Environmental Impact Assessment

Portmore International Hospital and Medical Center

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EXECUTIVE SUMMARY

Background (The font requirement for document submitted to Government is generally Times or Times New Roman 12pt. With margins of 1.0 inch on all sides.

Cayjam Development Limited has proposed the development of a first-world, private medical facility in Portmore St Catherine. The *Portmore International Hospital and Medical Centre (PIHMC)* when completed will be the first of its kind in the Caribbean and will be positioned as a private healthcare organization, with secondary and tertiary care facilities.

The National Environment and Planning Agency (NEPA), has stipulated that the Hospital will require an Environmental Impact Assessment (EIA), for which the Terms of Reference (TOR) were approved (see **Annexure 1**). This document presents the findings of the EIA for the proposed Development, addressing all of the items and aspects specified in the TOR.

Description of the Study Area

The study area is situated in Portmore, St. Catherine and falls within the boundaries of the Portmore Municipality. The specified location is a 104.7 acre property located 17.966919 ° North and -76.884985° West, flanked to the West by Newlands Road, to the South by Southboro Drive, to the East by Germaine Road and to the North by Portmore Lane. It is currently not being utilized, except as an illegal dumping ground, or as a through-road for local pedestrians. For the purposes of this analysis, the project influence area has been established to have a 2 km radius from the centre of the proposed site, and includes the communities of Newlands, Southboro, Portmore Gardens, Garveymeade, Westmeade and Bridgeport.

General Assessments

The following environmental factors were assessed for the purpose of the EIA:

- **Land**

The project site is located in the alluvial plain within the southeast part of St. Catherine. The general topography of the area is level to nearly level with 0 – 2^0 slope. The soil types are primarily alluvial in origin, consisting of Caymanas clay loam and Caymanas sandy loam.

- **Ambient Air Quality**

All gaseous emissions are below the detectable limits. However, Total Suspended Particulate (TSP) was on the high side for Westmeade, which may be attributed to wind direction and the presence of a construction site in the area. The project's impact on air quality is expected to be minimal during the construction period, but may be more significant during the operation of the hospital with the use of the Diesel Generator sets along with the incinerator. The development expects to mitigate this with the planned development of an enclosed gasification "green" plant that will eliminate the need for an incinerator. The hospital plans to install and use an autoclave instead of an incinerator in the short term and as a backup to the gasification plant.

- **Noise**

The project is located in a predominantly suburban area and therefore the residential noise standard of 55 dBA between 7 am to 10 pm will apply. The analysis shows that, even without the project construction activities, the decibel readings are above the residential target value. This is due mainly to the constant traffic movement on the surrounding roads. Other noise contributors were construction activities and music in close proximity. The Hospital therefore will not have any prolonged significant impact on the baseline noise levels.

- **Water Quality**

The water table in Portmore is not used as a potable water source, mainly because of saline intrusion; as a result, the proposed development will not access ground water. Suitable measures will be in place, to ensure that there is no effect on ground water quality.

- **Ecological Environment**

There are no wild life sanctuaries or any rare, endangered or endemic species within the 2 km radius of the project site. The ecology of the project area is not very rich in diversity or high in endemism, and is typical of a desert-type vegetation. Hence, there will be no impact in this aspect as it relates to the removal of animal life. There is expected to be an increase in vegetation as the landscaping of the property includes extensive use of plants and flowers.

Socio Economic Environment

The Kingston Metropolitan Area (KMA) including Portmore, is one of the largest urban areas in the Caribbean and contains 26.3 percent of the country's population. More significantly, the land area of the KMA zone has now expanded westward and is currently experiencing an annual growth rate of 2.30 percent, which represents the fastest growing of the country's urban areas. The Portmore Municipality, with a population of some 400,000 includes some 60 communities with populations ranging from a low of 803, to a high of 15,116. With the creation of jobs in all phases of the project, a positive impact will be made on the socio-economic environment of the community.

Assessment of the Impacts during Construction

While the project's construction poses certain environmental risks, these are short term, and/or easily reversed. The major effects expected during the construction phase include: a temporary strain on the existing infrastructure; soil pollution caused by spillage from construction machinery; surface water contamination as well as minimal levels of air and noise pollution. There is also expected to be an increase in the congestion of vehicular traffic and solid waste, however these negative impacts are short term. Positive impacts highlighted include the social benefits of migrant worker influx and the micro-economic development this will induce in the local area.

Assessment of the Impacts during Operation

There is expected to be a significant generation of biomedical waste during the project's operation, which is likely to pose health risks if they are not safely discarded. Air pollution may result from emissions from the DG Sets, vehicles and the incinerator, while ambient noise levels are threatened by the operation of the DG sets. There is no foreseen effect on ground water, and with an effective mitigation program, impacts on surface water quality are easily managed. Several positive impacts can be identified as a result of the introduction of the Hospital in the area, including; the establishment of a hospital in

Portmore, employment opportunities, enhancement of public health and safety and induced development.

Environment Management Plan

In keeping with relevant legislation and regulations of the Government of Jamaica, the management of the PIHMC will implement an extensive Environmental Monitoring Programme to cover all aspects of its operations. Results of this monitoring programme are summarized in Table 1 below:

Table 1: Environmental Monitoring Program

Potential Impact	Action	Parameters
1. Construction Phase		
Air Emissions	All equipment to be operated within specified design parameters	Random checks of equipment logs/manuals
	A management system for the control of vehicular emissions to be instituted	Random checks of equipment logs/manuals
	All loose material to be kept on site for the shortest possible time and provided with suitable covering	Absence of stockpiles or open containers of dusty materials
	Compaction of soil during various construction activities	Vehicle logs
	Ambient air quality within the premises of the proposed project to be monitored	The ambient air quality will conform to the National standards for SPM, SO_2, NO_x, and CO
Noise	List of all noise generating machinery on site along with the age to be prepared	Equipment logs
	Night working to be monitored	Working hour records/Night working monitoring
	Silencers and mufflers to be affixed to the exhaust systems of all mechanical equipment	Maintenance records of vehicles
	Implement good working practices to minimise noise and also reduce its impacts on human health (ear muffs, safe distances, enclosures)	Site working practices records, noise readings
	No machinery to be running when not required	
	Acoustic mufflers/enclosures to be provided in large engines	Mufflers/enclosures in place
	Noise to be monitored in ambient air within the plant premises	Noise readings

Potential Impact	Action	Parameters
	The noise level will not exceed the permissible limit both during day and night times	
Water	Control of runoff from site	Effective implementation and management of proposed site drainage plan
	Use of sediment and grease traps to intercept runoff from drainage areas	
Solid Waste	All solid waste to be appropriately disposed of in drums or dumpsters	No evidence of littering and improper waste disposal activities
Wastewater Discharge	No untreated discharge to be leaked to surface water, groundwater or soil	No discharged(?) hoses in vicinity of water courses
	The discharge point will be properly selected and sampling and analysis should be undertaken prior to discharge	Effluent standards as per NEPA guidelines
	Care taken in disposing wastewater generated such that soil and groundwater resources are protected	Effluent standards as per NEPA guidelines
Drainage and Effluent Management	Ensure drainage system and specific design measures are working effectively. The design will incorporate existing drainage pattern and avoid disturbance of the same	Visual inspection of drainage and records thereof
Waste Management	Implement waste management plan that identifies and characterises every waste product associated with proposed activities and that identifies the procedures for collection, handling and disposal of each type of waste	Comprehensive Waste Management Plan established and available for inspection
Non-routine Events and Accidental Releases	Plan to be drawn up considering likely emergencies and steps required to limit consequences	Mock drills and records of the same
2. Operation Phase		
Air Emissions	Stack emissions from DG sets to be optimally monitored	The ambient air quality will conform to the National standards for SPM, SO_2, NO_x, and CO
	Maintenance of internal roads to avoid dust generation	The ambient air quality will conform to the National standards for SPM, SO_2, NO_x, and CO
	Incinerator equipped with rigorous pollution control technologies	As per National and International Guidelines
	Air quality monitoring	As per NEPA guidelines
Noise	Noise generated from operation of DG sets to be optimised and monitored. DG sets to generate less than 75 dBA at 100 m from the	As per National and International Regulations

Potential Impact	Action	Parameters
	source. DG sets are to be provided with acoustic enclosures with height of chimney above roof level	
Water	Provision of suitable drainage system	As per approved drainage plan
	Rainwater harvesting	As per National guidelines
Wastewater Discharge	No untreated discharge to be leaked to surface water, groundwater or soil	No discharge hoses in vicinity of water courses
	Care to be taken in disposing wastewater generated, such that soil and groundwater resources are protected	Discharge standards for effluents
Solid Waste	Adequate number of collection bins to be provided separately for biodegradable and non-biodegradable waste	No evidence of littering and improper waste disposal activities
	Landscape waste managed to prevent surface runoff	
Biomedical Waste	Potentially infectious waste treated prior to disposal	Effective Biomedical Waste Management Plan
	Distinctive protocols for the classification and segregation of waste to be in place	
Drainage and Effluent Management	Ensure specific design system and design measures are working effectively. The design to incorporate existing drainage pattern and avoid disturbance of same	Visual inspection of drainage and records thereof
Indoor Air Contamination	Contaminants such as CO, CO_2, and VOCs to be reduced by providing adequate ventilation	Monitoring of indoor contaminants such as CO, CO_2 and VOCs
Energy Use	Energy usage for air-conditioning and other activities to be minimised. Conduct annual energy audit for the buildings	Findings of energy audit report
Emergency Preparedness, such as fire fighting	Fire protection and safety measures to take care of fire and exposure hazards, to be assessed and steps taken for their prevention	Mock drill records, on-site emergency plan, evacuation plan

Environmental monitoring will be carried out during the construction and operational phases of the project, based on the potential impacts identified. Results of this monitoring programme will be submitted to NEPA, as required under the NRCA Act of 1991


PORTMORE MEDICAL CENTER
PORTMORE, JAMAICA - CAYJAM DEVELOPMENT LTD.
MAY 18, 2006
McCLUGGAGE VAN SICKLE & PERRY
ARCHITECTURE - LANDSCAPE ARCHITECTURE - PLANNING - INTERIOR DESIGN

CHAPTER 1: INTRODUCTION

1.1 PREAMBLE

Cayjam Development Limited, a company registered in the Cayman Islands, has proposed the development of a first world private medical facility in Portmore, Saint Catherine, Jamaica. The *Portmore International Hospital and Medical Centre (PIHMC)*, when completed, will be the first of its kind in the Caribbean and will be positioned as a private, healthcare organization, with a secondary and tertiary care facility.

Based on the results of a feasibility study, it was recommended that the development of the hospital be done in two phases. Phase 1 is the development of a 64-bed facility that will provide a range of key medical and surgical services. Phase 2 will the development of an additional 56-bed facility, with consideration being made for the inclusion of a gated residential complex.

1.2 OBJECTIVE AND SCOPE OF STUDY

The objective of the study is to carry out an Environmental Impact Assessment (EIA) for the proposed project, to meet the environmental compliances laid down by the Ministry of Environment, Government of Jamaica. The scope of study would be as per the EIA guidelines outlined by the National Environment Planning Agency (NEPA), for new construction projects. Generally, Essentially the purpose of this EIA is to inform the decision makers, regulatory agencies, required to authorize actions, and the public regarding the anticipated environmental impact of the proposed development Hospital, and possible ways to mitigate them.

The study includes a description of the project setting, a comprehensive evaluation of the site, baseline studies, predicted environmental impacts and governing legislations. An Environmental Management Plan (EMP) will be prepared, which includes mitigation strategies, as well as measures and recommendations for the effective management of the impact of the project on the natural, social and economic environment.

1.2.1 Scope of Study

The Environmental Impact Assessment for the PIHMC will:

- Provide a comprehensive description of all components of the project and the work to be undertaken during the project.
- Give an overall assessment of the existing physical and biological environment of the proposed development area.
- Present a socio-economic and cultural evaluation of the proposed development area and its surroundings.
- Identify and assess the potential impact of the project on the surrounding area, particularly as it relates to the cumulative impacts of this project on any existing developments.
- Assess the drainage structure, particularly with respect to existing natural drainage channels, proposed man-made drainage/water features or any proposed changes in topography. Potential impacts of increased surface runoff and sediment loading will also be addressed.
- Describe the construction methods to be employed during the proposed works.
- Describe the mitigation measures to be employed during the proposed works.
- Outline disposal of solid, medical and hazardous waste during the construction and operational phases.
- Determine the method, level and location of the sewage treatment facility and the potential impact of disposal on the environment.
- Give the timelines/scheduling for individual tasks to be undertaken.
- Detail an environmental Monitoring and Management Plan. (Did you actually do this?)

1.3 GENERAL APPROACH

A team of experienced environmental professionals was assembled to conduct the scope of study highlighted above, as required by NEPA. The EIA professional team is described in **Annexure 2**. An iterative approach among the team members and other project professionals was adopted, facilitated by weekly team meetings as required.

The EIA team worked very closely with *Cayjam Development Limited,* including the business consultant, project manager, engineers and architects.

The Charette-style approach to methodology, data gathering and analysis was utilized, with team meetings used as a means to discuss the progress of investigations, as well as to facilitate integration of data towards an understanding of the systems at work.

Baseline data for the study area were generated using a combination of:

- Field studies
- Analysis of maps, plans, aerial photos
- Review of reports and background documents
- Structured interviews
- Laboratory analyses

1.4 Legal, Policy and Institutional Frameworks

The principal environmental regulatory agency in Jamaica is NEPA, which formulates environmental policies, and accords environmental clearances for different projects. **Table 2** highlights the legal and institutional framework, pertinent to environmental management of infrastructure development projects in Jamaica, especially as it relates to the proposed project.

Table 2: Regulatory Framework

No.	Legal Framework	Coordinating Agency	Objectives/ Highlights of Framework	Applicability
Natural Environment				
1	Natural Resources Conservation Authority Act (1991)	NRCA/ NEPA	Provides for the protection of Jamaica's natural resources	Applicable

No.	Legal Framework	Coordinating Agency	Objectives/ Highlights of Framework	Applicability
2	Natural Resources (Permit and Licenses) Regulation (1996)	NRCA/ NEPA	Establishes a permit and licensing system to control the undertaking of any new construction or development of a prescribed nature in Jamaica and the handling of sewage or trade effluent and poisonous or harmful substances discharged into the environment.	Applicable
3	Watersheds Protection Act (1963)	NRCA/ NEPA	Provides for the protection of watersheds and areas adjoining watersheds and promote the conservation of water resources.	Applicable
4	Wildlife Protection Act (1945) Wildlife Protection (Amendment) Act Order (1998)	NRCA/ NEPA	Primarily concerned with the protection, management and conservation of specified species of animals and the regulation of the hunting of specified animals including birds.	Applicable
5	The Endangered Species (Protection, Conservation and Regulation of Trade) Act (2000)	NRCA/ NEPA	Provides for the protection and regulation of the trade of endangered species.	Applicable

No.	Legal Framework	Coordinating Agency	Objectives/ Highlights of Framework	Applicability
6	Water Resources Act (1995)	WRA	Ensures the proper administration, development and optimal use of Jamaica's water resources	Applicable
7	Quarries Control Act (1984) Quarries Control (Amendment) Act (1994)	Mines and Geology Division, Ministry of Mining and Telecommunications	Controls and manages all quarrying activities in Jamaica.	Not Applicable
8	Pesticides (Amendment) Act (1996)	Pesticides Control Authority	Designed to manage and regulate the use of pesticides which are potentially harmful to the environment.	Applicable
9	Clean Air Act (1964)	Ministry of Health and Environment	Designed to control air pollution by regulating the amount of any noxious or offensive gas which is permitted to escape or is discharged from affected premises into the air.	Applicable
Social Environment				
10	Town and Country Planning Act (1958)	Town and Country Planning Authority and the Local Planning Authorities	Designates specific personnel who are given the responsibility of and the required power to ensure compliance with legislation.	Applicable
11	Land Development and Utilization Act (1966)	NEPA	Addresses the sustainable use of agricultural lands.	Not Applicable

No.	Legal Framework	Coordinating Agency	Objectives/ Highlights of Framework	Applicability
12	Public Health Act (1985)	Ministry of Health through Local Boards, namely the Kingston and St. Andrew Council and the Parish Councils for other parishes	Provides for the protection of public and environmental health, waste management and pollution control.	Applicable
13	Country Fires Act (1942)	Ministry of Agriculture	Designated to control and prevent the occurrences of fires which may be harmful to the surrounding environment.	Applicable
14	National Solid Waste Management Act (2001)	National Solid Waste Management Authority	Provides for the management of solid waste in an environmentally sound manner.	Applicable
15	Jamaica National Heritage Trust (1985)	National Heritage Trust	Designated to manage and protect National Monuments and National Heritage	Not Applicable
Handling of Hazardous Wastes				
16	The Natural Resources Conservation (Hazardous Wastes) and (Control of Trans-boundary Movements) Regulations, 2002	The Natural Resources Conservation Authority	Seeks to control trans-boundary movement of hazardous wastes, monitor and prevent illegal trafficking and provides assistance for environmentally sound management of these wastes. It also seeks to promote cooperation in the hazardous waste management field and development of Technical Guidelines for the management of hazardous wastes through the control of trans-boundary movement	Applicable

1.5 ENVIRONMENTAL STANDARDS

The Environmental Permit and License System (P & L System) introduced in 1997, established a framework to control the undertaking of any new development of a prescribed nature in Jamaica. The P & L System is administered by NEPA, through the Applications Section (formerly the Permit and License Secretariat). This system requires that all developments in Jamaica meet required standards in order to minimize negative environmental impacts. Under the NRCA Act of 1991, the Agency is authorized to issue, suspend, revoke, or otherwise decline issuance of permits and licences, if facilities are not in compliance with the environmental standards. An applicant for a permit or license must complete an application form, as well as a Project Information Form (PIF) for submission to the NEPA.

This section details the base standards for air quality, noise level, effluent discharge and water quality, as per the NEPA Development and Investment Manual, Volume 2 (2007), in satisfaction of the requirement for the preparation of the EIA. These standards are of significance for the proposed project and have been outlined below.

1.5.1 Ambient Water Standard

In order to ascertain and categorize the existing drinking water, the quality of potable water needs to be compared with the existing standards that have been adopted by NEPA. These water standards are outlined in **Table 3** below.

Table 3: Jamaican National Ambient Water Quality Standard – Fresh Water

Parameter	Measured as	Standards Range	Unit
Calcium	(Ca)	40.00 - 101.1	mg/L
Chloride	(Cl^-)	5.00 - 20.0	mg/L
Magnesium	(Mg^{2+})	3.60 - 27.0	mg/L
Nitrate	(NO_3^-)	0.10 - 7.5	mg/L
Phosphate	(PO_4^{3-})	0.01 - 0.8	mg/L
pH	(-)	7.00 - 8.4	-
Potassium	(K^+)	0.74 - 5.0	mg/L
Silica	(SiO_4)	5.0 - 39.0	mg/L
Sodium	(Na^+)	4.5 - 12.0	mg/L
Sulphate	(SO_4^{2-})	3.00 - 10.0	mg/L
Hardness	($CaCO_3$)	127.00 - 381.0	mg/L as $CaCO_3$
Biological Oxygen Demand		0.80 1.7	mg/L
Conductivity		150.00 - 600	ϕS/cm
Total Dissolved Solids		120.00 - 300	mg/L

1.5.2 Ambient Air Quality Standards

Jamaica has adopted the Clean Air Act (1964) that is administered by the Ministry of Health and Environment. This Act is designed to control air pollution, by regulating the amount of any noxious or offensive gas, which is permitted to escape, or is discharged from affected premises into the air. The Ambient Air Quality Standards that have been adopted are outlined in **Table 4** below.

