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Executive Summary

Introduction

This document presents the findings of an Environmental Impact Assessment of the proposed Ethanol Plant at Port Esquivel being proposed by Jamaica Broilers Group Ltd. in the parish of St. Catherine. Environmental Solutions Ltd. was contracted by Jamaica Broilers Group Ltd. to carry out the Environmental Impact Assessment, as part of the permitting requirements stipulated by the National Environment and Planning Agency (NEPA).

Proposed Development

The Jamaica Broilers Group Ltd. (JBG) proposes to construct and operate an Ethanol Dehydrating Plant adjacent to Port Esquivel in St. Catherine, on land purchased from Windalco. The proposed plant, a 60 million gallon per year facility, is based on the molecular sieve technology, which is the safest and most efficient alcohol dehydrating process available today. JBG has retained one of the largest and most experienced firms in the ethanol industry, DEDINI, to design and construct this facility. While less hazardous than a typical petrochemical refinery, the safety protocols to be adopted will parallel those in the petrochemical industry. The European Union and the USA safety standards for ethanol plants will be adopted in the operations.

Industrial alcohol containing at least 94.5% v/v alcohol will be used as the feedstock. This alcohol, is evaporated, in an Evaporator Column and then the vapours are superheated, passed through Adsorbent Beds and then through a Product Condenser where the vapours are condensed. The alcohol then passes into a Product Receiver where it is pumped into a Product Cooler where it is cooled before being sent for anhydrous alcohol storage.

Methodology

A multi-disciplinary team of experienced scientists and environmental professionals was assembled to carry out the required resource assessment, generation and analysis of baseline data, determination of potential impacts and recommendation of mitigation

measures. An iterative approach among the environmental team members and other project professionals was adopted. The EIA team worked very closely with the other project team members including the project manager, civil and sanitary engineers and architect.

The team utilized the Charette-style approach to data gathering, analysis, and presentation whereby team members conducted the reconnaissance investigations together to determine the critical elements for analysis and the issues to be highlighted for the design and planning process. Team meetings were held to discuss the progress of investigations and analyses and facilitate integration of data toward an understanding of the systems at work in both the natural and built environment.

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

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

Detailed methodologies for the physical, biological and socio-economic aspects of the baseline survey, including the marine environment, are presented in the report. Additionally, limitations to the study were identified.

Regulatory Framework

An application for an environmental permit was submitted to the National Environment and Planning Agency (NEPA). NEPA requested that an environmental impact assessment be done. Terms of Reference were prepared by Environmental Solutions Ltd., based on the NEPA generic terms of reference for Industrial Projects: Petroleum Production, Refinery, Storage and Stockpiling and submitted to NEPA for approval. NEPA responded with additional items to be included in the Terms of Reference and these were incorporated.

Several pieces of legislation were identified as being relevant to the project and included the Natural Resources Conservation Authority Act, the Endangered Species Act, the Natural Resources Conservation (Portland Bight Protected Area) Regulations, the Public Health Act, the Factories Act, and the Natural Resources conservation Authority (Air Quality) Regulations.

The Existing Environment

The site (N17° 53' W77° 07') is located immediately east of Windalco's Port Esquivel site (otherwise known as Longswharf) and accessed via the Windalco property. The site is bound by undeveloped lands to the north and east, and by the Caribbean Sea to the south. The site is for the most part undeveloped with only two small concrete dwellings on the property.

The proposed site is 25 acres of land located in the parish of St. Catherine, on the outskirts of Old Harbour. The site is also part of the Vere Plains Region and is within the boundary of the Portland Bight Protected Area, a protected area along the south coast of Jamaica rich in wildlife and natural resources. The footprint of the Ethanol Plant will occupy approximately 6 acres of the entire site. The project area is also part of 339 hectares of land zoned for Heavy Industries.

Existing industries in the general area include Windalco, Jamaica Public Service Company Power Plant, Jamalco and Hi Pro Feeds. The site is also close to the area proposed for the development of a Liquid Natural Gas (LNG) Plant.

Physical Environment

Monthly mean maximum temperature is likely to be similar to that encountered at Bodles ranging between 18°C in the cooler months to 34°C in warmer months.

