken to

				avoid any runoff in the nearby sea shore
4	Land Use and aesthetics	Land Development	Permanent positive impact	The impact has ample open and areas with sustainable infrastructure that will enhance the visual appeal in the area
5	Topography and Geology	Existing site is flat and minor levelling is required to maintain the natural topography of the area.	Minor impacts	Proper mitigation methods are required to maintain the local topography of the site.
6	Ecology Flora and fauna	Habitat disturbance during construction	Significant negative impact	The site and adjacent areas may have impact on flora and fauna diversity of the area and therefore proper care need to be taken to minimise the disturbance to local ecology.
7	Socio- economy	Increased job opportunity for locals. Economy related to commercial real estate development, material supply expected to boom.	Overall positive impact.	Reduction of unemployment in the local economy

8	Traffic pattern	Haul Truck movement and possibility of traffic congestion outside site on the highway	Minor negative impact.	In localised area
OPERATION PHASE				
1	Ambient Air Quality	Particulate matter and gaseous emissions from DG sets and vehicle movement	Minor negative impact inside the premises from onsite cars. Negative impact outside the site DG sets.	DG sets will be used for backup power only a maximum of 8 hours a day. A higher stack is recommended in the EPM
2	Noise	Noise from vehicle movement and operation of diesel generator sets during power failure.	Minor negative impact inside premises. No significant impact at sensitive receptors	Contribution of noise from the project during operational phase will be limited to minor increase.
3	Water Quality	Oil/ fuel and waste spills. Discharged of sewage Discharge of contaminated storm water	No significant adverse impact	Proper waste management plan and storm water management plan will be developed inside the premises only to avoid any contamination of nearby sea water
Item	Components	Activities	Predicted impacts	Extent of impacts
4	Water Availability	Use of 300 KLD of fresh water requirements at peak	Minor negative impact	BWA supply

5	Soil	Storage of disposal of solid and hazardous wastes Discharge of sewage	Minor negative impact	
6	Socio-economy	Increase job opportunities for local workforce on site. Project will involve road upgrading, better infrastructures and amenities	Overall positive impact	
7	Traffic Pattern	The project is likely to add to the traffic on nearby roads	Moderate Negative Impact	Traffic Management measures will be employed.