Table 4: National Ambient Air Quality Standard*

Pollutant	Averaging Time	Standard (Maximum Concentration in µg/m^3)
Total Suspended Particulate Matter (TSP) (a)	Annual	60
	24 Hours	150
PM_{10} (b)	Annual	60
	24 Hours	150
Lead	Calendar Quarter	2

Pollutant	Averaging Time	Standard (Maximum Concentration in µg/m^3)
Sulphur Dioxide	Annual	80 Primary; 60 Secondary
	24 Hours	360 Primary; 260 Secondary
	1 Hour	700
Photochemical Oxidants (ozone)	1 h	235
Carbon Monoxide	8 h	10,000
	1 h	40,000
Nitrogen Oxide	Annual	100

*Note that regulations should have specified that all air quality measurements expressed in mass per unit volume are to be corrected to 25^{0}C and 101.3 kilopascals

TSP indicates all particles and aerosols with aerodynamic diameter of 100 micrometers or less and can be measured by the high volume sampling method

PM_{10} refers to particles with an aerodynamic diameter of 10 micrometers or less as measured by the PM_{10} sampler.

The secondary standards for sulphur dioxide are designed to protect the public health and welfare. They represent the long term goal for air quality and provide the basis for an anti-degradation policy for unpolluted areas of the country and for continuing development of pollution control technology.

(Source: NEPA Website – Ambient Air Quality Guideline Document)

1.5.3 Ambient Noise Standards

Jamaica presently has no national legislation for noise. However, World Bank guidelines have been adopted by NEPA and are used for benchmarking purposes, along with the draft National Noise Standard that is being prepared. The guidelines for both daytime and nocturnal parameters have been outlined in **Table 5** below.

Table 5: The Recommended Zone Limits

Area Zone	Daytime Limits (dBA)	Nighttime Limits (dBA)
Industrial Area	75	70
Commercial Area	65	55
Residential Area	55	45
Silence Zone*	50	40

1.5.4 Effluent Discharge Standards

For the purpose of protecting and improving the quality of the environment and preventing and abating environmental pollution, Jamaica has draft regulations governing the quality of the effluent discharged from facilities to public sewers and surface water systems. These draft regulations were gazetted in 2006. The draft guidelines require the facility to meet certain basic water quality standards for trade effluent, including sewage. The trade and sewage effluent standards are outlined in **Tables 6 – 7** below.

Table 6: Trade Effluent Discharge

Parameter	Standard Limit
Ammonia/Ammonium	1.0 mg/l
Varium	5.0 mg/l
Beryllium	0.5 mg/l
Boron	5.0 mg/l
Calcium	No Standard
Chloride	300 mg/l
Colour	100 TCU
Detergent	15 mg/l or < 0.015 kg/1000 kg product
Fluoride	3.0 mg/l
Iron	3.0 mg/l
Magnesium	No Standard
Manganese	1.0 mg/l
Nitrate (as nitrate and nitrite)	10 mg/l
Oil and Grease	10 mg/l or < 0.01 kg/1000 kg product
pH	6.5 - 8.5
Phenols	0.1 mg/l
Phosphate	5.0 mg/l
Sodium	100 mg/l
Sulphate	250 mg/l
Sulphite	0.2 mg/l
TDS	100 mg/l
Temperature	2°C =/- average ambient temperature
TOC	100 mg/l
TSS	All times < 150 mg/l; Monthly average: 50 mg/l
Heavy Metals	
Arsenic	Limit 0.5 mg/l
Cadmium	0.1 mg/l

Parameter	Standard Limit
Chromium	1.0 mg/l
Copper	0.1 mg/l
Cynade (Free HCN)	0.1 mg/l
Total CN	0.2 mg/l
Lead	0.1 mg/l
Mercury	0.02 mg/l
Nickel	1.0 mg/l
Selenium	0.5 mg/l
Silver	0.1 mg/l
Tin	No Standard
Zinc	1.5 mg/l
Total Heavy Metals	2.0 mg/l
Stream loading	
BOD_5	< 30 mg/l
COD	< 0.1 kg/1000 kg product or < 100 mg/l
DO	> 4 mg/l
Bacteriology	
Total Coliform	< 500 MPN/100 ml
Faecal Coliform	< 100 MPN/100 ml

Acronyms for Parameters used in Standards

- BOD - Biochemical Oxygen Demand
- COD - Chemical Oxygen Demand
- DO - Dissolve Oxygen
- MPN - Most Probable Number
- TCU - Total Colour Unit
- TDS - Total Dissolved Solids
- TOC - Total Organic Carbon
- TSS - Total Suspended Solids

Further Clarification

- Nitrates refer to nitrogen in nitrates and nitrites
- Phosphates refer to phosphorous in phosphates
- pH measures acidity or alkalinity
- Residual Chlorine: Where natural treatment systems are designed to reduce coliform levels without the use of chlorine then the residual chlorine criteria would not apply.

Table 7: Proposed Sewage Effluent Standards – New Plants*

Parameter	Effluent
BOD	20 mg/l
TSS	20 mg/l
Total Nitrogen	10 mg/l
Phosphates	4 mg/l
COD	100 mg/l
pH	6 to 9
Faecal Coliform	1000 MPN/ 100 ml
Residual Chloride	1.5 mg/l

*A plant is considered new if it was constructed and commissioned on or after January 1, 1997 (i.e. the commencement of the NRA's permit and Licence system)

Parameters in Standards

The parameters for which the standard establishes limits are:

- BOD: Biological Oxygen Demand
- TSS: Total Suspended Solids
- Nitrates: Nitrogen in Nitrate and Nitrite
- Phosphate: Phosphorous in Phosphate
- COD: Chemical Oxygen Demand
- pH: Acidity or Alkanity
- Faecal Coliform: Coliform Bacteria
- MPN: Most Probable Number
- Residual Chlorine*

*Where natural treatment systems are designed to reduce coliform levels without the use of chlorine, then the residual chlorine criteria would not apply.

1.5.5 Stack Emissions Standard

The stack emissions standards presented in **Table 8** are emission targets, as per NEPA guidelines.

Table 8: Stack Emission Standards

Pollutant	Rates: Tonnes/Year
Carbon monoxide	100
Nitrogen oxides	40
Sulphur dioxide	40
Particulate matter (PM)	20
Fine particulate matter (PM_{10})	15
Volatile organic compounds (VOC)	40
Lead	0.6
Fluorides	3
Sulphuric acid mist	7
Hydrogen sulphide (H_2S)	10

1.6 REPORT LAYOUT

The objective of the study is to identify the possible environmental impacts, which can be anticipated as a result of the construction and operational phases of the proposed project, and to suggest suitable measures to mitigate the expected impacts on the environment. The work has been carried out in accordance with NEPA guidelines. Baseline information such as data on flora, fauna and demography have been collected from available documented field surveys. A sampling network was designed for field studies to collect air, water, soil and noise quality data. Data pertaining to hydrology, meteorology, and land use, were collected from secondary sources. The report is organized in Chapters as follows:

1. Chapter 1 - Introduction.
2. Chapter 2 - Project Description: a concise documentation is given on the proposed project's activities and facilities.
3. Chapter 3 - Environmental Baseline: summarises baseline environmental data as obtained prior to the commencement of the project.
4. Chapter 4 - Identification and Prediction of Impacts: presents potential and adverse impacts of the project.
5. Chapter 5 - Environment Management Plan: provides an environmental strategy to combat the probable adverse impacts.
6. Chapter 6 - Environment Monitoring Plan: outlines post-monitoring programmes and environmental costs.

CHAPTER 2: PROJECT DESCRIPTION

2.1 NEED OF THE PROJECT

The Kingston Metropolitan Area (KMA), including Portmore, is one of the largest urban areas in the Caribbean and contains 26.3 percent of Jamaica's population. More significantly, the land area of the KMA has now expanded westward (towards Portmore) and is currently experiencing an annual growth rate of 2.30 percent representing the fastest growth of the country's urban areas. Portmore, with almost 170,000 (check this out) inhabitants, at this time does not have a designated inpatient hospital facility, with the nearest located in Spanish Town (approximately 11 km West) and Kingston (approximately 10 km East). These hospitals are often over-crowded and poorly equipped; not being able to sufficiently meet the health needs of the Portmore population.

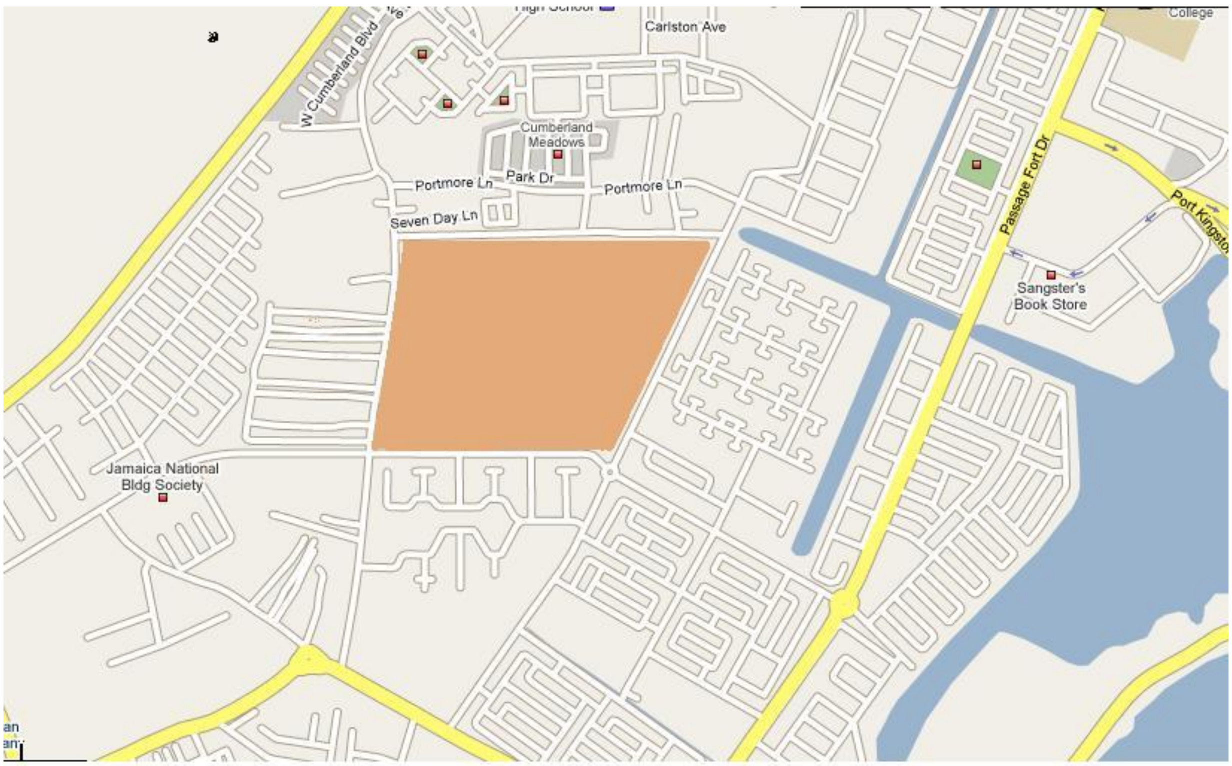
The idea is to develop a hospital of international standards, with quality building design, accommodations and medical equipment. The hospital will seek to become an accredited facility, by initially attaining relevant ISO accreditations and then over time, seeking Joint Commission International (JCI) accreditation from the USA.

Healthcare is undergoing a major transformation process, and only those organizations which are able to provide superior quality and value with sustainable funding will survive in the increasingly competitive environment. The increasing demand for state-of-the-art healthcare services and a shortage in certain disciplines, such as, Men's Health, Invasive Cardiology, Cardiac Surgery and Cancer treatment, provides a unique opportunity for the PIHMC to position itself as the leading private healthcare provider in Jamaica. A sustainable competitive advantage will therefore be built upon the framework of a clear and focused strategy to provide Clinical Services and dedicated care, enabled by state-of-the-art technology.

2.2 PROJECT LOCATION

The project is located in Portmore, a dormitory community next to Kingston, Jamaica. The specified location is a 104.7 acre property located West, 17.966919 ° North and -76.884985° West, bordered to the West by Newlands Road, to the South by Southboro Drive, to the East by Germaine Road and to the North by Portmore Lane (**See Figure 1** for specific location).

Figure 1: Site Location



2.3 PROJECT SCOPE

The sponsors, through a Public-Private Partnership, intend to develop a 120-bed hospital in Portmore that offers a comprehensive range of general, secondary and some tertiary medical services. Resulting from the Feasibility Study (2006), the sponsors recommend the development of 120 beds in two phases, rather than as a single project. Phase 1 is the development of a 64 bed facility that will provide a range of key general medical and surgical services. The focus of the first phase will be to develop the services in demand, while building the capacity and reputation of the Hospital and ensuring financial sustainability. The Hospital will subsequently increase the range of services as required, and sufficient land has been acquired to enable the project to expand. The following service portfolio will be provided over the course of the Hospital's development:

- Internal Medicine
- General Surgery
- Pediatrics
- Obstetrics & Gynaecology
- Orthopedics
- ENT
- Ophthalmology, including laser treatment
- Dental Services on an outpatient basis
- Imaging Services (General X-ray, Ultrasound, Fluoroscopy, CT)
- Anesthesiology
- Intensive and Coronary Care
- Nursery and Special Care Nursery
- Emergency/Accident Services
- Family Practice
- Dermatology

Specialist focus and super-specialties will include:

- Cardiology/Cardiothoracic Surgery: These services will include invasive catheterization, pacemaker implant, open heart surgery, coronary intensive care, as well as non invasive functional diagnosis such as Echocardiography, Stress Test, Holter, Pacemaker follow-up, ECG and cardiology services (including cardiac rehabilitation).

- Neurology /Neurosurgery: This service will focus on one of the leading causes of morbidity and mortality - stroke. The PIHMC will become the market leader in neurology services, providing full fledged diagnostic facilities. Treatment will include the full range of physiotherapy and occupational therapy services.
- Gynaecology/Fertilization: As the fertilization program becomes a known service, the hospital will provide IVF services.
- Urology/Nephrology: This will include all major diagnostic services as well as Lithotripsy. The services will be complemented by a dialysis unit, which will serve both inpatients and outpatients.
- Nuclear Medicine: To complement the cardiology and neurology focus, the hospital will also provide Nuclear Medicine Services with a Gamma Camera.
- Intensive Care Specialists: This will clinically support the services within the ICU/CCU unit.
- Haematology/Oncology: Services will provide outpatient chemo-therapy focused cancer treatment.
- Gastroenterology: Will include all modalities of diagnostic and therapeutic evaluations and treatment.
- Pulmonology.: To provide diagnostic and therapeutic care for the high incidence of respiratory ailments in Jamaica
- Endocrinology: Supports all other specialties.

A gated residential community is being investigated for development as part of the project that will include a lake-side community housing development for staff and residents (See **Figure 2** below for Project Site Plan). This development is not part of the current capital structure, and is the subject of review at present.

Figure 2: Project Site Plan

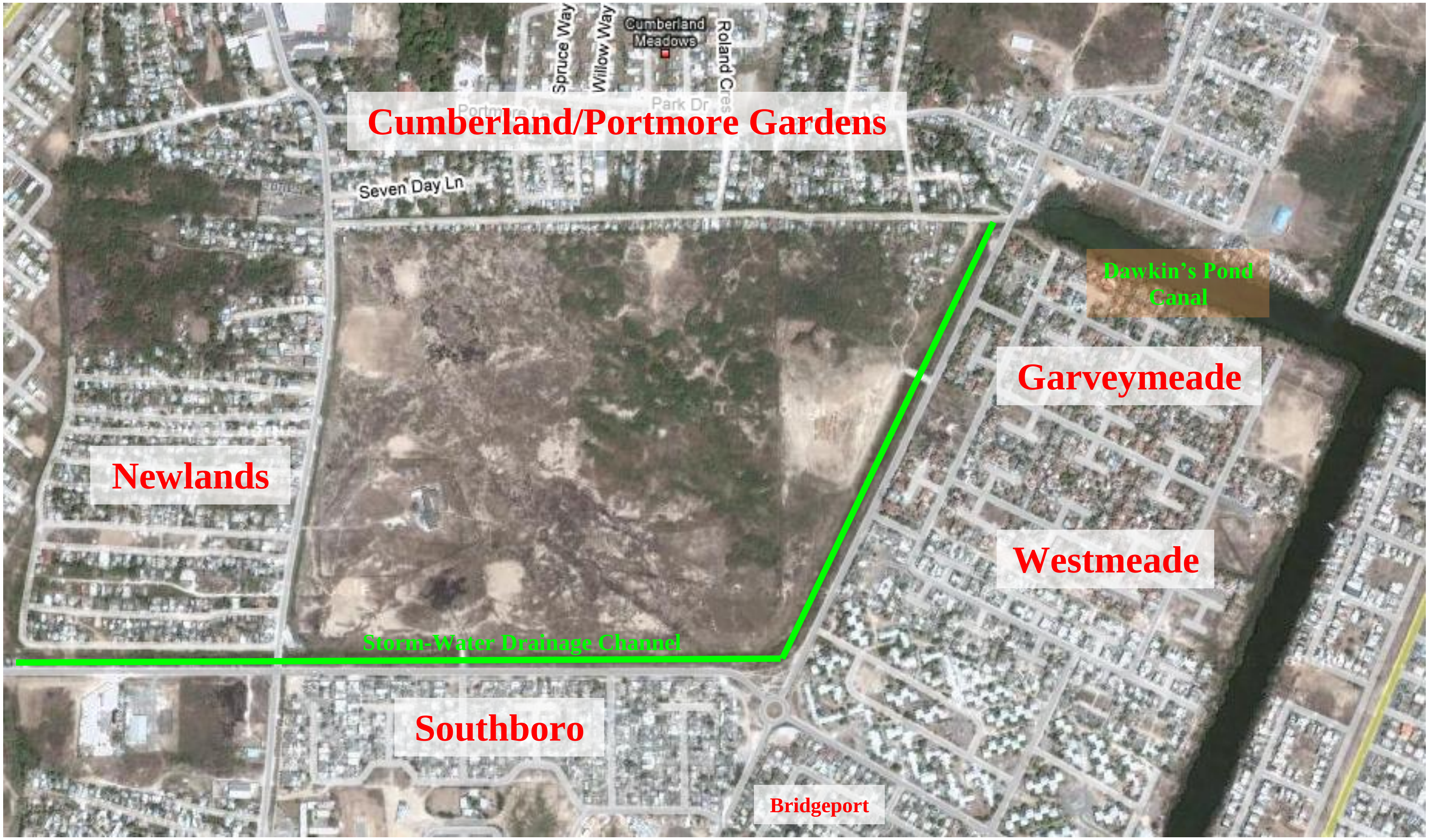
2.4 PROJECT INFLUENCE AREA

Table 9 gives the salient features of the project influence area, whereas **Figure 3** shows the location of the project site within the influence area.

Table 9: Salient Features of the Project Influence Area

Criteria	Details
Latitude and longitude	17.967° North; -76.867° West
Elevation above mean sea level	Less than 250 feet in elevation
Climate Conditions	Tropical maritime, hot and humid with a temperate interior
Land Availability	104.7 acres
Surrounding Land Use	Residential and commercial
Nearest Highway	Highway 2000; Mandela Highway
Nearest Airport	Tinson Pen(KTP), Kingston, (10.3 km) Norman Manley International(KIN), Kingston, (16.3 km)
Surrounding Communities	Newlands, Southboro, Portmore Gardens, Garveymeade, Westmeade, Bridgeport
Hills/Valleys	Mostly flat, except Hellshire Hills
Monuments and Archeologically Important Places	None
National Parks	None
Forests	None
Water Bodies	Naggo Head Spring
Location Advantage	Availability of basic infrastructure necessary for the proposed construction project

Figure 3: Location of the Project within the Influence Area



2.5 SITE DESCRIPTION

The proposed site falls under the jurisdiction of the *Portmore Municipality* and has been acquired for construction of a hospital. It has been observed to be almost level in topography, with sparse vegetation located inside the site area. The color of the surface earth had been observed to be brown, which depicts dry sandy soil. Roads from three sides, viz. Newlands Road (West), Southboro Drive (South) and Germaine Road (East) border the site, with canals running parallel to two of these roads (namely; Southhboro Drive and Germaine Road).