The Meteorological Service 30-year long-term mean monthly rainfall (1951-1981) for Old Harbour, St. Catherine ranges between 41 – 213 mm. 24-hour rainfall data was obtained from the Old Harbour station over the 48 year period 1937-1985.

The site is located on the western side of the Port Esquivel Alumina Storage and Shipment Wharf in St. Catherine. The landscape is flat and generally featureless to the shore where it meets the Caribbean Sea. Elevation ranges from approximately 10-15 feet above sea level. The site is characterized by loamy soil and sandy soil, interspersed with gravel at some locations.

The soils map of St. Catherine obtained from the Ministry of Agriculture indicated that the site is underlain by artificially made ground. Anecdotal evidence suggests that the site is comprised of material recovered from offshore dredging activities, which may explain the "made ground" determination on the soils maps. The WRA classifies both the solid geology and the superficial Alluvium deposits as aquifers.

Hydrology and Drainage

The nearest, named surface watercourse to the site is the Bowers River, which lies approximately 1000m to the west. An intermittent watercourse (Bowers Bully) is located approximately 1500m east of the site and drains into the Caribbean Sea. Neither water courses impinge on the site, and therefore are not considered material to the site's contributing drainage system.

Given that the site is being developed near to lands that have been developed in the past, existing drainage controls have already been implemented as evidenced by the main site drain that borders the eastern boundary of the Windalco site. This drain is lined with masonry material comprising stone and cement and is trapezoid in shape. No upper contributory catchment could be easily defined for the site. It is likely that the main masonry drain effectively controls stormwater runoff from the lands north of the site. No over-topping of the drain has been reported. Therefore it is likely that run-off will be generated for the site footprint and no other up-gradient source.

The total storm runoff due to the site from a storm event with a 4% chance of occurring in any one year is approximately 1.4 m^3/s. This assumes no ponding or retention and flows directly into the Caribbean Sea. For post development storm runoff land use

determinations were interpreted from the site layout plan which shows the site with the tank farm to the north, and office and staff quarters to the south. Post-development the predicted runoff with a 4% chance of occurring in any given year is estimated to be 1.95 m^3/s, giving an increase of 0.5 m^3/s.

Marine Sediments

For this study, bottom sediment samples were collected from seven coastal sites in proximity to the proposed Jamaica Broilers Ethanol Plant project and analyzed for four metals: copper, iron, lead and manganese. Levels were are compared with the concentrations of these elements in unpolluted northeastern US soils. NEPA does not have any guidelines for the concentration of metals in sediments or soils. The results were also compared with the NEPA guidelines for metals in trade effluent. Onsite observations reveal that the sampling stations were all quite turbid. The coastal zone receives a considerable amount of runoff carrying high solids loading from the town via Bowers Gully resulting in the need to dredge the bay quite frequently. The concentrations of copper, iron and manganese significantly exceed the respective NRCA trade effluent guidelines at all sites except one.

Air Quality and Noise

The noise levels recorded at the stations monitored are currently above the NEPA guideline for perimeter noise. The site is being impacted by the industrial activities at Windalco as well as high winds and high wave action.

Respirable particulates levels were well within the recommended ambient air quality PM10 guidelines established by NEPA.

Natural Hazards

The WRA has no reports of any flooding incidents within 1km of the site. The low permeability of the upper soils, however, does occasionally cause shallow ponding after heavy precipitation. But this is not a material concern as the main plant will be located on concrete pads which will preclude any future ponding.

The WRA, with reference to the National Irrigation Development nt Master Plan, indicates that the site is vulnerable to storm surges (quantities not given) as they have occurred in the past.

The site is flat hence the potential of landslides will be non-existent.

Flood history was ascertained from discussions with Windalco as well as with data from ODPEM. Windalco reported no flooding incidents on the site.

Jamaica is susceptible to hurricanes and other storm events as indicated by the historic hurricane tracks. The rainy season is from May to October, with peaks in May and October, and tropical depressions, storms and hurricanes can occur any time during this period. These systems usually result in storm surge, which has been reported from this site.