2.6 LAND USE

The area surrounding the project site has predominantly been used for housing development since the early 1980's. This specific site has been a commercial space since the said period, and has housed the transmissions facility of Telecommunication of Jamaica (TOJ), now Lime. However, this operation has been abandoned for several years.

2.7 GROUND COVERAGE

The buildings will be constructed within the designated site, with plot area of 50 acres as per the defined building laws of the Municipality. Please refer to **Annexure 4** for the Master Plan of the Proposed Project.

2.8 INFRASTRUCTURE REQUIREMENT

The infrastructure requirement for the proposed project has been broadly classified into the following two categories:

- Basic Infrastructure: includes construction material, water supply, drainage power, parking, road and streetlight.
- Environmental Infrastructure: comprising drainage and sewage system, bio-medical and solid waste management and green areas/landscaping.

2.8.1 Basic Infrastructure Requirement

Construction Material

The major materials required for construction of the proposed project will be steel, cement, bricks, metal, flooring tiles/stones, wood, sanitary and hardware items, electrical fittings, water and roof materials. All the items to be used in the proposed project will be as per the National Building Code specifications.

Water

During the construction stage, water will be sourced from the National Water Commission (NWC), primarily through tankers, and stored. To supply the anticipated demand during operations, a 500,000 gallon cistern for water storage will be constructed and fed in two ways:

1. Roof drainage will be provided by roof drains and interior rain leaders, which will convey water to a basement water storage with excess runoff to an exterior storm sewer. A completely independent overflow drainage system will channel rain water to the building exterior, should there be a failure in the primary drainage system, or if there is a need to redirect rain water directly to the building exterior – such as during a storm.

2. The second supply will be from the public water system.

With the exception of the irrigation system, all water supplied to the facility, or stored in its cisterns, will be processed through a water softening system, including reverse osmosis, before distribution to any area.

The facility will have a significant amount of landscaping with trees and shrubs (see landscaping section below). To augment the water demand for this area, there will be a five-acre man-made lake that will provide water for irrigation purposes. This lake will also add to the ambience of the development, as well as act as a catchment for excess rain water roof runoff. Excess overflow from the lake will be piped directly to the canal next to Portmore Lane that leads directly to the sea. Please refer to **Annexure 5** for the project's water and drainage plan.

There is a proposed gasification plant that will process water from the lake, producing approximately 50,000 gallons of potable water per day. The gasification plant will generate sufficient water to supply the entire hospital, with the excess being available for resale to NWC (if required and based on successive agreements).

Storm Water Drainage System

In general, the rainwater from terraces and other elevated open areas shall be collected through rainwater down-take pipes and connected to catch basins. The rainwater from hard courts and landscaped areas shall be collected by catch basins through a RCC pipe network, or open drains with gratings, and connected to the storm water channels. Water from the roofs will flow through downpipes, into manholes and to the untreated water tank.

Power

The developers have been assured by the public utility company that there is adequate capacity to meet the demands of the facility, as well as any future expansions. Power will be supplied via a 24 kV Primary connected to the national grid, with a Secondary of 415 V. The Hospital is expected to have two pad mounted transformers of 1.5 MVA and 3 MVA respectively to provide for a maximum possible connected load of 4.5 MVA. The normal power demand is expected to be approximately 1.65 MW. It is proposed that a back-up power supply of 1500 kW Diesel Generator Sets will be installed to power critical loads only, in the event of any emergency. As per NEPA guidelines, these DG sets shall be silent sets housed in approved acoustic enclosures, so as to control the noise pollution to 55/45 dBA at 1 m distance.

Parking Provisions

There will be adequate parking provisions within the project site, with plans being made for about 365 vehicles at ground level. Parking areas are dispersed all around the premises and are projected to have adequate green cover and lighting arrangement. The development will also work with the Municipality as well as the National Works Agency, to provide parking for buses and taxis.

Roads and Street Lighting

There will be adequate street lighting within the project location.

2.8.2 Environmental Requirement

Sewage System

Approximately 21,780 sq. ft. have been allocated on the site for a sewage plant, which will be set apart. The site will have an elaborate system exceeding the requirements of NEPA. This will initially be a 120,000 gpd system that can be expanded as it becomes necessary to accommodate higher utilization.

It is proposed that all the waste pipelines from the toilets, laundries, kitchen and pantries will be interconnected. Internal toilets will be connected to a horizontal header at the ceiling of the first basement and then led out to the sewage treatment plant.

The treatment plant will take suction from an equalization tank with its own feed pump. The pump is level controlled and has a capacity, which is 2-3 times the average daily flow. The plant operates in an intermittent mode for hydulin flow, while the air blower supplying air to the bioreactor is continuously running.

The biodegration reactor will have three stages to enhance cleaning efficiency. The bioreactor will degrade the dissolved organic matter by oxidation into carbon dioxide – which escapes into the air – and produce biomass, which acts as activated sludge. A suspended, free floating biofilm carrier medium provides a large, protected biofilm surface as host for the bacteria and simultaneously accumulates the activated biosludge inside the reactor biochambers. A third oxic chamber is added to provide full nitrification in order to meet total Ammonia requirements.

The biodegraded fully nitrified water flows into a clarification stage where the suspended solids settle by gravity. The water is directed through a skim well to a tube settler system, which provides the final clarification of the effluent. The flow continues under a skimmer and over an adjustable weir. Sedimentation may be enhanced by addition of polymers. Please refer to **Annexure 6** for the project's Drainage Plan.

It is estimated that about 120-125 kld of treated effluent will be generated, which will be completely consumed for reuse in cooling and horticultural purpose. No discharge from the premises will take place to the sewer.

Municipal and Biomedical Waste Generation

It is envisaged, that about 480-500 kg of solid waste will be generated from the project, and in this about 48-50 kg of Bio-medical waste will be generated. During the construction and operation phases, solid waste will be transported to the city's waste disposal site at Riverton City. All hospital waste deemed hazardous to the environment, will be dealt with by the hospital incinerator. As a long-term objective, it is expected that the site will manage its own waste via its own gasification plant (after about 2 years).

Green Area/Landscaping

Within the proposed project site approximately 60 percent is open space, and in this about 30% of the total space has been designated for green areas. This will achieve a blend between modern buildings and various species of plants, shrubs and aquatic attractions, to create a clean, healthy and aesthetic environment that provides a visual retreat and relaxation to the occupants of these buildings. A combination of evergreen trees and ornamental flowering trees, shrubs and palms will be used.

2.9 FIRE SAFETY

The basic system for Fire Fighting shall be designed as per the provisions of the National Building Code. For fire protection, provision is being made for a fire water storage tank. Water from these reserve tanks will be drawn by electrically driven fire pumps and supplied into the hydrant ring main and wet riser system. Minor line losses would be made up by an on-line jockey pump. A diesel engine driven fire pump will also be provided as a stand by. The Hospital will be a fully sprinkled building and the sprinkler heads shall be distributed as per the National Building Code.

2.10 MAN POWER

During construction, about 1000 skilled, unskilled and professional personnel, including temporary and permanent employees shall be required. This workforce shall be hired locally in order to generate employment for the local labour force. The project operation stage will require approximately 1,500 persons to cover all activities.

2.11 PROJECT SCHEDULE

The project is expected to be completed two years after commencement.

CHAPTER 3: BASELINE FINDINGS

3.1 BACKGROUND

This Chapter presents the existing baseline environmental status of the influence area of the project's site. The database for all environmental components is collected from secondary sources as well as from primary site investigations. Furthermore, the data have also been analyzed from Environmental Monitoring Surveys (viz. air, soil, noise and water) conducted at selected locations. **Table 10** gives various environmental attributes considered for formulating the environmental baseline and **Table 11** gives the frequency and monitoring methodology for various environmental attributes.

Table 10: Various Environmental Attributes

No.	Attribute	Parameter	Source of Data
1	Land Use	Trend of land use change for different categories	Secondary data sources: Portmore Municipality
2	Water Quality	Physical, Chemical and Biological parameters	Grab samples are collected for a season study from 4 locations
3	Ambient Air Quality	RSPM, SPM, SO_2, NO_x, and CO	Ambient air quality monitoring at 4 locations
4	Noise Levels	Noise levels in dB (A)	Noise level monitoring at 4 locations
5	Ecology	Existing terrestrial flora and fauna within the project site	Samples collected from site and identified through secondary sources
6	Geology	Geological history	Secondary sources: Mines and Geology Division
7	Soils	Soil types and samples analyzed for physical and chemical parameters	Data collected from secondary sources and soil analysis at project site
8	Socio-economic Aspects	Socio-economic characteristics of the affected area	Based on field survey and data collected from secondary sources

Table 11: Environmental Attributes - Frequency and Monitoring Method

Attributes	Sampling		Measurement Method	Remarks
	Network	Frequency		
A. Air Environment				
Suspended Particulate Matter(SPM)	Requisite locations in the project's influence area	24 hours	High Volume Sampler	As per NEPA standards
Respirable Suspended Particulate matter (RSPM)			High Volume Sampler	
Oxides of Sulphur (SO_2)			PHD Plus Portable Gas Detector	
NO_x			PHD Plus Portable Gas Detector	
CO			PHD Plus Portable Gas Detector	
B. Noise				
Half-hourly equivalent noise levels	Requisite locations in the project's influence area	Once	Quest Electronic Sound Level Meter	
C. Water				
Parameters for water quality: pH, temperature, sulphate, nitrate, sodium, potassium, total nitrogen, total phosphorous, BOD, COD, Heavy metals, Total coliforms, faecal coliforms, TSS	Set of grab samples at requisite locations for surface water	Once	Samples for water quality collected and analyzed as per SMEW* methods for sampling and testing of water and waste water analysis.	
D. Land Environment				
Parameters for soil quality: pH, electrical conductivity, phosphate, calcium, potassium and manganese, titanium, iron, silica and aluminum	Requisite soil samples collected at project site	Once	Collected and analyzed using X-ray Fluorescence plus the ASTM Method	

3.2 Land Environment

Several site visits were made for the purpose of conducting a complete biological assessment of the proposed project site. The ecological site inspection was conducted to provide an overview of the site layout, types of habitats and their floral and faunal composition. The visit involved walking within the perimeter of the site, as well as along the boundaries.

3.2.1 Topography

The project site is located in the alluvial plain in the southeast part of St. Catherine. The general topography of the area is level to nearly level with 0 – 2^0 slope. The area is generally less than 250 feet in elevation and receives an average of 50 inches or less precipitation annually.

3.2.2 Geology

Published geological information (Geological Sheet 23, 1:50,000 Imperial Series) indicates that the majority of the project area is underlain by Holocene which is predominately mangrove and salina. This is an extensive area of marshy, stagnant salina consisting of calcareous sand and silt, with rotting salt crusts and rotting mangrove roots occurring in low-lying bays around the coastline.

3.2.3 Soils

Soil types in the project area are primarily alluvial in origin. Caymanas clay loam (127) and Caymanas sandy loam (128) are the soils present in the area. These soils are known to have moderate internal drainage and are alkaline with low moisture supplying capacity and high natural fertility. A fieldwork consisting of two (2) boreholes to depths of 40-feet below ground was conducted at the site on February 14 and 15, 2006. The borings were advanced by means of a power driven spiral auger 8-inch with a 4 inch diameter. No water or other fluids was added during the course of borings. Soil samplings were carried out in each borehole at frequent intervals of depth in accordance with Standard Penetration Tests (SPT) procedures and representative soil samples recovered during the performance of SPTs. Detailed borehole records showing the soil types, stratification and penetration resistance data are presented in **Table 11.**

Two soil samples were retrieved from the site on March 10, 2009 and chemical analyses conducted. The results revealed a silica content, which confirms the high percentage of silica and highlighting the predominantly alluvial nature of the soil. A detailed description of the chemical characteristics is also presented in **Table 12** below.

Table 12: Physio-Chemical Characteristics of Soils

Parameter	Unit	Sample	
		S. No. 1	S. No 2
pH	-	9.71	9.65
Conductivity	% by mass	208.8	206.9
Phosphate	% by mass	0.185	0.119
Calcium	% by mass	4.227	2.489
Potassium	% by mass	2.654	3.809
Manganese	% by mass	0.14	0.09
Titanium	% by mass	0.791	0.642
Iron	% by mass	6.32	4.53
Silica	% by mass	59.445	67.617
Aluminium	% by mass	15.64	14.43
Zinc	% by mass	0.009	0.006
Sodium	% by mass	3.4	3.74
Magnesium	% by mass	1.729	0.865

3.2.4 Land Use

Sections of the site are presently being used for recreational activities by community members. It is also used as an access point with evidences of illegal dumping observed during site visits (See **Figure 4** below).

Figure 4: Photograph depicting Illegal Dumping on Proposed Site

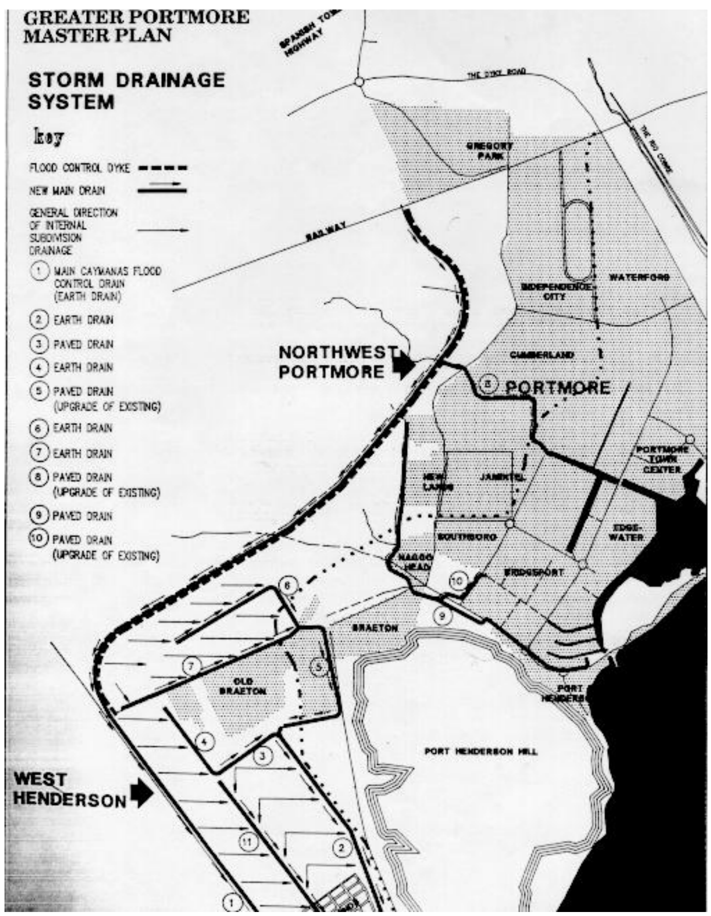
3.3 WATER ENVIRONMENT

The project area falls within the Rio Cobre Watershed. The area is formed from an alluvial aquifer. An aquifer is any subsurface unit that is competent in storing and transmitting significant quantities of water under normal pressure gradients, formed by the deposition of weathered materials such as sand and silt particles.

3.3.1 Water Quality

The water table in Portmore is not used as a potable water source mainly because of saline intrusion; as a result, the proposed development will not access ground water. Also, the project is not expected to have any adverse impact on ground water quality; as such, there was no need to do boreholes for ground water testing (see mitigation and management plans below for further discussion). Surface water sources were noticed along the perimeters of the site in canals (See **figure 5** below).

Figure 5: Portmore Storm Drainage System



To assess surface water quality, water samples were collected from four (4) different locations within the project influence area, as per the procedures specified in the standard methods for examination of water, adopted by NEPA. The results of the chemical analysis are summarized in **Table 13**.

Table 13: Water Quality in Project Influence Area

S. No	Parameter	Newlands	Southboro	Westmeade	Germaine Road Bridge	Standard
1	pH	8.1	8.2	8.2	8.2	6.5 - 8.5
2	Temperature	25.2	24.9	25.2	25.1	n/a
3	Phosphate mg/L	9.1	1.14	0.38	1.54	5
4	Sulphate mg/L	100	75	50	175	250
5	Nitrate mg/L	0.7	0.5	0.3	0.6	10
6	Chemical Oxygen Demand (C.O.D) mg/L	100.5	18	17	17.5	100
7	Sodium (Na+) mg/L	218	453	581	450	100
8	Conductivity	1.07	1.44	1.46	1.15	n/a
9	Biological Oxygen Demand (B.O.D) mg/L	121.5	20.1	18.3	26.8	<30
10	Total Suspended Solids (TSS) mg/L	40	32	4	8	50
11	Faecal Coliform mpn/100 ml	1600	500	900	500	<100
12	Total Coliform mpn/100ml	>1600	1600	900	500	<500
13	Total Hardness*	n/a	n/a	n/a	n/a	n/a
14	Total Disolved Solids*	n/a	n/a	n/a	n/a	n/a

*The parameters total hardness and total dissolved solids, are important considerations for analyzing potable water, and therefore were not deemed necessary for this analysis.

Observations

- **pH** is within acceptable limits at all the sample locations
- While the **phosphate** level is within acceptable limits at Southboro, Westmeade and the exit point at Germaine Road Bridge, it almost doubles the required standard at Newlands. This may be attributed to a car wash being operated in close proximity to the canal, to which wash water is directed.
- **C.O.D** is slightly above the recommended standard at Newlands. This may also be accounted to the car wash, as well as the dumping of chemical containers (e.g. bleach and pesticide bottles) that was observed in this section of the canal.
- The **sodium** level is high in all areas, particularly at Westmeade. This may be attributed to the areas' proximity to the sea.

- **BOD** is very high at Newlands because of the high presence of floral growth (particularly algal) in this section of the canal, which is linked to the water's high nutrient (phosphate and nitrate) content.
- **Total and Faecal Coliform** is high in all areas, especially in the section of the canal closest to Newlands. This is probably because of the stray animals that were observed.

3.3.2 Ground Water

The 2006 soil investigation fieldwork revealed groundwater in both boreholes, encountered at 5 feet in borehole # 1 and 4 feet 10 inches in borehole # 2. As previously established, no groundwater analysis is needed for the purpose of this project, hence no boreholes were done for the EIA.

3.4 AIR ENVIRONMENT

With the introduction of the new Air Quality Regulations adapted by NEPA, it has become important to adopt a clean air policy as it relates to the construction and operation of the proposed development. For the purposes of this EIA, several parameters were examined as it relates to the air environment: meteorology, air quality, temperature and humidity.

3.4.1 Meteorological Environment

The climate of the site, like the rest of Jamaica, can be classified as tropical maritime, hot and humid with a temperate interior. Mean daily temperatures range from a seasonal low of 26°C in February to a high of 28°C in August. Daily sunshine hours are fairly constant throughout the year, averaging about 8.2 hours in the southern plains. Humidity ranges from 66 percent to 87 percent with a significant diurnal variation, resulting in high morning humidity dropping off significantly in the afternoon. Long-term mean annual rainfall over the island is about 1980 mm. Much of the rainfall results from the northeasterly trade winds, which deposit most of their moisture on the northern slopes of the axial mountain ranges while the southern half of the island is in rain shadow. Annual rainfall on the northeastern slopes of the Blue Mountain Range is generally 3000 to 5000 mm, whereas in the south coastal plains of St. Catherine and Clarendon, it is generally less than 500 mm. Annual rainfall exhibits a characteristic pattern, with a primary maximum in October and another in May. Jamaica experiences the lowest rainfall levels during the period February to March and the month of July. See **Table 14** for the country's overall rainfall pattern.