Biological Environment

In general the project site is highly disturbed and influenced by the activities occurring at the neighboring Port. The site exhibited some natural zonation due mostly to the influence of the sea. The low canopy height and plant species diversity did not readily support a great diversity of other wildlife. The beach zone showed signs of significant disturbance but this may be related to recent hurricane activity although this damage was more obvious in the mature mangrove forest to the east of the site. The vegetation suggested that the site may have been cleared in the past and been re-colonised by many of the naturally occurring species along the beach but inland areas are dominated by a

few introduced or pioneer species. The high soil salinity and air would have prevented many other invasive species from occupying the site although it had been cleared.

The fauna observed on the site included native, endemic and migrant bird species, butterflies, reptiles, amphibians and mammals. No bats were observed. There were only thirty five bird species observed during the survey. Many of these species were detected from the neighboring wetlands to the east or along the beach. The Thorn Scrub which was the largest habitat type was the poorest in species diversity. The relatively low diversity is a reflection of the highly disturbed nature of the site.

Marine Environment

The benthic community at all inshore sites samples was similar, consisting of fine, silty, muddy sediment, and ranging from one to three (1–3) metres in depth. As a result, visibility was poor as the water was extremely turbid. Very small patches of sparsely growing seagrass were occasionally seen at one site, but other than that, the entire inshore area was devoid of seagrass. Very few variegated urchins (*Lytechinus variegatus*) were seen interspersed along the seafloor. The sediment samples lacked any sort of life as well, however, numerous polychaete mounds and holes were observed in the muddy substrate throughout the entire inshore area.

The offshore sites, located about 3 km from the shore, are characterized by shallow (1.5m), flat pavement covered by a thin layer of white, medium grain sand. Here exists extensive, healthy, seagrass meadows comprised solely of *Thalassia testudinum*, with interspersed benthic macroalgae. Mounds of dead coral heads overgrown by fleshy macroalgae, occurred sporadically amongst the seagrass bed, as well as patches of coral rubble. Fish life is comprised of juvenile reef fish, namely damselfish and parrotfish, while the benthic macroinvertebrate fauna consists of variegated urchins and sea stars.

Portland Bight Protected Area

This proposed development is located within the boundaries of the Portland Bight Protected Area (PBPA). The PBPA is a multi-use area with several environmental management goals as stated in its management plan (C-CAM 1999). It is Jamaica's largest protected area and has been in existence since April 1999. The responsibility for managing Jamaica's proposed system of protected areas belongs to the governments National Environment and Planning Agency (NEPA) and their policy is to delegate some of this responsibility to local non-government organizations. The Caribbean Coastal Area Management (C-CAM) Foundation has been delegated some management responsibilities within the PBPA since 2003.

American Crocodiles (*Crocodylus acutus*) were not observed during these surveys but are known to frequent the area and have been recorded on the beach during crocodile surveys (C-CAM unpublished data). The crocodile is a locally and globally threatened and protected species. The American Crocodile is the only species of special concern with respect to this development in the PBPA.

Socio-economic Environment

As a general characterization, settlement communities within the project zone have been experiencing population growth. Rhoden's Pen comprising 12 houses is at one extreme having remained at this size over the past several years. Old Harbour Bay and Cockpit appear to be growing slowly, whereas Bodles Junction and Bodles Crescent are both experiencing rapid growth as indicated by construction activity and attested to by residents and key informants. Longville Park housing estate built in 1991, is rapidly expanding its existing housing stock mainly through extensions to the original core units.

As a consequence of growing populations the communities collectively, are lagging behind in social infrastructure.

The main land use in the zone is settlement. Manufacturing, mining, and agriculture combined, also utilize significant acreage. The Project is bounded to the north by

Jamaica Dairy Farmers Federation. To the east it is bounded by marsh land and scrub. To the south is the sea and to the west by Windalco's port operations. The closest large human settlement is Cockpit, an unplanned community comprising about148 housing units and shops.

The Highway 2000 (H2K) Corridor Development Plan is a comprehensive document outlining proposed infrastructural development between Portmore and Clarendon Park. The Development Plan is phased with the implementation of the Highway 2000 project, to ensure that the areas contiguous to the highway are "recognized spatially, physically, socially, institutionally and economically, in a manner that is efficient, stimulating and sustainable". The proposed ethanol plant is within an area zoned for industrial development.