Table 14: Parish Rainfall Summary for January 2008 - 2009

Parishes	KEY	JAN 2009	JAN 2008	JAN 30 YR NORMAL (1951 – 80)	FEB 30 YR NORMAL (1951 – 80)	% of 30 YR NORMAL 2008 Nov	% of 30 YR NORMAL 2009 Dec	% of 30 YR NORMAL 2009 Jan
Hanover	HAN	37	32	88	91	93	20	42
Westmoreland	WES	19	44	64	70	126	6	30
Manchester	MAN	20	18	60	52	146	15	34
St. Elizabeth	STE	31	34	69	60	108	39	46
Clarendon	CLA	7	18	54	39	96	40	13
Trelawny	TRE	33	80	99	76	162	25	34
St. James	STJ	21	58	91	77	189	24	23
St. Ann	STA	91	96	145	90	127	37	63
St. Mary	STM	158	147	181	129	110	40	87
Portland	POR	589	367	321	236	119	41	184
St. Thomas	STT	44	45	121	91	62	7	36
Kgn. & St. And.	KSA	28	34	53	49	87	25	52
Jamaica	JAM	85	76	108	85	118	30	79

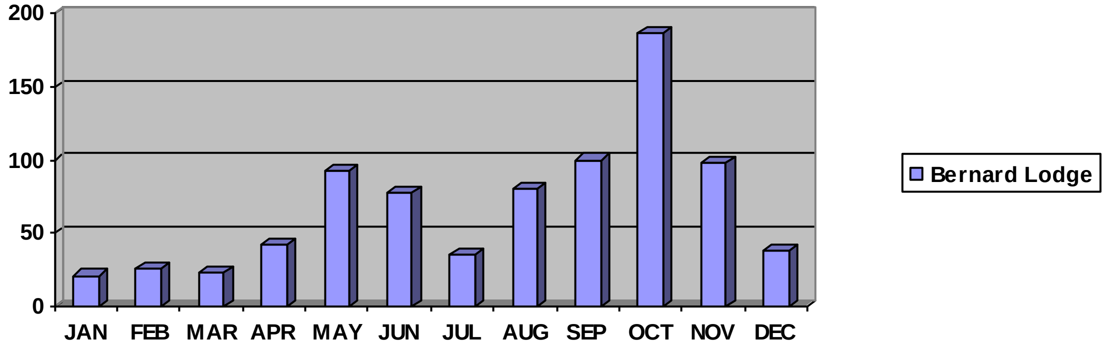
3.4.1.1 Precipitation

The Meteorological Service of Jamaica (Metservice) has no climate and wind frequency data specific to the Portmore area. However, the office has a number of monitoring stations in close proximity to the proposed site. Bernard Lodge (8 km from the site), is one such station and it is expected that some similarities exist. **Table 15** and **Figure 6** below present rainfall data as per the Bernard Lodge Monitoring Station.

Table 15: Mean Monthly Rainfall (mm) for Bernard Lodge, St. Catherine (1931 – 1985)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean rainfall (mm)	21	26	23	42	92	78	35	80	100	187	98	38

Figure 6: Mean Monthly Rainfall (mm) for Bernard Lodge, St. Catherine (1931-1985)



Based on the data outlined above, the months of May, August, September, October and November were the wettest, while the driest periods were experienced between January and March.

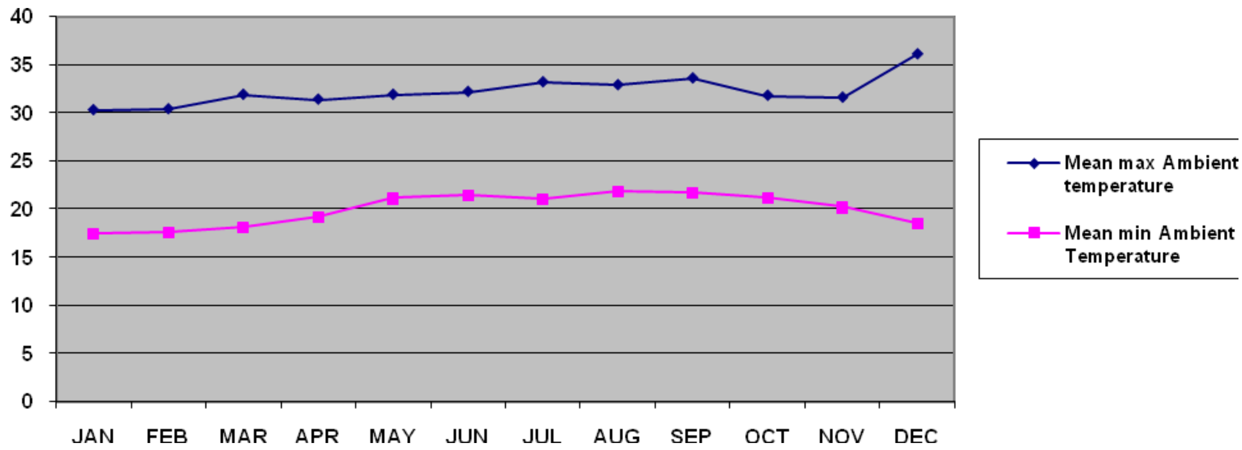
3.4.1.2 Temperature and Humidity

Based on Jamaica's location, the island can receive a maximum of 13.2 hours/day of sunshine (June) with a minimum of 11.0 hours/day (December). Specific ttemperature data for the Portmore area is not available. However, data from the monitoring station at Bernard Lodge indicated a 30 year maximum temperature of 36.1^{0}C with a minimum of 17.5^{0}C, as presented in **Table 16** and **Figure 7** below.

Table 16: Temperature and Rainfall in the Bernard Lodge Area

Attributes	Mean max Ambient Temperature (^oC)	Mean min Ambient Temperature (^0C)	Mean Temperature (^0C)	Relative Humidity (%)	Rainfall (mm)
Jan	30.3	17.5	23.9	0	29
Feb	30.4	17.6	24	0	20
Mar	31.1	18.1	24.6	0	23
Apr	31.4	19.2	25.3	17.7	48
May	31.9	21.1	26.5	19.1	95
Jun	32.2	21.4	26.8	19.8	81
Jul	33.2	21.0	27.1	19.9	34
Aug	32.9	21.8	27.35	20.1	69
Sep	33.6	21.7	27.65	20.0	99
Oct	31.8	21.2	26.5	19.7	188
Nov	31.6	20.2	25.9	19.4	76
Dec	36.1	18.5	27.3	18.3	37

Figure 7: Monthly Mean Maximum and Minimum Temperature for Bernard Lodge Area



In Jamaica, the average annual percent relative humidity ranges from 89 percent to 93 percent. This value is tempered by usual afternoon showers occurring especially in the hilly interiors. Specific to the project site, data collected on March 20, 2009 show temperature ranging between 27^0C and 29^0C and relative humidity ranging between 74 percent and 80 percent.

3.4.1.3 Winds

Jamaica's wind pattern is dominated by the Northeast Trade winds during the day combined with the sea breeze on the North Coast to give an East-North-Easterly wind at an average speed of 15 knots (17 miles per hour). Along the South Coast, the East-South-Easterly winds have an average speed of 18 knots (21 miles per hour). However, during the period December to March, the Trades are less dominant and the local wind regime is a combination of Trades, sea breeze, and a Northerly or North-Westerly component, associated with cold fronts and high-pressure areas from the North (United States of America).

3.4.1.4 Ambient Air Quality

The prime objective of collecting baseline air quality data is to assess the ambient air quality of the project influence area. Ambient air quality monitoring was carried out for a total of 24 hours during the month of March, 2009 at the following locations: (i)

Newlands (ii) Southboro (iii) Westmeade (iv) Project Site. Analytical results are presented in **Table 17** below.

Table 17: Air Quality Assessment

S. No	Parameter	Newlands	Southboro	Westmeade	Site	Standard
1	Temperature	27	28	27	29	-
2	Humidity	75	78	74	80	-
3	Nox	0 (1)	0	0	0	400 ug/m^3
4	Sox	0	0	0	0	700 ug/m^3
5	CO	0	0	0	0	40,000 ug/m^3
6	H_2S	0	0	0	0	ug/m^3
7	Total Suspended Particulate	105.5	85	126.1	N/D (2)	150 ug/m^3

1. 0 = Below detectable limit
2. N/D = No analysis done

Observations

All gaseous emissions were below the detectable limits. TSP was on the high side for Westmeade (although within the 24-hour limit), which may be attributed to wind direction and the presence of a construction site in the area.

3.5 NOISE ENVIRONMENT

Noise levels have been measured at four locations (same as those for air quality) to determine minimum, maximum and average levels. The noise levels were recorded between the (state the day and time.......during a 10-hour period, as per the following schedule with the monitoring results summarized in **Table 18**.

Day-time: 08 – 10 Hrs (Morning)
12 – 14 Hrs (Afternoon)
16 – 18 Hrs (Late Afternoon)

No monitoring was done during the night, since legal requirements indicate that no work generating noise above the acceptable standard should be done between 6 pm to 8 am.

Table 18: Noise Monitoring Results

8 – 10	Area	Maximu	Minimum	Average	Comments

	Maximum			
Newlands	80	65	74	Above Limit
Southboro	76	65	70	Above Limit
Westmeade	85	70	78	Above Limit
Site	60	50	56	Above Limit

12 - 14

Area	Maximum	Minimum	Average	Comments
Newlands	80	70	76	Above Limit
Southboro	80	70	74	Above Limit
Westmeade	75	65	72	Above Limit
Site	65	50	62	Above Limit

16 - 18

Area	Maximum	Minimum	Average	Comments
Newlands	80	65	75	Above Limit
Southboro	76	65	70	Above Limit
Westmeade	85	70	75	Above Limit
Site	62	50	54	Within Limit

Observations

The project is located in a predominantly suburban area and therefore the residential noise standard of 55 dBA between 7 am to 10 pm will apply. The analysis shows that even without construction activities, the decibel readings are above the residential target value. This is due mainly to the constant traffic movement on the surrounding roads. Other noise contributors were construction activities and music.

3.6 TRAFFIC SCENARIO

A Traffic Volume Survey was conducted at the proposed site at the Newlands Road, Southboro Drive and Braeton Parkway intersection on Friday, March 13, 2009. The counts were conducted for both directions from 7:00 a.m. to 7:00 p.m. A manual observation method was employed, where observers used tally sheets to record traffic numbers and types, as well as direction of travel. The total daily traffic was divided into four types:

- Light Motor Vehicle (LMV); cars, sports utility vehicles (SUVs), mini-vans
- Heavy Motor Vehicle (HMV); pick-ups, heavy trucks,

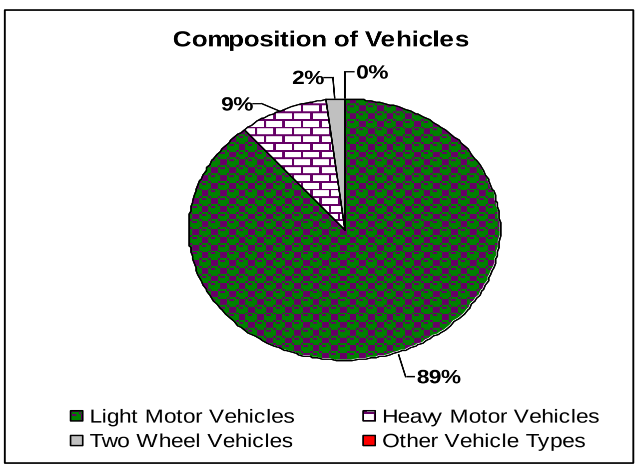
- Two Wheel Vehicle (TWV); motor bikes and bicycles
- Other Vehicle Types (OVT); tractors, commercial equipment, and any other moving objects in the roadway

Table 19 shows the traffic volume by vehicle types for morning (7:00 am – 12:00 pm) and afternoon (12:01pm - 7:00pm) periods. The traffic volume periods are similar, with an average hourly count of 259 vehicles in the morning and 253 in the afternoon.

Table 19: Traffic Volume by Vehicle Type

Vehicle Types	7-00 - 12:00		12:01 - 7:00		Total
	Frequency	Mean	Frequency	Mean	
Light Motor Vehicles	4552	227.6	6326	225.9	10878
Heavy Motor Vehicles	526	26.3	598	21.4	1124
Two Wheel Vehicles	102	5.1	145	5.2	247
Other Vehicles	1	0.05	1	0.04	2
Total	5181	259	7070	253	12251

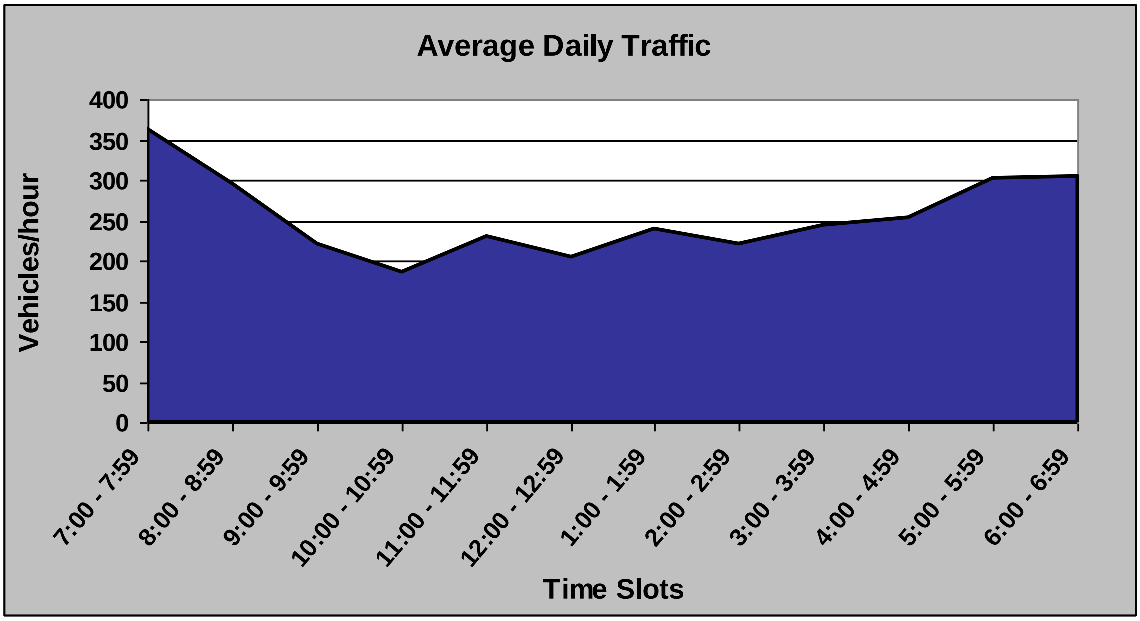
Figure 8: Vehicle Types



As **Figure 8** illustrates, there is significantly more LMV that ply the roads, accounting for 89 percent of the total number of vehicles for the period. HMV accounted for only 9 percent, TWV 2 percent and OVT almost non-existent.

The average daily traffic flow for the site is shown in **Figure 9**, which reveals peak traffic periods between 7:00 a.m. to 8:59 a.m. and 5:00 p.m. to 7 p.m. The morning period was observed to have a greater volume than the evening period, with the greatest volume peaking to an average rate of 362 (is this per hour) per car type compared to 302 in the evening. The morning peak hour for the intersection consisted of 976 LMV and 151 HMV traveling Eastbound on Southboro Drive. The evening peak similarly found Southboro Drive to have the highest volume of traffic, with most of the vehicles being LMV.

Figure 9: Average Daily Traffic Flow



3.7 ECOLOGICAL ENVIRONMENT

There are no wild life sanctuaries within the 2 km radius of the project site. Neither are there any rare, endangered or endemic species recorded. The ecology of the project area is not very rich in diversity or high in endemism, and is typical of a desert-type vegetation as is depicted by the photograph in **Figure 10**.

Figure 10: Section of Proposed Site

Flora

The assessment of the vegetation on the proposed site, entailed the collection of samples, which were identified using Adams' (1978) work on Jamaica's foliage. The major plant life that was observed to dominate the area are:

- Seaside purslane (*Sesuvium portulacastrum*)
- Acacias (*Racosperma mangium*)
- Cactus (*Euphorbia sp; Opuntia dilleni; Stenocereus hystrix*),
- Reedmace (*Typhaceae domingensis*)
- Star grass (*Cynodon Nlemfuensis*)
- Sorobulus virginicus

Seaside purslane is noted to strive in coastal areas, where they can tolerate saline soils and salt laden winds. The presence of this plant therefore indicates that the soil is saline**. Figure 11 – 12** gives a visual image of some of the plant types found on the site.

Figure 11: Plant Types on Site

Seaside purslane *(Sesuvium porulacastrum)* Reedmace*(Typhaceae domingensis)*

Acacias (*Racosperma mangium*) Fern *(Sesbania sp.)*

Figure 12: Cactus Types found on the Site

Tuna (*Opuntia dillenii)*

Stenocerdeus hystrix *Euphoreia sp.*

Fauna

The animal life found on the site includes the following:

- Goats
- Dogs
- Crows
- Cattle Egret
- Lizards
- Ants

The mammalian animals were strays from nearby communities, in search of food items dispersed among the solid waste disposed on the site. The birds were also present for feeding purposes, particularly those who were scavenging. The canal contained fish, and frogs, as well as algal growth. The presence of algae substantiates the high nutrient content of the water.

3.8 SOCIO-ECONOMIC ENVIRONMENT

The main purpose of the socio economic analysis is to place the proposed project within the context of the local human environment, upon which it is expected to have an important influence. Similarly, the analysis also examined the ways in which the local human environment might impact the project and may be supportive of it. Of corollary concern, was the proposed project's impact on the existing site in relation to any potentially important heritage elements that exists, or are likely to exist. The project was also examined within its wider regional setting. The information used for the socio-economic analysis was based on the following sources:

- Statistical information provided by the Government of Jamaica;
- Selective interviews with public and private health care institutions and health professionals in Jamaica;
- Information provided by the Portmore Municipality and members of the Portmore Municipality Council; and
- Public consultations with community members within the project influence area

3.8.1 The Portmore Municipality

The Portmore Municipality, which has a population of 166,845, is a contiguous urban settlement, comprised mainly of housing schemes and commercial developments. It includes some 41 communities with populations ranging from a low of 803 (Port Henderson) to 15,116 (Waterford). It exists within the Kingston Metropolitan Area (KMA), one of the largest urban areas in the Caribbean, which contains 26.3 percent of the country's population. More significantly, the land area of the KMA zone has now expanded westward and is currently experiencing an annual growth rate of 2.30 percent, which represents the fastest development of the country's urban areas. Most notable is the growth that has taken place in the St. Catherine, Portmore and Hellshire regions, which experienced a growth of 22.9 percent (See **Table 20**).

Table 20: Population in the St Catherine Area

Parish & Urban Center	2001	1991	1982
St Catherine	**482,300**	**382,000**	**332,700**
Spanish Town	131,500	114,200	88,000
Portmore & Hellshire	161,700	97,000	77,600
Old Harbour	23,800	18,400	8,800
Ewarton	10,800	9,000	8,700
Linstead	15,700	14,600	15,100
Bog walk	11,200	9,100	5,300

The large size of the Portmore Municipality is combined with unique demographic characteristics, influenced by: a high percentage of home ownership; median age; as well as educational and occupational profiles. The socio-economic characteristic of resident households place them largely in the middle to upper quartiles, in terms of poverty indicators.

Kingston is the main and closest business district, providing employment for Portmore residents. Therefore, a large number of employed persons commute to Kingston and St Andrew on a daily basis.

3.8.2 Communities

Several communities are within 2 km of the project site, namely; Bridgeport, Newlands, Southboro, Garveymeade, Portmore Gardens, and Westmeade. The town center is approximately 5 km from the proposed development site. **Table 21** provides the population of these communities.

Table 21: Current and Projected Population of Surrounding Communities

Area	Population		Projected Population				
	1991	2001	2005	2010	2015	2020	2025
Bridgeport	6,045	5,091	4,962	4,899	4,847	4,796	4,745
Garveymeade	2,676	2,369	2,312	2,277	2,189	2,156	2,123
Newlands	2,927	3,932	4,424	4,765	4,947	5,135	5,330
Portmore Gardens	9,117	10,567	11,209	12,068	12,803	13,286	13,787
Southboro	4,257	4,251	4,249	4,246	4,243	4,240	4,237
Westmeade	1,539	1,578	1,594	1,614	1,634	1,655	1,676

3.8.2.1 Informal Settlements

The rapid growth and development of urban centers, coupled with the slow rate of formal housing delivery has resulted in the significant growth of the number of people housed in squatter settlements.