Public Health and Safety

A fire brigade station located in Old Harbour (Area 3) provides services to both Old Harbour and Old Harbour Bay and back-up services throughout the parish as required. It has one unit which carries a limited supply of water, there being no water tender unit assigned to the station. The practical consequence of this is that in the event of a serious fire at the plant, the equipment and manpower capacity of the Old Harbour fire station would be totally inadequate to respond effectively. This, both in terms of number of units and the specialized equipment and training requirements for fighting chemical fires.

Plant personnel will be thoroughly trained in firefighting techniques specific to the plant. During this training process, the Old Harbour fire fighters will be invited to participate. Ongoing plant safety is therefore an important component of the operations. Fire detention and fire suppression systems will be installed in various areas of the plant.

Public health facilities available to Old Harbour and Old Harbour Bay comprise a single Type 3 clinic located in Old Harbour. A Type 3 clinic carries the full compliment of services offered by this category of facility and provides a medical doctor and a dentist and dental nurse daily. Four satellite clinics also serve the Old Harbour region. The

nearest hospitals serving the Project are in May and Spanish Town. Old Harbour is served by approximately 12 private medical practionners.

In any worse case scenario involving a plant catastrophe, Ministry of Health disaster contingency planning provides for involvement of the countries four regional hospitals with additional medical facilitation if necessary in Cuba and the United States.

National disaster management planning also envisages medical evacuations being facilitated by the Jamaica Defense Force. First aid stations will be strategically located throughout the facility. The Red Cross will be consulted to provide CPR training for all staff members.

Potential Impacts and Mitigation Measures

Community Concerns

A rapid appraisal approach was used to canvass opinions about the project. Structured, semi structured and unstructured interviews were conducted with targeted and non targeted individuals. There were no outright objections to the establishment of the project. As is normally the case with proposed projects, community members welcomed the implied economic benefits associated with a new plant.

Some of the issues raised by the communities interviewed were:

- **Effluent discharge and its potential impact on fisheries**

  The effluent will be treated and the process waste and domestic waste will meet NEPA effluent discharge standards. No additional biological or chemical loading is expected on the coastal waters.

- **Odour**

  Existing ethanol plants in Kingston do sometimes relese odours. The technology for the proposed Jamaica Broilers plant will utilize alcohol as the feedstock, not sugar cane or other biological matter, and therefore the fermentation process, which causes odours will not be required. Additionally, the plant operations will include closed systems to minimize evaporation of the alcohol. Odours in the air will indicate evaporation of product which will represent a financial loss.

- **Flooding**

No flooding has been reported on the site.

- **Heritage**

  No heritage issues have been identified on the project site.

Issues Identified

Several issues have been identified for the proposed Ethanol Plant that must be taken into consideration at the design, construction and operation phases. These issues have been explored in light of the potential impacts of the project on the existing environment. It should be noted that some of the potential impacts that have been raised by the public during the consultation process have already been mitigated by the engineering design of the project and the type of technology being used.

The main issues that have been identified are:

Air Quality:	Construction phase dust and Operation phase emissions. Mitigation measures are presented to minimize dust during the construction phase including wetting and covering of stockpiles of earth materials. Air emissions will include volatile organic carbons, particulates, sulphur oxides and nitrous oxides from stack emission. Effective product management and materials handling will be required to minimize volatile emissions, which represent a loss of product. Manufacturer's specifications for all equipment should meet the National Ambient Air Quality Standards for emissions.
Coastal Water Quality:	Terrestrial run-off, trade/sewage effluent disposal, Increased BOD and COD. The treatment systems recommended for both process waste and domestic waste are lined stabilization ponds or a recirculation enhanced stabilization pond system. Both will produce effluent parameters within the NEPA guidelines. There should be no additional nutrient loading on coastal waters.
Coastal Dynamics:	Storm surge. Storm surge has been reported on the site. Mitigation measures include adequate setback of the plant and associated facilities. This setback will be more than the required 30m.