There are three important characteristics that help in the understanding of squatter settlements:

1. Physical Characteristics: A squatter settlement, due to its inherent "non-legal" status, has services and infrastructure below the "adequate" or minimum standard. These services include infrastructure such as water, garbage collection, sanitation, electricity, roads and drainage
2. Social Characteristics: Squatter settlement households belong to the lower income group, either working as wage labourers or in various informal sector enterprises. On an average, most earn wages at or near the minimum wage level
3. Legal Characteristics: The settlement is characterized by the fact that there is no legal ownership of the parcel of land on which the housing unit is constructed

There are two informal settlements within the 2 km radius of the project influence area: Newlands and Portmore Gardens. Both communities exhibit the above characteristics and provide specific implications for the development, in terms of formalization and relocation exercises. **Figure 13** gives a pictorial illustration of the informal settlements near the site.

Figure 13: Sections of Informal Settlements on/near the Proposed Site

3.8.3 Infrastructure

Table 22 summarizes the basic infrastructure contained in the Municipality, with details in the subsequent sub-sections.

Table 22: Portmore Infrastructure

Population (estimated)	225,000
Number of housing units (estimated)	45,000
Number of persons with access to running water	195,000
Capacity of sewage treatment plants	9.7 m.g.d.
Illegal Dumpsites	11
Dental clinics	1
Health Centres	3
Fire Station	1
Libraries	4
Police Stations	4
Post Offices	4
Courts	1
Educational/Training Institutions – of which:	65
Basic	38
Primary	16
Secondary	5

Tertiary	1
Other (Skills training)	5

Source: Roundtable Workshop for Governance in Portmore

3.8.3.1 Electricity

JPS is the sole distributor of electricity in Jamaica. **Table 23** below gives details of the source and distribution of electricity within the Municipality.

Table 23: Distribution of Households by Source of Lighting, Portmore Municipality 2001

Total	Electricity	Kerosene	Other	Not Reported
42,779	41,348	357	91	989

Source: The Portmore Sustainable Development Plan, 2007

3.8.3.2 Water

The NWC is the main institution responsible for all major water and sewage operations, including water production, treatment and disposal of urban sewage. The company, which produces more than 90 percent of Jamaica's total potable water supply, operates a network of more than 160 wells, over 116 river sources (via water treatment plants) and 147 springs. The various Parish Councils and a small number of private water companies supply the rest of the potable water. **Table 24** provides specific details on water distribution in Portmore, which is based on the 2001 Census Data.

Table 24: Distribution of Households by Source of Water for Domestic Use, Portmore Municipality

Water Source									
PUBLIC SERVICE					PRIVATE SOURCE				
Total	Piped into Dwelling	Piped into yard	Stand-pipe	Catchment	Piped into Dwelling	Catchment	Spring/River	Other	Not Reported
42,779	36,814	2,418	76	40	1,367	196	1	643	1222

Source: The Portmore Sustainable Development Plan, 2007

3.8.3.3 Solid Waste

The National Solid Waste Management Authority (NSWMA) is the governing body responsible for solid waste management in Jamaica. The Authority provides waste disposal through the Metropolitan Parks and Market (MPM), which has portfolio management responsibilities for St. Catherine, Clarendon, St Thomas, Kingston and St. Andrew.

Like the rest of the island, Portmore residents have their garbage collected and disposed twice per week. Private commercial entities however, have to make arrangements for their garbage to be picked up (at a cost), either through the NSWMA, or by garbage collection contractors.

3.8.3.4 Sewage

Over 90 percent of all communities in Portmore have water closets linked to a sewer, according to the 2001 census. The majority of households have access to some kind of toilet facility, which is not shared (See **Table 25**). There are two sewage treatment plants serving the area: The Portmore (Waterford) Sewage Plant, and the Greater Portmore Sewage Plant.

Table 25: Distribution of Households by type of Toilet Facility, Portmore Municipality

Total	Shared			Not Shared			Not Reported			No Facility
	Water Closet	Pit	Not Reported	Water Closet	Pit	Not Reported	Water Closet	Pit	Not Reported	
42,779	3,308	969	24	35,641	1,402	156	556	72	407	244

Source: The Portmore Sustainable Development Plan, 2007

3.8.3.5 Health Services

As was previously established, there is no hospital in Portmore. Health services may however be accessed at government health centers and private medical facilities.

3.8.3.6 Schools

Portmore has adequate educational resources, with several primary, secondary and even tertiary institutions located in the area. The provision of primary and secondary education is the responsibility of the Government, although there are various privately owned preparatory schools. There is one high school – Cumberland High School in the Cumberland area, while Bridgeport Primary and High School is approximately 1 km away. Tertiary education in Portmore, is mainly provided through the Portmore Community College, where programs from other institutions, such as the University of the West Indies and the University of Technology, may be accessed.

3.8.3.7 Police Station

The nearest Police Station to the project site is the Bridgeport Police Station

3.8.3.8 Fire Station

The Waterford Fire Station services the entire Municipality and is approximately 4 km from the project site.

3.8.3.9 Transportation

Portmore, like Kingston, is served by Jamaica Urban Transit Company (JUTC), which connects Portmore residents with no ownership of a car, with Kingston and its surrounding environs, such as Spanish Town. The Portmore Toll Road is the major commuter Highway, which connects the two cities of Kingston and Portmore via the Hunts Bay Bridge.

3.8.4 Community Perception and Knowledge of the Project

There is no question regarding the need of a hospital in Portmore. Out of 1,497 persons interviewed for the project's Feasibility Study (2006), 97 percent answered '*yes*' to the question – '*Do you think Portmore needs its own hospital?'* Indeed, this quantitative data is substantiated by ongoing media expressions, echoing the community-wide approval of this kind of development. And as George Lee, past Mayor of Portmore aptly expressed "this is a meaningful gesture that Portmore can do well with … with the development of the toll road and the building of several new communities, the hospital is coming at an opportune time" (Turner, *Jamaica Gleaner,* 2006)

A crucial part of the Feasibility Study involved obtaining views and perceptions of the proposed development, as well as the inclusion of local knowledge and expertise. Focus groups were extensively utilized by the Developers for this process. This method of qualitative research is quite useful in this context, giving insights into the opinions of various stakeholders, improving the planning and design of the proposed project, and providing a means of evaluating existing programs. Focus groups were convened during the project's design phase, as follows:

- Meetings with Stakeholders
- Meetings with the Ministry of Health
- Meetings with community members

Table 26 provides a brief synopsis of these discussions.

Table 26: Public/Stakeholder Focus Groups on Proposed Development (Do you think we should have another column with recommendation or resolution (if that information was captured that is?)

Date	Focus Group	Parties Present	Purpose	Discussion
28-Apr-05	Cayjam Development/Portmore Municipal Council/Various Stakeholders	Cayjam Development Team; Portmore Municipal Council, Jamaica Fire Brigade Representative, Jamaica Public Service Co. Ltd. Representative, National Water Commission Representative, National works Agency Representative, Water Resources Authority Representative, Ministry of Health Representatives	A group discussion between the Developers and the relevant Stakeholders, where roles and contributions were established, as well as to heighten the Developers awareness of the respective agencies, their authority and policies to be embraced, in order to expedite their duties in an efficient manner	Environmental Issues pertaining to public health, water resources and waste water
				Infrastructural Issues pertaining to construction works, roads, street lighting, traffic, power supply, fire, drainage and potable water
13-May-05	Cayjam Developers/Ministry of Health	Cayjam Development Team, Portmore Municipal Council, Ministry of Health Representative, St. Catherine Health Department Representative, Southeast Regional Health Authority Representative, Ministry of Local Government Representative	The session was convened to access guidance from the Ministry of Health, to enhance the progress of the joint development partnership between Cayjam Ltd. and the Portmore Municipal Council, towards the construction of a hospital within the municipality.	The public/private partnership; demand assessment; hospital services; hospital equipment; pricing and affordability; human resources and staffing; health insurance; technical support
14-Jan-06	Cayjam Developers/Citizens Associations	Approximately 50 members of the Portmore Community	The developers met with the residents to discuss the feasibility of the Hospital within the Municipality.	The social, economic and cultural implications of the proposed development

Informal interactions between the EIA Team and several residents of the Newlands, Garveymeade and Southboro communities between March and April 2009, highlighted the receptive sentiments of the communities. In fact residents were so ecstatic about pending development, that the specific location was not an issue, all that mattered to them was that a hospital would be in Portmore. They were also encouraged by the job prospects and other spill-off opportunities that the Hospital presents to them at the proposed site.

3.8.5 Analysis of Alternatives

Alternatives to the project, including the no action alternative will be presented in this section, as well as the historical use of the overall area in which the project site is located. These alternatives will be discussed from environmental and socio-economic perspectives.

3.8.5.1 Development of a Major University Campus

Currently, most of the tertiary level students living in Portmore attend schools in Kingston. A tertiary institution of similar status to the two recognized ones (University of West Indies and University of Technology), will serve the community well and reduce the travelling time of students who commute to the neighbouring city.

From an environmental point of view, the building of a school of this magnitude would create similar environmental concerns as a hospital, particularly in the construction phase. However, the operation of the school may be less detrimental to the environment, as it is assumed that the former will have less equipment emitting undesirable gases into the atmosphere.

A school will create socio-economic benefits for the community through the creation of jobs and increased educational access. However, it is likely that the government would be required to pioneer this development, which may create an additional economic burden on the entire country. Also, it does not address the most pressing need of the residents of Portmore.

3.8.5.2 Development of a Residential Community

This alternative would provide housing solution to many persons who are seeking to purchase their homes. This type of development would reflect the general land usage of the area surrounding the projected site. A major housing development that fully utilize the 104.7 acre land space will have similar environmental impacts as the proposed development in the construction phase, but may require more monitoring.

From a socio-economic point of view, another major housing development may cause serious concerns to the existing residents who already believe that the Portmore is over populated. It would also add a significant burden to the existing infrastructure: water, electricity, road, school and health facilities, among others. Other than the employment opportunities that will be generated during the construction phase, this type of development provides no real economic return to the Portmore Municipality. A housing development therefore, cannot be considered as the best usage for the proposed site. Also, as cited in earlier sections of this report, consideration is being made to have an adjoining residential complex on the project site.

3.8.5.3 Development of a Recreational Park/Tourist Attractions

Portmore does not have any space allotted for retreat and relaxation, similar to a *Devon House* or *Emancipation Park* concept (both located in Kingston). Also, it has always been the desire of various political administrations of the Municipality, to have some form of activities or areas that will attract tourists. Environmentally, the area will benefit from the planting of trees and flowering plants, which will drastically improve the ecosystem of the area.

The area may reap many socio-economic benefits, ranging from the creation of jobs, to an inflow of income from surrounding areas and tourists. However, as in the case for a university, this type of development would be publicly funded, thus similarly creating a strain on the national budget.

3.8.5.4 The No-Action Alternative

Without the proposed development, the location will remain in its current abandoned state. This no-action alternative in itself, presents environmental concerns, as the site in its current state has attracted illegal dumping activities, which has serious implications on the nearby canal. From a socio-economic perspective, the no-action alternative will definitely not yield any benefit to Portmore residents, and will continue to result in loss of income.

CHAPTER 4: IDENTIFICATION AND PREDICTION OF IMPACTS

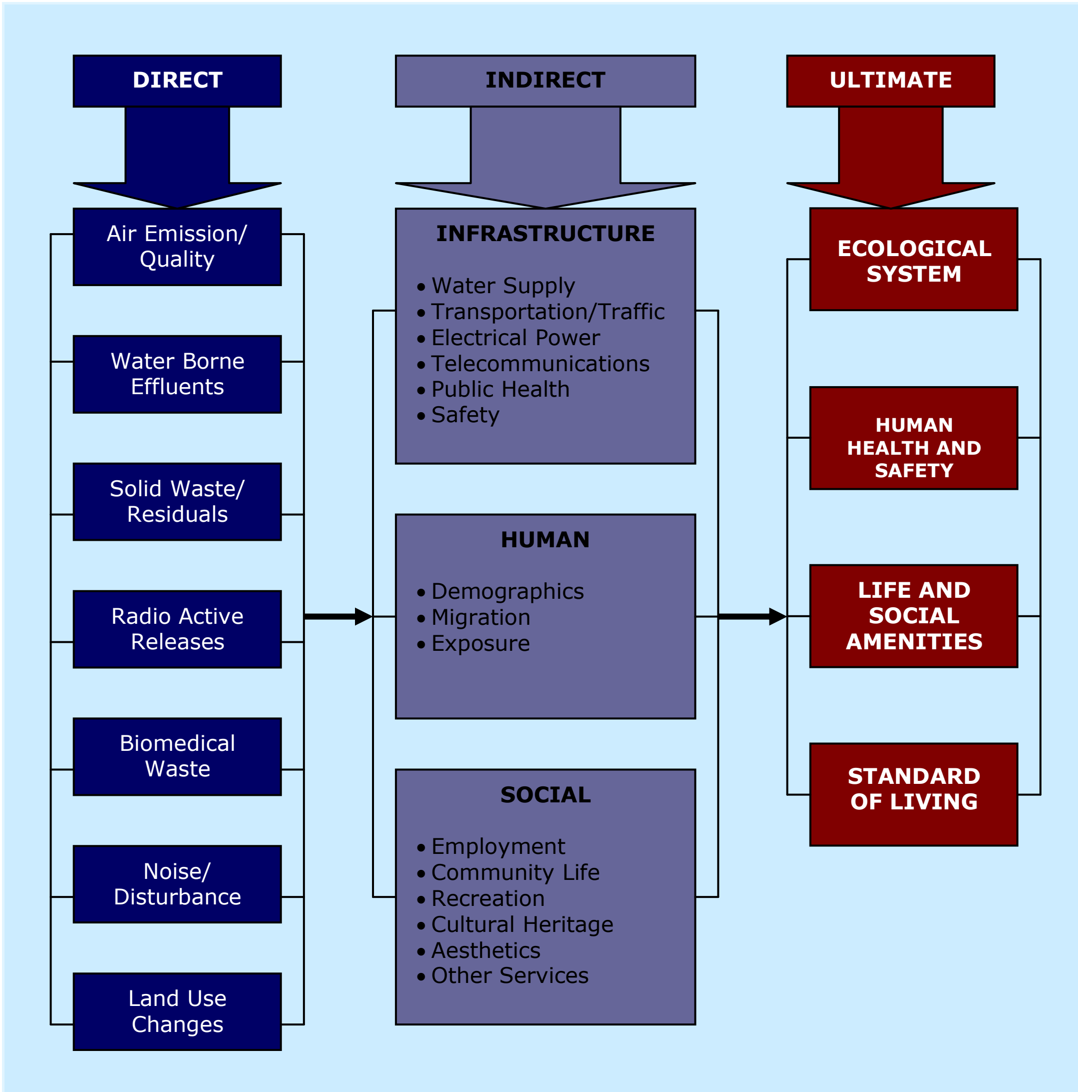
4.1 INTRODUCTION

Assessment of impacts depends on the nature and magnitude of the activity being undertaken, as well as the type of environmental control measures that are envisaged as part of the project proposal. Since the proposed is a construction project spread over 100 acres, comprising of a hospital complex with ultra modern technology, the potential impacts from the project area are identified and assessed based on the type and scale of the various activities associated with this project. Several aspects and potential impacts were identified for each phase (Project Location, Construction and Operation) of the development, with iimpacts evaluated in terms of their nature, occurrence, possibility and severity potential.

4.2 POTENTIAL IMPACTS

Several impacts are likely as a result of the construction (including pre-construction), and operation of the project. Such impacts may be direct, indirect or ultimate (See **Figure 14**) For the purposes of this EIA, these potential impacts (whether direct, indirect or ultimate), are assessed based on their magnitude (short-term or long-term) and effect (positive or negative). Impacts are also classified in three groups: impacts due to project location, impacts as a result of project construction and impacts as a result of project operation.

Figure 14: Evironmental Impact



All the potentially significant environmental impacts from the project are grouped below:

Air Environment

- Impact on ambient air quality

Noise Environment

- Impact on ambient noise

Water Environment

- Impacts on surface and ground water quality

Land Environment

- Impacts on land use
- Impacts on soil fertility

Ecological Impacts

- Impacts on trees/vegetation
- Impacts on forests and wildlife

Socio-Economic Impacts

- Impacts on other infrastructure
- Impacts on employment
- Impacts on public health and safety
- Impacts on cultural resources
- Impacts on aesthetics

Table 27 below gives the overview of the potential impacts due to project location, construction and operation.

Table 27: Overview of Potential Impacts due to Proposed Project

No.	Impacts	Negative		Positive		No Impact
		Short Term	Long Term	Short Term	Long Term	
A	**Project Setting**					
i	Displacement of People				√	
ii	Change of land use				√	
iii	Loss of trees/vegetation	√				
iv	Shifting of utilities					√
v	Impact on archaeological property					√
B	**Construction Phase (including pre-construction activities)**					
i	Pressure on local infrastructure	√				

No.	Impacts	Negative		Positive		No Impact
		Short Term	Long Term	Short Term	Long Term	
ii	Impact on water quality					√
iii	Impact on air quality (including dust generation)	√				
iv	Noise pollution	√				
v	Traffic congestion	√				
vi	Staking and disposal of construction material	√				
vii	Public health and safety	√				
viii	Social impact			√		
C	**Operational Phase**					
i	Change in ambient air quality		√			
ii	Increase in noise levels		√			
iii	Water harvesting and recharge				√	
iv	Disposal of solid and biomedical waste					√
v	Induced infrastructure development				√	
vi	Quality of life				√	
vii	Increment in green cover				√	

4.3 IMPACTS DUE TO PROJECT LOCATION

The development will have both socio-economic and environmental implications as discussed in the sub-sections below.

4.3.1 Relocation of People

Currently, there are minimal infringements on the project site that therefore will require relocation exercises.

4.3.2 Change of Land Use

The project site has not been productively utilized for a number of years, and is presently misused, especially for solid waste disposal. It is aesthetically unappealing, because of its "*dumpsite*" and desert like appearance. The development however, will comprise not only of a built environment, but also of landscaped vegetation and water attractions, thus enhancing the aesthetic value of the area.

4.3.3 Loss of Trees

Considering the scale of the project and commonly found flora and fauna within the project influence area, no significant adverse effects are envisaged on the ecology of the area.

4.3.4 Shifting of Utilities

There will not be any shifting of existing utilities such as water supply pipelines, sewers, electrical lines, etc. due to the proposed project.

4.3.5 Impact on Archaeological Property

Within the project influence area there are no significant archaeological properties, hence no impact in this area is anticipated.

4.4 Impacts Due To Project Construction

Project constructions typically change the natural environment, creating negative impacts in some cases. These are short-term impacts of low magnitude, which are easily managed.

4.4.1 Pressure on Infrastructure

During the construction stage, demand for basic amenities such as water and electricity may put pressure on the existing infrastructure. Considering the nature of the project, the impact shall be short term and low in magnitude and are limited to the construction phase only.

4.4.2 Contamination of Soil

If not properly disposed of, the spillage of oil from the machinery, cement residue from concrete mixer plants, sewage and solid wastes, might contaminate the soil.