Ecology:	Loss of habitat. Although there will be modification of the existing terrestrial habitat, resulting in loss of some habitat area, the species located on the site are mostly ubiquitous and will easily relocate to adjacent areas.
Parks and Protected Areas:	Species of special interest. The American Crocodile, protected by law, has been reported from the site. The main mitigation measure to protect both the crocodiles and the workers is perimeter fencing around the entire development.
Solid Waste Management:	Removal of vegetative matter, removal of domestic waste and construction waste to an approved disposal site. Solid waste during the construction and operation phase will be removed by an approved contractor.
Liquid Waste Management:	Approval and licensing of Wastewater Treatment Plant. The design of the WWTP will produce effluent parameters within the NEPA guidelines. The WWTP will require its own permit for construction and license for effluent discharge.
Natural Hazards:	Storm surge, flooding. No flooding has been reported on the site. Mitigation measures to minimize impact from storm surge include substantial setback from the coastline.

Technological Hazards

Pubic Health and Safety:	Fires, Explosions, Accidents. Process Safety Management has been included in the project design. All areas of the plant's operations including the Storage Tank Farm, the Dehydrating Plant, the Boiler House, the Boiler Fuel and Water Tank Yard, the Electrical Switchgear Room, and Import/Export Facilities have included safety and response measures. These include the installation of fire detection and fire suppression systems, emergency shut-off valves, high pressure high velocity foam/water nozzles, quick action lock-off valves, portable fire fighting units, lagging, lined berms

(as appropriate) and spill/overflow capacities. Staff training, refresher training and audits are also included in the plant procedures.

Livelihoods: Fisheries. Fisheries are not expected to be negatively impacted by the plant's operations.

Consideration of Alternatives

Alternatives considered included the Salt River area as a potential site and options for wastewater treatment. The present project site provided a more feasible option due to the availability of a pier.

Outline Monitoring Programme

If a permit is granted for the proposed development, and before site preparation and construction activities begin, a Monitoring Programme should be prepared for submission to NEPA, for their approval. The Monitoring Programme should include several components, including an inspection protocol; parameters to be monitored; frequency of monitoring and reporting procedures. The duration of the monitoring programme should be for the entire construction period, with monthly reporting. The Monitoring Programme cannot be prepared in detail before the permit is received from NEPA as Terms and Conditions of the permit must be taken into consideration, and included in the monitoring programme as appropriate.

Operation phase monitoring should include materials handling, transport and storage; worker health and safety; wastewater treatment effluent discharge; and air quality and emissions monitoring.

****

1.0 Introduction

This document presents the findings of an Environmental Impact Assessment of the proposed Ethanol Plant to be developed by Jamaica Broilers Group Ltd., at Port Esquivel in St. Catherine. Environmental Solutions Ltd. was contracted by Jamaica Broilers Group Ltd. to carry out the Environmental Impact Assessment (EIA) as part of the permitting requirements stipulated by the regulatory agency, the National Environment and Planning Agency (NEPA).

1.1 Purpose

Jamaica Broilers Group Ltd. submitted an application for a development permit to the National Environment and Planning Agency (NEPA) on April 3, 2006. The application was accompanied by a Project Information Form (PIF) and supporting documentation. On April 3, 2006 NEPA responded to that application with a request that an Environmental Impact Assessment (EIA) be conducted on the proposed development, based on their review of the permit application (Appendix I). NEPA supplied Generic Terms of Reference for Industrial Projects: Petroleum Production, Refinery, Storage and Stockpiling and requested modification of these Terms of Reference to be specific to the project. The modified Terms of Reference were submitted to NEPA for their approval on October 4, 2006 and a response was received from them on October 11, 2006.

The approved TOR's are given in Section 2.0, and the complete document as re-submitted to NEPA is presented in Appendix II.

1.2 Description of the Project

1.2.1 Project Overview

The Jamaica Broilers Group Ltd. (JBG) proposes to construct and operate an Ethanol Dehydrating Plant at Port Esquivel in St. Catherine, on land purchased from and adjacent to Windalco (Figure 1.2.1 a and Plate 1.2.1). The proposed plant, a 60 million gallon per year facility, is based on the molecular sieve technology, which is the safest and most efficient alcohol dehydrating process available today.

JBG has retained one of the largest and most experienced firms in the ethanol industry, DEDINI, to design and construct this facility. “No cost is being spared to obtain the best and latest technology available in the design and construction of this plant” (JBG).

While less hazardous than a typical petrochemical refinery, the safety protocols to be adopted will parallel those in the petrochemical industry. The European Union and the USA safety standards for ethanol plants will be adopted in the operations.

Industrial Alcohol containing at least 94.5% v/v alcohol is pumped from the rectified spirit (RS) collection tank to the dehydration section. The RS is preheated and then fed to the top tray of the Evaporator Column. The vapours produced are then passed through the Superheater where they are superheated. The superheated hydrous alcohol vapours are then sent to twin Adsorbent Beds for moisture to be absorbed. The product alcohol vapours are then passed through the Regeneration Preheater and Feed Preheater for heat recovery and then passed through the Product Condenser for condensation. The Product alcohol will eventually be sent for anhydrous alcohol storage.

Engineering details of the proposed plant and project concept are given in Appendix III and the proposed layout of the plant in Figure 1.2.1 b.

Figure 1.2.1 a: Site Location of Proposed Ethanol Plant

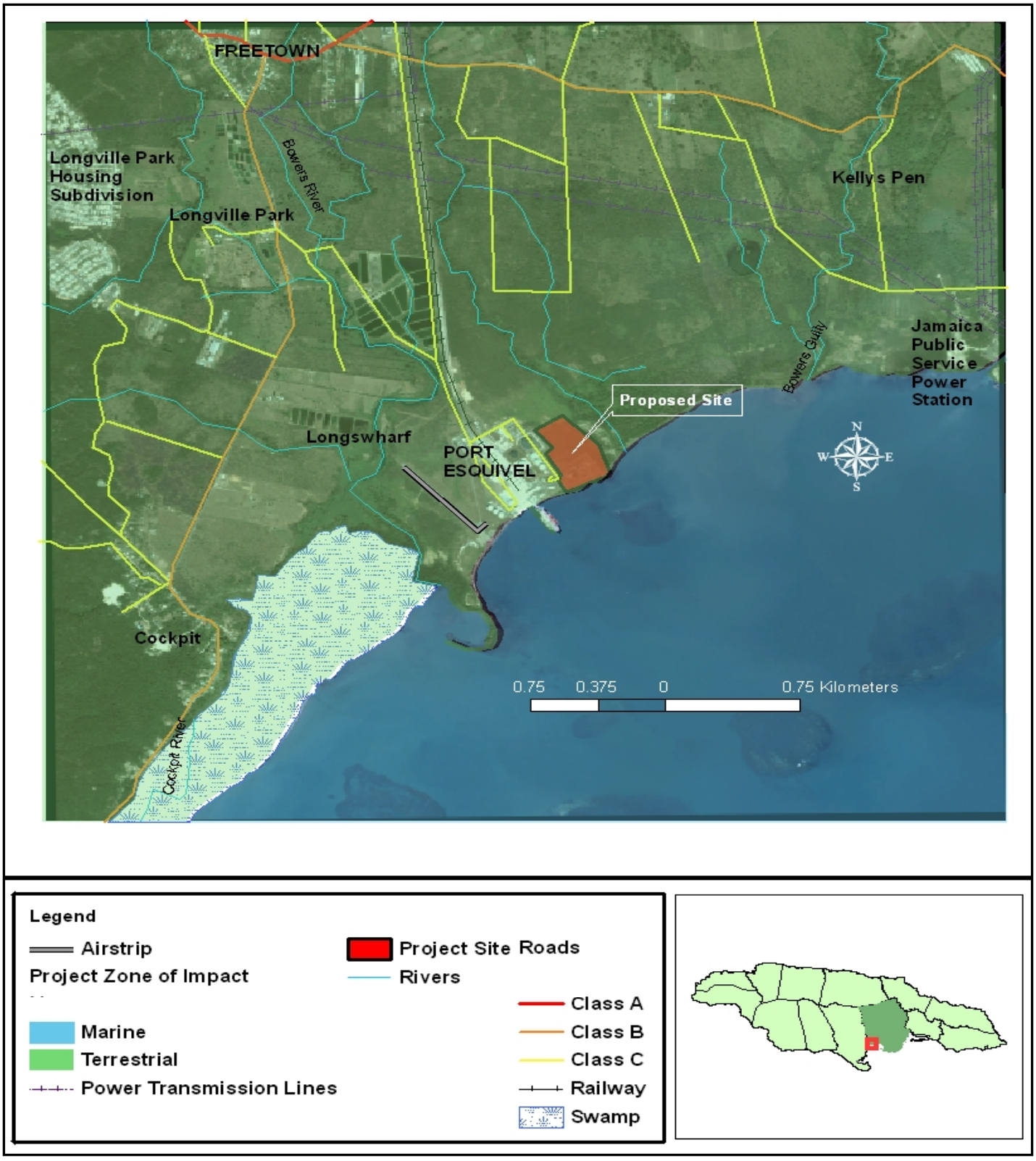
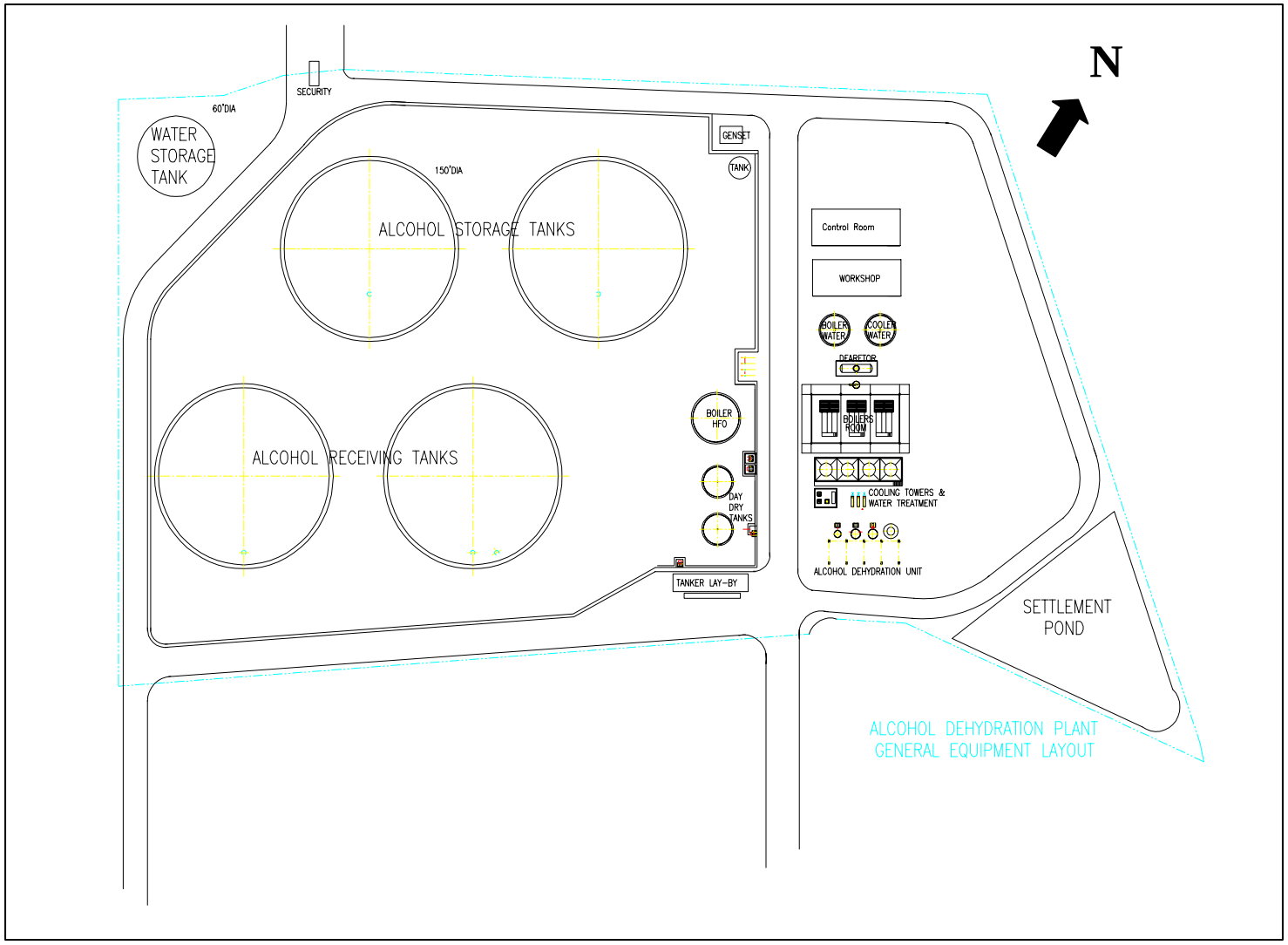