4.4.3 Water Quality Degradation

No impact is expected on potable water, since this will be directly supplied and stored on site. Surface water however, may be impacted as follows:

- Chemical contamination from construction materials such as cement, paint and mechanical fluids
- Increased siltation caused by surface runoff (as a result of the removal of vegetation and the placement of raw materials e.g. sand)

4.4.4 Impact on Air Quality

Potential impact on the air quality during the construction stage will be due to the fugitive dust and the exhaust gases generated in and around the construction site. Although gaseous air pollution was not detected, the baseline reveal that on windy days, nuisance level fugitive dusting occurs. Dust is a major component of air pollution, generated mainly from the following construction activities:

- Site clearance and use of heavy vehicles and machinery/equipment etc. at construction site
- Procurement and transport of construction materials, such as sand and cement to the construction site
- Excavated materials (soil) stockpiled

4.4.5 Noise Pollution

Noise is perceived as one of the most undesirable consequences of construction activity. Though the level of discomfort caused by noise is subjective, the most commonly reported impacts of increased noise levels are interference in oral communication, and disturbance in sleep. Noise levels in the vicinity of the site were found to be above normal limits for residential areas. Due to the various construction activities, there will be short-term noise impacts in the immediate vicinity of the project corridor, which may exceed acceptable limits and reach nuisance levels for residents. These include:

- Concreting and mixing
- Excavation for foundations with driller (if used)
- Construction plant and heavy vehicle movement (e.g. cranes)

Since the project site is surrounded by open areas, no major adverse impacts are envisaged in the project area. Also, the noise levels are not expected to exceed occupational limits; therefore no adverse effects on employees should result. Nonetheless, noise conservation procedures will be introduced when necessary.

4.4.6 Traffic Congestion

The proposed site is located in a dormitory type area and as such will see traffic volumes highest in the morning when residents are on their way to work, and in the evenings on their return. There is expected be a short-term negative impact on traffic, especially if construction materials are being delivered during peak times. The transportation of construction material from source to site will entail the use of slow moving heavy trucks, which have the potential to contribute to traffic build-up.

4.4.7 Stacking and Disposal of Construction Material

Construction activities will lead to the generation of solid waste in significant amounts, mainly in the form of construction debris. If these waste streams are not properly managed, then the potential exists for a negative environmental impact.

4.4.8 Public Health and Safety

The generation of solid waste, sewage, fugitive dust and gaseous emissions can impact on public health and safety, if not properly managed.

4.4.9 Social Impacts

There will be a long-term, positive impact on the social landscape of the project area. Social impacts could result from an influx of migrant workers and associated induced development. This will ensure a rise in the consumption of consumer goods in the local area, which will further affect the wider economy. As far as possible, local labour within the project influence area will be utilized for construction purposes.

4.5 Impacts Due To Project Operation

During the operation phase, there will be impacts on the air, water and land environment, as well as on socio-economic aspects. The following sub-sections present the impacts due to the operation of the proposed project

4.5.1 Biomedical Waste

Biomedical waste is any waste, which is generated during the diagnosis, treatment or immunization of human beings or animals, or in research activities pertaining to the production or testing of biological material or substance. The World Health Organization (WHO) along with NEPA, concur that the following wastes should be classified as infectious waste:

- sharps (needles, scalpels, etc.)
- laboratory cultures and stocks
- blood and blood products
- pathological wastes; including tissues, organs and other body parts and fluids that are removed during surgery or autopsy, or their medical procedures, and specimens of body fluids and their containers.
- wastes generated from patients in isolation because they are known to have an infectious disease
- chemicals and other hazardous materials used in patient diagnosis and treatment

The types of biomedical waste expected to be generated during the operations of the proposed Hospital, are outlined in **Table 28**. The unsafe disposal of these healthcare waste poses serious public health risks (WHO, 2004). Contaminated needles and syringes represent a particular threat, as the failure to dispose of them safely may lead to dangerous recycling and repackaging, which lead to unsafe reuse. Contaminated injection equipment may be scavenged from waste areas and dumpsites and either be reused or sold to be used again. WHO estimated that, in 2000, injections with contaminated syringes caused:

- 21 million Hepatitis B virus (HBV) infections (32% of all new infections);
- two million Hepatitis C virus (HCV) infections (40% of all new infections); and
- at least 260 000 HIV infections (5% of all new infections).

In 2002, the results of a WHO assessment conducted in 22 developing countries showed that the proportion of healthcare facilities that do not use proper waste disposal methods ranges from 18 percent to 64 percent.

Table 28: Expected types of Biomedical Wastes

Type of Waste	**Waste Description**	Generation Area
Human Anatomical	Human tissues; amputated body parts	Operating Theatres (OTs),
Infectious Solid Waste	Items contaminated with blood and body fluids, including cotton, dressings, solid plaster casts, beddings, pathological wastes, infected blood, patient samples and specimens	OTs, Intensive Care Units (ICUs), Pathology Lab, Blood Bank, Wards, Emergency Room (ER)
Microbiology Waste	Cultures; stocks and micro-organisms; dishes and devices used for culture	Microbiology Lab
Sharps	Needles; syringes; scalpels; blades; glass, etc	OTs, Cath Labs, ER, ICUs, Wards
Disposables	Disposables other than sharps, e.g. Gloves, catheters, IV-sets, valves, and any other infected plastics	OTs, Cath Labs, ER, ICUs, Wards
Liquid Waste	Waste generated in the laboratories	Labs
Chemical Waste	Chemicals used in the production of biologicals	Labs
Discarded Medicines	Wastes comprising outdated, contaminated and discarded medicines	All patient areas, Pharmacy
Incineration Ash	Ash from the incineration of any biomedical waste	Incinerator site

4.5.2 Use and Disposal of Radioactive Isotopes

It is understood that during the operational stage of the Hospital's Nuclear Medicine Department, the following radioactive isotopes will be utilized (half-life indicated in brackets):

- Technetium-99m (6 h): Used to image the skeleton and heart muscle in particular, but also for brain, thyroid, lungs (perfusion and ventilation), liver, spleen, kidney (structure and filtration rate), gall bladder, bone marrow, salivary and lacrimal glands, heart blood pool, infection and numerous specialised medical studies. Produced from Mo-99 in a generator
- Xenon-133 (5 d): Used for pulmonary (lung) ventilation studies
- Iodine-131 (8 d): Widely used in treating thyroid cancer and in imaging the thyroid; also in diagnosis of abnormal liver function, renal (kidney) blood flow and urinary tract obstruction

If radioactive isotopes are released into the environment, through accident, poor disposal, or other means, they can potentially cause harmful effects of radioactive contamination. They may also cause damage if they are excessively used during treatment, or in other ways applied to living beings through radiation poisoning. The preservation, transportation, and disposal of this type of waste, will be as per NEPA specifications, with adequate preventative and cautionary measures undertaken to prevent any accidental loss or damage to topsoil. A brief handling, management and disposal plan for the radioactive waste is provided in **Chapter 5**.

4.5.3 Solid Waste

It expected that along with biomedical waste, certain quantum of solid waste, domestic in nature will also be generated during the operation stage. For the collection of such waste, receptacles will be provided at each ward and arrangements made, to prevent contact with biomedical waste. Such waste will be collected separately once a day, and disposed of in a suitable manner, as per the directives of Municipal authorities. A separate solid waste collection chamber has been designed on the extremity of the hospital premises, hence no major impact is expected.

4.5.4 Air Environment

Pollution of the air environment may be caused by:

- DG Sets emission: It is estimated that a typical DG set will emit 25 – 30 pounds of Nitrogen Oxides (NO_X) per megawatt hour of power generated. The level of Sulphur Oxides (SO_X) depends on the percentage sulphur in the oil being used in the generator.
- Vehicular emissions: Carbon Monoxide (CO) is the major pollutant emitted by motor vehicle exhaust systems. This is highest when vehicles are poorly maintained, causing incomplete combustion to take place.
- Incinerator: There is intense concern about the emissions of chemicals from incinerators, and its possible effects on humans. There are two main outputs of incinerators: ash, and the emission to the atmosphere of flue gases. Flue gases may contain significant amounts of particulate matter, heavy metals, dioxins, furans, CO_2, SO_X and hydrochloric acid. Dioxins and furans are of most concern to Environmentalists. **Table 29** shows a number of air pollutants, which can be found in incinerator emissions. The hazard shown is usually very much related to the dose and therefore it cannot be assumed that emissions of low levels of the substances will result in measurable health effects, although a precautionary approach would mean that increases in levels of persistent toxic chemicals should be avoided.

Table 29: Some Air Pollutants in Incinerator Emissions

Pollutant	Health Hazard
Nitrogen Oxides	Respiratory effects (and is a precursor of ozone, which also contributes to respiratory problems)
Sulphur Oxides	Respiratory effects
Particulates/PM10s	Respiratory effects; no known safe threshold
Dioxins	Class 1 Carcinogen (as TCDD). Affects development and reproduction; highly toxic, persistent, bio-accumulative. Can contaminate the food chain.
PAHs (polycyclic, aromatic hydrocarbons)	Some are carcinogens
PCBs	Properties similar to dioxins
Carbon Monoxide	Reduces oxygen in the blood
Hydrogen Chloride	Acid, irritant to tissue including respiratory tract
Hydrogen Fluoride	Irritant; affects bone formation

Cadmium	Class 1 carcinogen
Chromium III Chromium VI	Type VI is a Class 1 Carcinogen
Thallium	May affect several organs and nervous system
Mercury	Kidney function
Arsenic	Class 1 carcinogen
Cobalt	Class 2B carcinogen
Lead	Class 2B carcinogen
Manganese	Neurological effects
Nickel	Class 1 carcinogen (as compounds of nickel)
Vanadium	Respiratory effects
Antimony	A number of effects, including respiratory

4.5.5 Noise Environment

A typical DG set emits approximately 117 dBA of noise. This is way above the National ambient noise standards, and presents a nuisance to those in close proximately. When mitigation measures are applied, the noise generated from the DG Sets and Pumps should be regulated to acceptable limits. Employees working close to these equipments for extended periods, will be encouraged to wear ear protection.

4.5.6 Sewage

The sewage treatment plant will accommodate sewage from all areas of the hospital. Pollution to surface water may occur, if not properly managed.

4.5.7 Waste Water Environment

During the operation, 120,000 gpd waste water will be generated that will be treated in the sewage treatment plant. **Table 30** shows the expected waste water characteristics.

Table 30: Expected Waste Water Quality

Parameter	Expected Waste Water Characteristics
Load	50,000 gpd
pH	6 to 8
Temperature	15^{o} C
BOD	250 mg/l

TSS	250 mg/l
NH3-N	25 mg/l

The value of the treated waste water will be reused for horticultural and cooling purposes, and will be within the land disposal standard, hence no immediate adverse impacts are envisaged on the waste water environment. Any bursting or choking of internal sewer may cause adverse impact such as foul smell, unhygienic waterlogged condition and health related impact on the live-in population. Therefore regular maintenance checks shall be carried out by the health and safety staff.

4.5.8 Traffic Environment

The location of the development has presented the Hospital with two main road footages; the Newlands main road, and Southboro Drive, with the latter being one of the heavier used roads in Portmore. The Hospital will no doubt add traffic to burden these roads, and as an acute care center, will have emergency vehicles going in and out of the facility.

4.6 POSITIVE IMPACTS

Several positive impacts can be identified as a result of the introduction of the hospital in the area. These include, but are not limited to the following.

4.6.1 Health Infrastructure

As was previously mentioned, Portmore does not have a designated in-patient hospital facility, the nearest being located in Spanish Town and Kingston. The 120-bed multi-specialty tertiary Hospital will be the first in Portmore and will feature the latest state-of-the-art medical equipment and information technology systems. As one resident remarked "we in Portmore realised that the population is growing…, so the development of a hospital is really critical to the welfare of people in the community" (Campbell, *Jamaica Gleaner,* 2007)

4.6.2 Physical Infrastructure

The development will also feature a gated residential complex with a recreational area, as well as a commercial center. Spill-off infrastructure development will entail road expansions, drainage improvements, as well as an improvement to the general aesthetic of the area (See **Figure 15** below).

Figure 15: Artist Renderings of the new PIHMC - 2009

4.6.3 Employment

Jobs will be created for community members during the construction phase, as well as during operation. More than 1,500 persons will be employed to the complex.

4.6.4 Enhancement of Public Health and Safety

The general enhancement of public health and safety will be achieved through the following means:

- Improved drain management
- Proper management of solid waste disposal
- Public health outreach programs

CHAPTER 5: ENVIRONMENT MANAGEMENT PLAN

5.1 OBJECTIVE

The objective of mitigation measures is to identify and implement actions to reduce and/or eliminate negative impacts arising from the project activities.

5.2 MITIGATION MEASURES FOR BIOMEDICAL WASTE

Biomedical waste is the most critical aspect of any hospital project and as such, a Biomedical Waste Management Plan will be enforced to minimize the adverse impacts on the human, land and water environment. Waste that is deemed potentially infectious may be treated prior to disposal by a number of different technologies that either disinfect or sterilize them. These technologies include steam sterilization (autoclaving), dry heat thermal treatment, chemical disinfection processes, among others. In order for treatment systems to work properly, distinctive protocols for the classification and segregation of wastes must be in place. These methods, if properly adopted, may significantly cut down the infective and harmful properties of the biomedical waste.

5.3 MITIGATION MEASURES FOR NUCLEAR MEDICINE DEPARTMENT AND THE HANDLING OF RADIOACTIVE ISOTOPES

The Nuclear Medicine Department will be as per the specifications of NEPA, and any other applicable regulatory body. For effective implementation of radiation safety in the Department, the following will be ensured:

- Minimum furniture will be used
- Top surfaces of the work tables will have a smooth laminated finish
- Adequate numbers of lead containers and interlocking lead bricks will be procured for, providing adequate shielding in storage and handling rooms
- Remote handling devices for different operations will be procured
- Suitable ventilation fumes will be installed
- Drainage ducts from isolation wards (from sinks, wash basins, toilets and water closets), will be connected to delay tanks and then to the sanitary systems

Handling of radioactive material is often associated with exposure to potentially dangerous radiation and as such, the documentation of the radiation dose received by persons working with radioactive material and radiation producing equipment is critical to minimizing such exposures, and ensuring compliance with government and international regulations. Best practices for radiation minimization, for example, the *As Low and Practically Possible (ALARP)* approach for occupational radiation threat assessment and minimization, will be adopted.

Contrary to popular belief, the radioisotopes used in nuclear medicine are mostly short lived and the half life of these range from a few hours to few days. Because of the short half lives, the disposal of the radioactive waste will be done using simple methods of decay and disposal. For ultimate disposal of the radio-active isotopes, these will be handed over to the approved agencies.

5.4 TRAINING AND AWARENESS PROGRAM

A comprehensive program will be implemented to ensure that hospital staff are aware of all the established procedures governing disposal of biomedical and other hazardous waste. The program will involve training in the handling and disposal of hazardous and medical wastes, and the proper maintenance of disposal facilities, including the incinerator.

5.5 MITIGATION MEASURES FOR AIR POLLUTION

5.5.1 Construction Stage

Air Quality around the project site will be adversely impacted during the construction stage. Various construction activities, especially those related to the handling of loose material likely to cause generation of fugitive dust, may adversely impact the air quality of the surrounding area of the project site. To minimize such impacts, the following measures shall be taken:

1. All the loose material, either stacked or transported, shall be kept on site for the shortest possible time and provided with suitable covering, such as tarpaulin

2. Water sprinkling shall be done at the location where dust generation is anticipated
3. To minimize the occupational health hazard, proper personal protective gears i.e. dust masks shall be provided to the workers who are engaged in dust generation activity
4. To control vehicular emissions, a system shall be put in place constituting the following guidelines:
    - All Contractor and Sub-contractor with diesel powered construction equipment with engine horsepower (HP) ratings of 60 HP and above, that are on the project for a period in excess of 30 consecutive calendar days, shall be retrofitted with emission control devices and/or use clean fuels to reduce diesel emissions
    - In addition, all motor vehicles and/or construction equipment shall comply with all pertinent National regulations relative to exhaust emission controls and safety
    - The reduction of emissions of carbon monoxide (CO), hydrocarbons (HC), nitrogen oxides (NOx), and particulate matter (PM_{10}) will be accomplished by installing Retrofit Emission Control Devices or by using less polluting clean fuels

5.5.2 Operation Stage

Table 31 gives the overview of the air pollution control measures to be adopted during the project operation stage.

Table 31: Overview of Air Pollution Control Measures

Air Pollutant	Source	Control
SO_2, NO_X	DG Sets	Adequate stack height, acoustic enclosure
Dust, SO_2, NO_X, CO, HC	Vehicles	Internal Roads will be maintained properly to reduce fugitive dust and provide for the smooth movement of vehicles

Air Pollutant	Source	Control
		Informatory sign shall be provided to encourage vehicle owners to maintain their vehicle and follow the emission standards fixed by Government Authorities

Measures for Controlling Vehicular Emissions

About 600 cars are expected to move around the Hospital complex per day. To control the emissions from the movement of vehicular traffic, the following measures shall be adopted:

- Proper maintenance of the internal roads
- Adequate greenbelt will be developed and maintained

Mitigation Measures for Controlling Emissions from DG Sets

To minimize emissions from DG sets, it is necessary to ensure that the stack height for exhausting the flue gases is such that, there shall be proper dispersion of gases without increase in the ground level concentration. The minimum height of the stack, as well as emission standards, should be as per NEPA guidelines.

Mitigation Measures for Controlling Incinerator Emissions

Modern incinerators are equipped with rigorous pollution control technologies to decrease the emissions of potentially toxic chemicals. The use of these systems greatly reduce, but does not eliminate the emissions of chemicals from incinerators. Also, as with any technology, there is always the risk of accidents of various sorts, which in the case of an incinerator, could result in a relatively uncontrolled emission of pollutants for some period of time.

Because there are no such guidelines within the national context, mitigation measures for controlling incinerator emissions are adapted from the Australian Environmental Protection Authority (EPA), an independent statutory authority and the key provider of independent environmental advice to the Australian Government. The EPA's objectives are to protect the environment and to prevent, control and abate pollution through the development of Guidance Statements to assist the environmental impact assessment of proposals. These guidance statements on the control of emissions from biomedical waste incinerators, are provided verbatim in **Annexure 3**.

5.6 Mitigation Measures for Noise Pollution

5.6.1 Construction Stage

During the construction stage, expected noise levels shall be in the range of 70-90 dBA, which will decrease inversely with the increase in distance. Silencers and mufflers should be affixed to the exhaust systems of all mechanical equipment being used on the project site. Any activity that is deemed to be noisy and maybe a nuisance, shall be scheduled at times least likely to impact those within hearing distance. Isolation of the source and sensitive receptors during the construction phase will be undertaken to minimize the impacts of noise and vibration. To prevent any occupational hazard, ear muff/ ear plug shall be provided to the workers working around or operating plant and machinery emitting high noise levels.

5.6.2 Operation Stage

All the equipment to be used should be designed to have a noise level not exceeding 90 dBA as per the requirement of NEPA. There are few potential sources such as DG sets, pumps, etc. that would generate noise levels above 75 dBA during operation. In order to control noise pollution, DG sets shall be housed in approved acoustic enclosures. Employees working close to the units, will be encouraged to practice hearing conservation habits, as is necessary (such as wearing adequate protective measures in the form of ear muffs and earplugs).

5.7 Mitigation Measures for Traffic Congestion

5.7.1 Construction Stage

The traffic survey showed peak times for the traffic environment to be 7 am to 9 pm and 5 pm to 7 pm. In order not to further encumber the roadways, the traversing of heavy motor vehicles may be scheduled outside of these times.

5.7.2 Operation Stage

There will be two entrances to the facility; one main grand entrance that is proposed to be on Southboro Drive, and an emergency and auxiliary entrance on the Newlands main road. Once the development is complete, the developer will work with the municipality to upgrade these roads to ease traffic flow. The storm drain is approximately 40 feet wide and represents an additional 10 feet boundary to the main road. *Cayjam* intends to cover a portion of this drain, which would allow for traffic easement.

5.8 Management Plan for Water Pollution

5.8.1 Construction Stage

During the construction phase, run-off from the site will not be allowed to stand (water logging), or enter directly into the roadside canal. In order to reduce runoff contamination to ground water and the lake, sediment and grease traps will be used to intercept run-off from drainage areas.

5.8.2 Operation Stage

In order to mitigate adverse impacts on the water environment due to the surface run-off and waste water, provisions for adequate infrastructure such as suitable drainage system, waste water collection and conveyance, including treatment and reuse, has been developed during the project design stage (refer to Chapter 2 for details). Please refer to **Annexure 5**. Moreover, rain water harvesting provisions has been made, which will adequately replenish the local aquifer. No further measures are needed, other than proper and regular maintenance of such facilities.

5.9 Waste Management

5.9.1 Construction stage

During the construction phase, a considerable quantity of waste, such as soil, debris and other materials, will be generated. All solid waste should be appropriately disposed of in drums or dumpsters. Stacking and disposal of such material should not disturb the surrounding land use and should be disposed of at the designated disposal site identified by the Municipality. Strategically located and maintained portable chemical latrine facilities must be made available for construction workers.

5.9.2 Operation Stage

During the operation stage, other than biomedical waste, two other types of waste are expected to be generated: (i) domestic waste and (ii) landscape waste. Measures to be taken to minimize the adverse impacts are given below:

Domestic Solid Waste

- Adequate number of collection bins separate for biodegradable and non-biodegradable waste shall be provided as per the NSWMA guidelines. Waste from such containers shall be collected separately on a daily basis
- All the collection bins shall be properly maintained on regular bases
- Arrangements will be made with the Municipality, for the provision of a central garbage station or transfer point, from where all waste collected from collection bins shall be disposed of for further disposal by the Municipal authorities

Landscape Waste

Landscape waste comprises of fallen leaves and other vegetative material. These shall be collected at a secured location, such that it does not hinder daily activity scheduling. These waste also need to be specially managed, in order to prevent surface run-off that may lead to the choking of drains.

5.10 DISASTER MANAGEMENT PLAN

Disaster is an unexpected event due to sudden failure of the system, external threats, internal disturbances, earthquakes, fire and accidents. The project area is particularly prone to certain types of natural disasters as follows:

- Flooding: The soil type found at the project site does not readily facilitate water perculation. Therefore, storm water is likely to accumulate, creating ponding or surface flows. If this is not properly managed, flooding may occur.
- Hurricane Hazard: The Atlantic hurricane season occurs between June and November, during which tropical cyclones originating in the South-Eastern Atlantic may bring increased rainfall to Jamaica. In most cases hurricanes affect the Southern parishes of Jamaica (including St. Catherine) more than the Northern parishes. Portmore, due to its topography, can easily be affected by storm surges in cases where hurricanes produce high levels of precipitation.
- Earthquake Hazard: Based on Jamaica's proximity to a major plate boundary, the island is prone to earthquakes, with a few extremely devastating earthquakes including Port Royal 1692 and Kingston 1907 on record. The property is situated beside a fault line, which would make the site prone to seismic activity. However, the faults are not known to be seismically active.

The following subsections describes the measures to be undertaken by the project proponent to minimise the risk of unexpected event.

5.10.1 Preventative Action

Once the likelihood of a disaster is suspected, action has to be initiated to prevent a failure. Engineers responsible for preventive action should identify sources of repair, equipment, materials, labour and, expertise for use during emergency.

5.10.2 Emergency Action Plan

The emergency measures should be adopted to avoid any major failure in the system such as lights, fire, means of escape, ventilation shafts etc. The aim of the Emergency Action Plan is to identify areas, population and structures likely to be affected due to a catastrophic event or accident. The action plan should also include preventive action, notification, warning procedures and co-ordination among various relief authorities.

5.10.3 Disaster Management Program

A Disaster Management Program will be established in order to facilitate effective emergency preparedness and response. This will include training programs for staff members and volunteers, installation and maintenance of emergency equipment and instituting a command center.

5.10.4 Fire Protection

Fire protection systems will be installed as per the National Building Codes and will include the following systems:

Fire Detection System

These include alarms and smoke detectors

Fire Suppression System

These will include fire extinguishers, fire hoses and sprinkler system

CHAPTER 6: ENVIRONMENT MONITORING PLAN

6.1 BACKGROUND

In keeping with the legislation and regulations of the Government of Jamaica, the management of the PIHMC will implement an extensive Environmental Monitoring Programme to cover all aspects of its operations. Results of this monitoring programme will be submitted to NEPA as required under the NRCA Act of 1991.

The Environmental Monitoring Programme is a vital process in the Management Plan for any construction project. This helps in signalling the potential problems that would result from the proposed project and will allow for prompt implementation of effective corrective measures. The environmental monitoring will be required during the pre-construction, construction and operational phases and will be based on the potential impacts identified.

6.2 WATER QUALITY AND PUBLIC HEALTH

Water quality parameters shall be monitored before, during and after the completion of the project. Monitoring shall be carried out on a monthly basis to cover seasonal variations for four years and will be analysed by applying the standard technique. Since the NWC will supply potable water, only surface water monitoring will be done. The parameters recommended for monitoring are as follows:

- pH
- Biochemical Oxygen Demand
- Total Dissolved Solids
- Temperature
- Sulphates
- Nitrates
- Total Nitrogen

- Total Phosphates
- Total and Faecal Coliform

6.3 Air Quality Monitoring

The monitoring programme for the construction and operation stage for air quality is presented in **Table 32**.

Table 32: Air Quality Monitoring Program during the Construction and Operation Phases

Ambient Air Quality Monitoring		
1	Parameters to be Monitored	Suspended Particulate Matter (SPM)
		Respirable Particulate Matter (RPM)
		Sulphur Dioxide (SO2)
		Nitrogen Oxide (NOX)
		Carbon Monoxide (CO)
		Hydrocarbons
		Lead
2	Sampling Methodology	The air quality monitoring should be conducted using High Volume Samplers. CO will be collected by Peroxide tube method or by portable CO meter. HC should be collected in Mylar Bags.
3	Number of locations	Three locations to be monitored
4	Frequency of Measurements	Twice per month @ two days per week
5	Compliance	The monitoring results should be compared with the National Ambient Air Quality Standards.

6.4 Noise Quality Monitoring

The monitoring programme for the construction and operation stage for noise quality is presented in **Table 33**.

Table 33: Noise Monitoring Program during the Construction and Operation Phases

1	Parameters to be monitored	As per NEPA guidelines
2	Sampling Methodology	The noise levels should be recorded using a portable hand held noise level meter.
3	Number of Locations	One location to be monitored (on site)
4	Frequency of Measurements	Once per month
5	Compliance	The monitoring results should be compared with the National Ambient Noise Quality Standards.

6.5 WASTE WATER QUALITY

Waste water samples shall be analysed to meet the Municipal sewage discharge standards mentioned in Table 7 of **Chapter 1**. One sample twice per month shall be analysed for the parameters mentioned in the table, to confirm the compliance of Municipal waste water discharge standards.

6.6 ENVIRONMENTAL MANAGEMENT SYSTEM

The Environmental Management System constitutes provision of an Environmental Department, which should be staffed by an Environmental Engineer/Officer, an Environmental Assistant and other support staff. The task assigned should include supervision and co-ordination of studies and the monitoring and implementation of environmental mitigation measures.

6.7 ENVIRONMENTAL COSTS

Environmental costs are for the most part, already included in the project's costing. These include: provision for rain water harvesting, provision for sewage treatment plant, provision of storm water drainage system, provision for green belt development and biomedical waste management. The project's costing however, does not include the costs to be incurred from Environmental Awareness/Training Programme and health and safety measures.

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ANNEXURE

PROJECT BRIEF

Cayjam Development Limited, a company registered in the Cayman Islands, has proposed the development of a first world private medical facility in Portmore, Saint Catherine, Jamaica. The *Portmore International Hospital and Medical Centre (PIHMC)*, when completed, will be the first of its kind in the Caribbean and will be positioned as a private, healthcare organization, with a secondary and tertiary care facility.

Based on the results of a feasibility study, it was recommended that the development of the hospital be done in two phases. Phase 1 is the development of a 64-bed facility that will provide a range of key medical and surgical services. Phase 2 will the development of an additional 54-bed facility, with consideration being made for the inclusion of a gated residential complex.

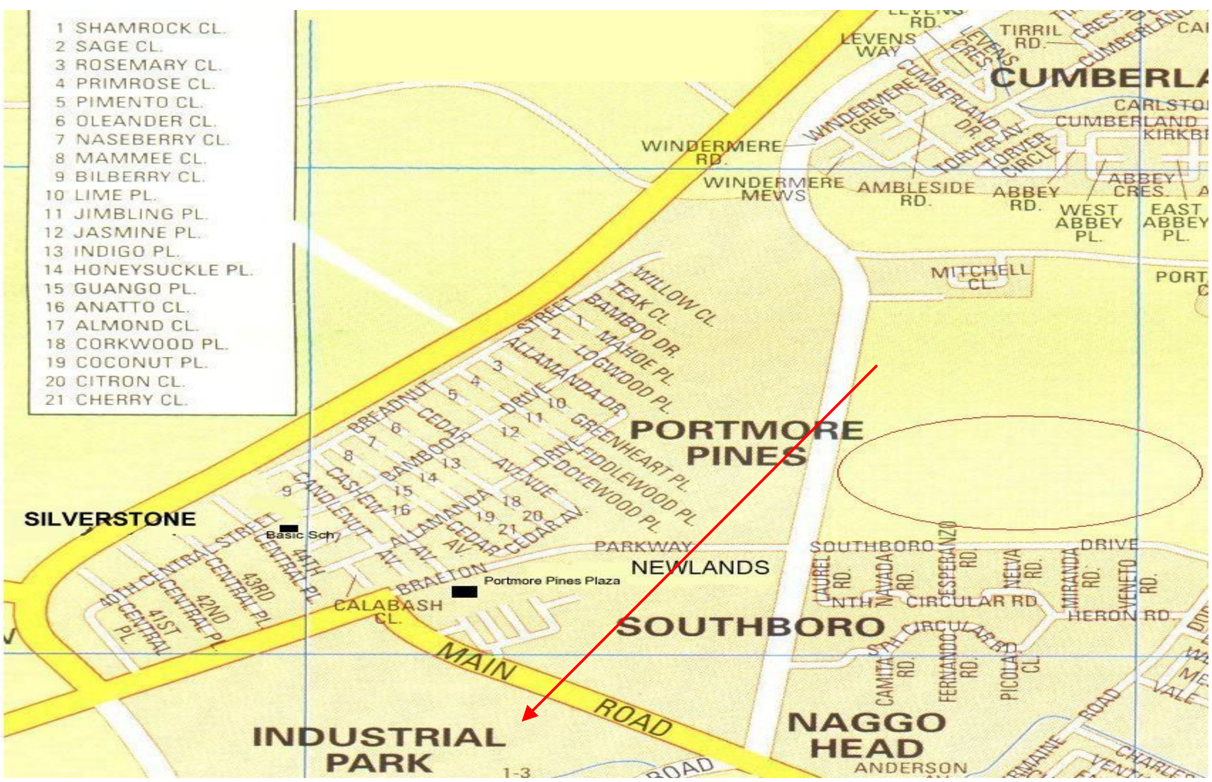
This draft Terms of Reference (TOR), has been modified from the NEPA generic TOR's for the development and construction of Hospitals. It outlines the aspects of an Environmental Impact Assessment (EIA), which when thoroughly completed, provides a comprehensive evaluation of the site, description of the project, predicted environmental impacts, governing legislations, mitigation strategies, measures and recommendations for the effective management of the impact of the project on the natural, social and political environment. The EIA is site and project specific and consequently, the generic TOR has been modified to be specific to the project – the *Portmore International Hospital and Medical Center.*

SITE LOCATION

The project is located in Portmore, a dormitory community next to Kingston, Jamaica. The specified location is a 104.7 acre property, bordered by Newlands Road, Southboro Drive and Germaine Road. See below for a map of Jamaica (Figure I) highlighting the geographical location, and Figure II, which highlights the specific location.

Figure I: Map of Jamaica

Figure II: Map of sections of Portmore highlighting the proposed location of PIHMC



Site Location

TERMS OF REFERENCE

The Environmental Impact Assessment for the Portmore International Hospital and Medical Center will:

1. Provide a comprehensive description of all components of the project and the work to be undertaken during the project.
2. Give an overall assessment of the existing physical and biological environment of the proposed development area.
3. Present a socio-economic and cultural evaluation of the proposed development area and its surroundings.
4. Identify and assess the potential impact of the project on the surrounding area, particularly as it relates to the cumulative impacts of this project on any existing developments.
5. Assess the drainage structure, particularly with respect to existing natural drainage channels, proposed man-made drainage/water features or any proposed changes in topography. Potential impacts of increased surface runoff and sediment loading will also be addressed.
6. Describe the construction methods to be employed during the proposed works.
7. Describe the mitigation measures to be employed during the proposed works.
8. Outline disposal of solid, medical and hazardous waste during the construction and operational phases.
9. Determine the method, level and location of the sewage treatment facility and the potential impact of disposal on the environment.
10. Give the timelines/scheduling for individual tasks to be undertaken.
11. Detail environmental Monitoring and Management Plan.

The following tasks will be undertaken in implementing this EIA:

Task 1 - Description of the Project

The business model is to develop a medical facility of quality, which approaches an accredited North American Hospital with quality building design, accommodations and equipment in accordance with this strategy. A comprehensive explanation of the project will be presented, with a full description of the surrounding environment. This will include the following specifics:

1. The project's objectives.
2. Information on the nature, location, timing, duration, frequency, general layout and size of the facility, including ancillary buildings, pre-construction activities, construction methods, works and duration, and post construction plans.
3. A description of raw material inputs, technology and processes to be used as well as products and by-products generated. Areas to be reserved for construction will be noted, as well as areas to be preserved in their natural states.
4. A description of sewage treatment system including treated effluent disposal as well as a solid waste disposal option.
5. Plans for storm water collection and disposal will be outlined.
6. Plans for providing utilities and other services will be clearly stated. This will involve the use of maps at appropriate scales, site plans, aerial photographs and other graphic aids and images, as appropriate.

Task 2 - Description of the Environment/Baseline Studies Data Collection and Interpretation

A detailed description of the methodology to be utilized for baseline and other data will be provided. The generation of the baseline data in turn, will be used to describe the study area as follows:

1. ***Physical Environment:*** which will delineate the following:
   a) The existing soil structure, geology, landscape, aesthetic values and hydrology. Special emphasis will be placed on storm water run-off, drainage patterns, aquifer characteristics, effect on groundwater and availability of potable water.
   b) The water quality of any existing wells, ponds, streams or coastal waters in the vicinity of the development. Quality Indicators will include, but not necessarily limited to nitrates, phosphates, faecal coliform and suspended solids.

c) Climatic conditions and air quality in the area of influence, including particulate emissions from stationary or mobile sources, NOx, SOx, wind speed and direction, precipitation, relative humidity and ambient temperatures.
d) Noise levels of the undeveloped site, and the ambient noise in the area of influence.
e) Obvious sources of existing pollution and extent of contamination.
f) Availability of solid waste management facilities.

2. Biological Environment

The EIA of the PIHMC will provide a detailed description of the flora and fauna of the area, with special emphasis on rare, threatened, endemic, protected and endangered species. Migratory species, wild food crop plants and the presence of invasive alien species will also be considered.

3. Socio-economic & Cultural Environment

The following areas relating to the socio-economic environment of the Portmore International Hospital and Medical Center will be explored in the EIA:

a) The current and projected population of the area.
b) The present and proposed land use and planned development activities.
c) Issues relating to informal settlement and relocation.
d) Economic structure, including base employment, income distribution, goods and services.
e) Utilities; recreation; public health and safety.
f) The cultural peculiarities, aspirations and attitudes of the area including its historical importance (heritage, archaeological sites and feature) or other material assets.
g) The socio-economic and cultural assessment will be informed by public perception of the proposed development. This assessment will be derived through the utilization of public meetings and surveys.

Task 3 – Policy, Legislative and Regulatory Considerations

The EIA will outline the relevant regulations and standards governing environmental quality, safety and health, protection of sensitive areas, protection of endangered species, siting and land use control at the national and local levels. The examination of the legislation will include those pertinent to hospital construction and operation projects such as the NRCA Act, the Town and Country Planning Act, Building Codes and Standards, Development Orders and Plans and the appropriate international convention where applicable.

Task 4 – Identification and Assessment of Potential Impacts

The methodology that surrounds this task will be to:

1. *Identify* the significant environmental and public health/safety issues of concern and indicate their relative importance.
2. *Identify* the nature, severity, size and extent of potential terrestrial and/or aquatic environmental impacts during the pre-construction, construction and operational phases of the development as they relate to, (but are not restricted by) the following:
    - change in drainage patterns
    - flooding potential
    - landscape impacts of excavation and construction
    - loss of and damage to geological and paleontological features
    - loss of species and natural features
    - habitat loss and fragmentation of species
    - biodiversity/ecosystem functions
    - pollution of potable, coastal, marine, surface and ground water
    - air pollution
    - capacity and design parameters of proposed sewage treatment facility
    - socio-economic and cultural impacts.
    - impact of flooding, loss of natural features, excavation and construction on the historic landscape, architecture and archaeology of the site.
    - risk assessment

- noise
- solid waste
- soil
- access to resources such as beaches
- carrying capacity of the proposed site

3. *Identify* the interaction between the impacts that have occurred, and those impacts which could still occur as a result of the clearing works that were conducted on the site prior to the preparation of this TOR.
4. *Distinguish* between significant positive and negative impacts, reversible or irreversible direct and indirect, long term and immediate impacts as well as avoidable and irreversible impacts.
5. *Characterize* the extent and quality of the available data, explaining significant information deficiencies, assumptions and any uncertainties associated with the predictions of impacts. A major environmental issue is determined after examining the impact (positive and negative) on the environment and having the negative impact significantly outweighing the positive. It is also determined by the number and magnitude of mitigation strategies which need to be employed to reduce the risk(s) introduced to the environment. Project activities and impacts will be represented in matrix form with separate matrices for pre and post mitigation scenarios.

Task 5 – Drainage Assessment

The EIA Report will consist of an assessment of Storm Water Drainage, which will outline:

1. Drainage for the site during construction, including mitigation for sedimentation to the aquatic environment
2. Drainage for the site during operation, including mitigation for sedimentation to the aquatic environment
3. Drainage control for the canal surrounding the property, including the impacts that this drain will have on aesthetics, water quality and sedimentation.

Task 6 Mitigation

The EIA report will highlight mitigation measures for avoiding or reducing, as far as possible, any adverse impacts due to the proposed building of the PIHMC. Recommendations will be given for the optimum development of the existing environmental attributes; particularly as it relates to drainage and sewage issues.

Task 7 - Environmental Management and Monitoring Plan

A plan will be devised for the management of the natural, historical and archaeological environments of the project to monitor implementation of mitigatory or compensatory measures and project impacts during construction and operation of the PIHMC.

The EIA will include an outline monitoring programme and a detailed version will be submitted to NEPA for approval after the granting of the permit, and prior to the commencement of the development. At the minimum, the monitoring programme and report will include:

1. An introduction outlining the need for a monitoring programme and the relevant specific provisions of the permit and/or licence(s) granted.
2. The activity being monitored and the parameters chosen to effectively carry out the exercise.
3. The methodology to be employed and the frequency of monitoring.
4. The sites being monitored. These may in instances, be pre-determined by the local authority and should incorporate a control site where no impact from the development is expected.
5. Frequency of reporting to NEPA

The Monitoring report will also include, at minimum:

6. Raw data collected, with graphs and tables used where appropriate
7. Discussion of results with respect to the development in progress, highlighting any parameter(s) which exceeds the expected standard(s).
8. Recommendations
9. Appendices of data and photographs if necessary.

Task 8 - Project Alternatives

Alternatives to the project, including the no-action alternative will be presented. This examination of project alternatives will incorporate the historical use of the overall area in which the site is located.

REPORTING

All Findings will be presented in an EIA Report reflecting the format presented in the TOR. Ten hard copies and an electronic copy of the report will be submitted to NEPA and copies prepared for the Parish Library and Parish Council offices to facilitate Public Reading. The report will include baseline data, references, plans, maps, and photographs, as well as appendices items such as plans, the study team, and supporting reports and documents.

Annexure 2 – Description of Project Team

The following is a list of the members of the EIA project team

- Mrs. Natalie Wheatle, Team Leader
- Mr. Clive Miller, Environmentalist and Safety Specialist
- Mrs. Georgette Lugg, Environmentalist
- Mrs. Denise Dallas, Social Scientist
- Mr. Horace Haigh, Bio-Chemist

Annexure 3 – Management of Air Emissions from Biomedical Waste Incinerators

Purpose

The purpose of this Guidance Statement is to assist in preventing air pollution from biomedical waste incinerators**.**

This Guidance Statement addresses:

a. protection of the environment as defined by the *Environmental Protection Act 1986 (WA*) (the Act) with a focus on emission standards and criteria for the operation of biomedical waste incinerators and design standards for biomedical waste incinerators.
b. the factor of air pollution from biomedical waste incinerators; and
c. the need to present to proponents, who have proposals subject to environmental impact assessment (EIA) and the general public, the Environmental Protection Authority's (EPA) position on Management of Emissions from Biomedical Waste Incinerators.

1. Introduction

In 1990 the DEP foreshadowed the introduction of regulations for biomedical waste incinerators throughout WA. All biomedical waste incinerator operators were given notice that incinerators that were operated for the purposes of biomedical waste incineration after February 1996 would be required to be licensed. The DEP licence required biomedical waste incinerators to comply with strict limits on emissions to reduce organic, acid and heavy metal emissions to an acceptable standard. All but one of the incinerators, the Stephenson & Ward incinerator, have closed down. Biomedical waste that may be incinerated is defined as infectious or potentially infectious waste produced by health care establishments, or by pathology, dental, or veterinary

practises, or by laboratories. The Stephenson & Ward Incinerator located in Welshpool provides an essential service to the State for the destruction of a range of biomedical waste including some which may be considered to be a hazard to human health. A significant portion of the biomedical waste stream has the potential to release dioxins, furans and acid gases to the atmosphere if burnt in uncontrolled conditions. The EPA guidance statement addresses the standards of operation and emissions of biomedical waste incinerators to ensure that emission levels are controlled.

2. The Environmental Objective

The EPA's environmental objective for the management of emissions from biomedical waste incinerators is to ensure that humans and other living things are not adversely affected by emissions either from incineration or from disposal of flyash.

3. The development of operating and design requirements for biomedical waste incinerators

The standards required for the operation of the Stephenson & Ward incinerator should be the minimum standards required for the operation of biomedical waste incinerators throughout Western Australia. The Stephenson & Ward incinerator is licensed under the *Environmental Protection Act 1986 (WA)* and therefore must comply with a set of licence conditions. The licence conditions apply criteria to air emissions, specific operating conditions, and require regular testing and monitoring of emissions. The emission limits for the Stephenson & Ward incinerator were adapted from the strict emission and control legislation applied to New South Wales municipal waste incinerators (*Clean Air (Plant and Equipment) Regulation 1997*, *Part 9, Dioxins and Furans*) by the NSWEPA. The dioxin/furan goal of 0.1ng/m3 has also been adopted by the VicEPA. The dioxin and furan limit of 0.1ng/m3 has been internationally accepted as a "goal" and not as a strict emission standard for a number of years because there is still incinerator technology in use that cannot achieve such low emission limits. The German Federal Environmental Agency (Umweltbundesamt) has implemented the dioxin and furan limit of 0.1ng/m3 as a strict emission control limit for incinerators and industry operating near populated areas. Testing on the Stephenson & Ward incinerator following the upgrading of the pollution control equipment has indicated that the dioxin and furan goal of 0.1ng/m3 can be readily achieved. The EPA has adopted a standard of 0.1ng/m3 criteria for dioxins and furans.

4. Biomedical Waste Incinerator Design, Operation and Emission Requirements

a) Minimum Requirements for Incinerator Design and Operation

- Biomedical wast incinerators shall be sited on appropriately zoned land away from residential areas.
- The secondary chamber is to be sized to achieve a 1 second minimum gas residence time within the secondary combustion chamber at a temperature of at least 1100°C, o r a 2 second minimum at a temperature of at least 1000°C, under maximum operating conditions. The residence time is measured from the flame front to where the secondary chamber temperature sensor is positioned. The primary and secondary chamber temperature sensors are to be located so they do not receive direct radiation from the chamber’s burner or flame.
- The primary chamber must operate at a temperature of between 650°C and 900°C. Temperatures below 650°C have been shown to produce incomplete physical destruction. Avoiding temperatures in excess of 900°C minimises excessive gas velocities and thus prevents carryover of particles and ash.
- Gases entering the particulate control device must be below 230°C, avoiding temperatures between 250°C and 400°C prevents the formation of dioxins and furans.
- Gas exiting the secondary chamber should have an excess oxygen content of at least 6%.
- The incinerator shall go into “interlock mode” within 120 seconds if the secondary chamber exhaust gas temperature falls below 1000°C. The interlock shall prevent waste from being loaded into the primary chamber until the secondary chamber temperature reaches 1000°C.

b) Incinerator Emission and Monitoring Requirements

- An essential ingredient for any incinerator is regular on-stream monitoring of certain air quality parameters. The exhaust gases of biomedical waste incinerators are normally required to be analysed for the contaminants specified in Table 1.

- Gas volumes are to be expressed dry, at 0°C, and at absolute pressure 101.325 kPa and 7% O_2
- The oxygen content of the exhaust gases leaving the secondary combustion chamber must be accurately measured and recorded daily whenever the incinerator is operating.
- Carbon monoxide (CO) and carbon dioxide (CO_2) content of exhaust gases must be accurately measured and recorded daily whenever the incinerator is operating. Combustion efficiency (CE%) is to be calculated and recorded. The incinerator is to operate with a combustion efficiency of better than 99.8%.

  CE% = concentration o f C O 2 x 100%

  (concentration of CO_2 + concentration of CO)

- Chlorinated dibenzodioxins and dibenzofurans must be reported in the following groups together with the specified congeners. This allows computation of toxic equivalents and gives an indication of the classes of compound present. The two major groups, chlorinated dibenzodioxins and the corresponding furans must be reported separately. Each level of chlorination from tetra to octa substitution must be reported separately.

  Within each level of chlorination:

  i. All those compounds including chlorine substitution at the 2,3,7,8 positions must be reported individually;
  ii. Those compounds not substituted at the 2,3,7,8 positions must be reported as a composite group (for each level of chlorination), for example "non-2,3,7,8 hexachlorinated dibenzodioxins".
- Operator training is essential for the efficient and effective operation of the incinerator. Operator training should be designed to ensure correct incinerator operation in all circumstances, including during emergency situations or unexpected power supply problems. Adequate training will assist in preventing unacceptable environmental impacts.

Table 1: Western Australian Environmental Protection Authority

Emission Levels for Biomedical Waste Incinerators

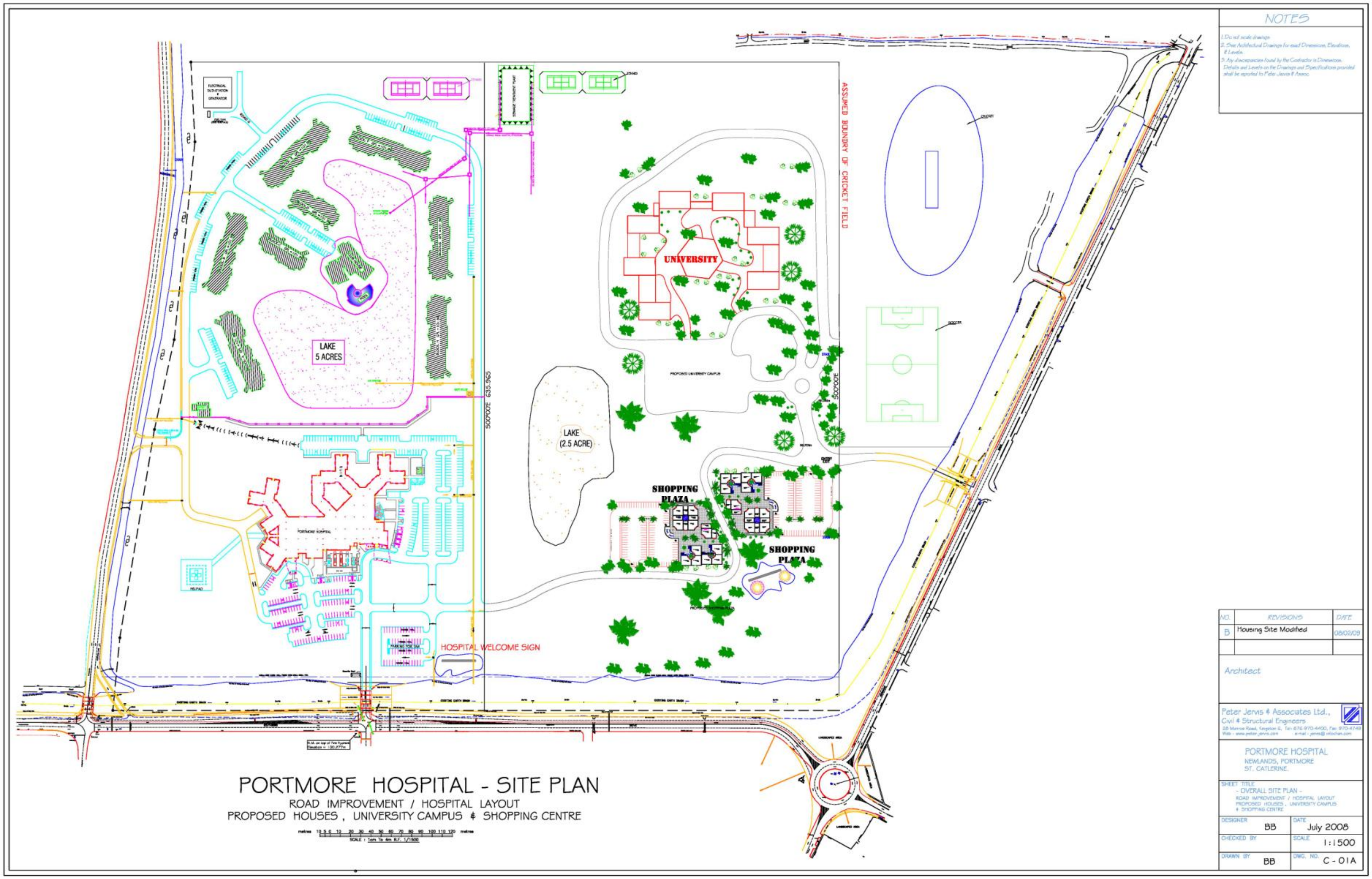
Emission	Measured as	Levels
Smoke	Ringelmann scale	1
Soot	Bacharach scale	3
Solid particles	adjusted to 12% CO_2	0.070 g/m^3
Hydrogen sulphide	H_2S	0.005 g/m^3
Nitrogen oxides	NO_2	0.500 g/m^3
Carbon monoxide	CO	0.150 g/m^3
Sulphur trioxide or H_2SO_4 mist	SO_3	0.100 g/m^3
Chlorine and chlorine compounds	HCI	0.050 g/m^3
Fluorine and fluorine compounds	HF	0.005 g/m^3
Organic compounds	C	0.030 g/m^3
Antimony, arsenic, cadmium, lead, mercury	Total as element or in compounds	0.010 g/m^3
Cadmium and compounds	Maximum concentrations of each as elements or compounds	0.003 g/m^3
Mercury and compunds	Maximum concentrations of each as elements or compounds	0.003 g/m^3
Dioxins and furans	Total toxic equivalents	0.100 ng/m^3

c) Fly ash and Incinerator Residue Disposal

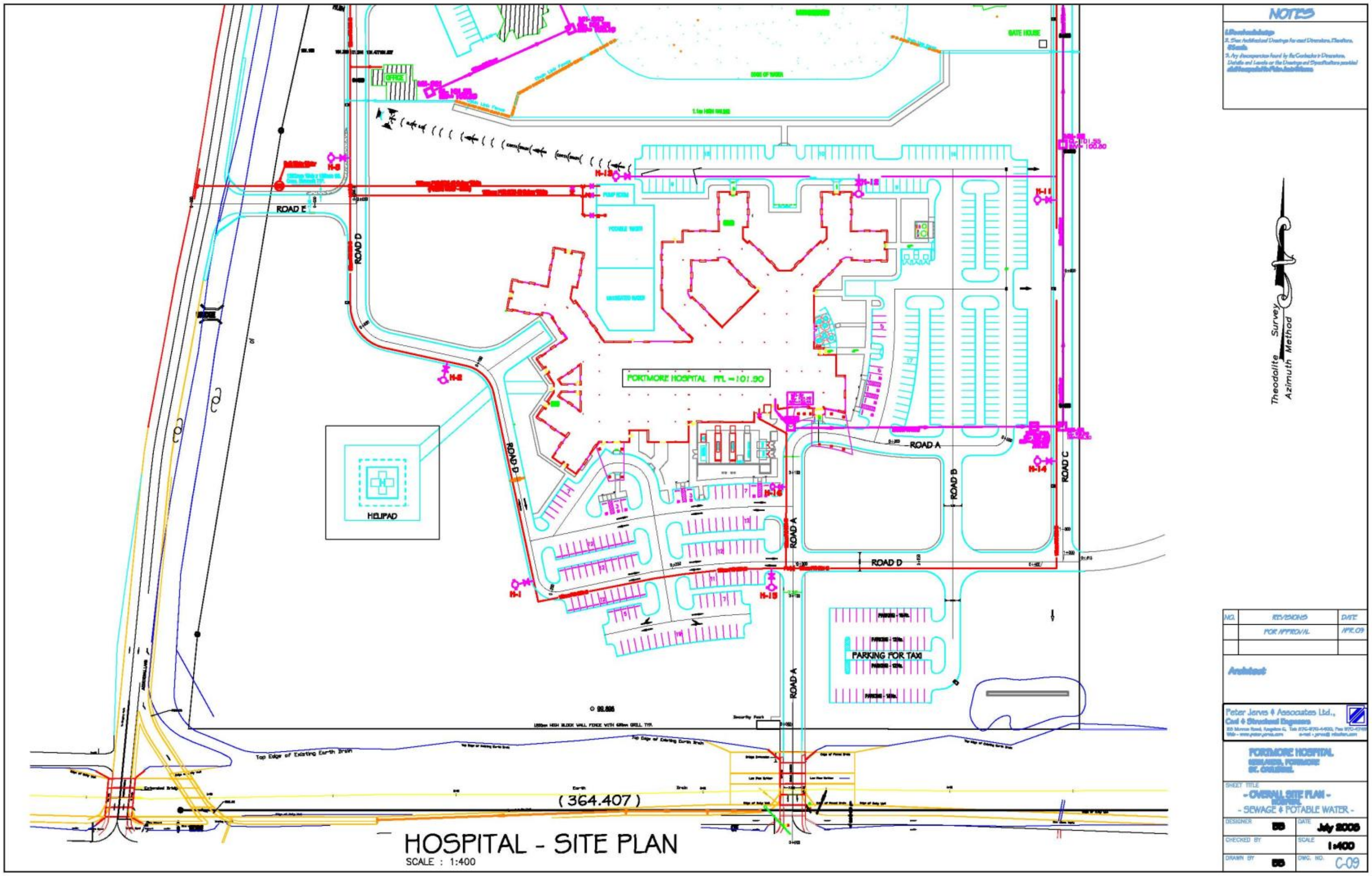
- Ash and particulate residue are to be disposed of at a landfill site licensed for the purpose under the Environmental Protection Act (WA) 1986. Prior to disposal, chemical analysis of the waste is required to ensure that the content of substances which are environmentally hazardous, including Hg, Cd and Pb, is maintained below an acceptable level.

- When analysing flyash the following must be assessed:
  Total PAH, benzo (A) pyrene, chlorine compounds expressed as HCl, chlorinated dibenzodioxins and chlorinated dibenzofurans, mutagenicity by Ames test.
- When analysing bottom ash the following must be assessed:
  Total PAH, leachable metal species (Cd,Co, Cr, Cu Hg, Ni Pb, Sn, Zn) by Toxicity Characteristic Leaching Procedure Method 1311 (EPA/SW - 846, 1986)
- Flyash and incinerator residues may be disposed of at a landfill as determined by the maximum leachable fraction (Refer to current Department of Environmental Protection *Landfill Waste Classification and Waste Definitions*).

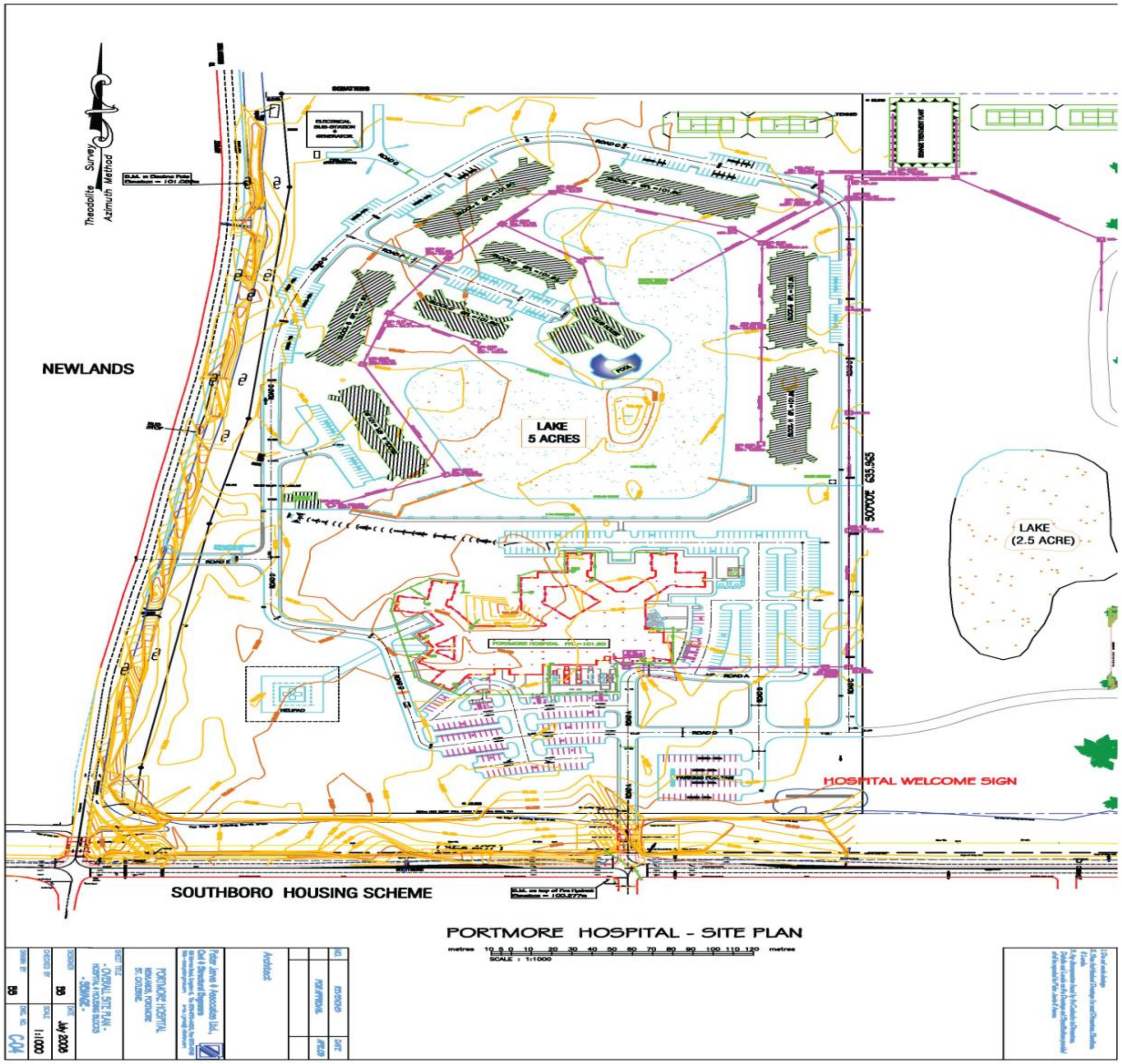
Annexure 4 – Hospital Site Plan



Annexure 5 – Site Plan: Potable Water



Annexure 6 – Site Plan: Sewage



Annexure 6 – Site Plan: Sewage