Plate 1.2.1: Aerial of Project Site showing Proximity to Windalco Operations at Port Esquivel

Figure 1.2.1 b: Proposed Layout of the Ethanol Plant



1.2.2 The Product

The feedstock to be utilized is hydrous alcohol, which will be imported and processed at the proposed ethanol plant. The final product is pure ethanol (99.99%) which will be primarily for the export market.

Ethanol is a pure alcohol similar to that contained in beers or vodka. It is a colorless liquid and though flammable, less so than gasoline. While foam rapidly removes all oxygen during a fire, water is used as a fire suppressant for ethanol. Water in effect dilutes the ethanol and as such erodes its flammability and flash point.

1.2.3 Degradation of Ethanol

Tests have shown that ethanol rapidly degrades aerobically in soil within 7 days (Corseuil et al., 1998).

1.2.4 Methods for Cleaning up Ethanol

Should ethanol spill, dry lime, sand or soda ash may be used to cover the spilled product. The area may then be washed down with water thereafter.

1.2.5 The Proposed Plant

The project is to be constructed on a 10-acre site and will consist of five primary functional areas.

1.2.5.1 The Storage Tank Farm

The tank farm will be located to the north western section of the site, with the eastern berm wall being some 100 meters east of the property line. The tank farm will be located beside Windalco's existing tank farms. There will be four 3.5 million gallon tanks: two will store hydrous feedstock, and the other two processed ethanol. The feedstock and the purified product will be conveyed via pipes to and from the tank farm. The tanks are vented via an integral flame and vapor arrestor vent cap.

Safety Measures Proposed for the Tank Farm

The tanks will be enveloped with a lined clay and marl berm. Based on European Union and USA industry standards along with local regulations, the bermed area will have a capacity of 125% of the largest tank. Any spillage will be contained by this berm. Quick Action shut-off valves will be strategically installed on alcohol supply and return lines to the tank farm.

The tank farm will be protected by a 3,000 gallon foam proportioning fire fighting system and a 5,000 gallon per minute diesel and electric driven fire water system. There will be ten 500 gallons per minute high pressure fire fighting stations around the perimeter of the tank farm. Each tank will have three high volume foam suppressor heads strategically located around the circumference of each tank.

1.2.5.2 The Dehydrating Plant

The dehydrating plant is the central processing center, which will be located 300 meters east of the property line with the adjacent neighbor, Windalco. All ethanol processing takes place in this area.

The process is a series of heating and cooling of the feedstock at various temperatures and pressures, the objective being to remove all impurities and water from the hydrous feedstock. The process is a relatively quiet process with only steam flow and water flow generating noise.

Safety Measures Proposed for the Dehydrating Plant

High pressure and temperature steam is employed in this area. The pressure vessels are welded stainless steel units rated at multiples of the operating pressures and temperatures. All pipes and vessels will be lagged with mineral wool then covered with polished aluminum sheeting. This serves to minimize heat loss in the pipes conveying the various fluids while simultaneously protecting personnel from burn injury.

The pressure vessels are equipped with relief valves to limit pressures to safe levels. Quick action alcohol shut-off valves will be strategically installed on alcohol feed and return lines.

Fire detection and fire suppression systems are an integral part of the dehydrating plant. In addition, there will be high pressure, high velocity fire fighting nozzles strategically located external to the plant. Additionally, dry chemical hand held and wheeled fire fighting portable units will also be strategically placed throughout the facility.

1.2.5.3 Boiler House

The boiler house serves as the main energy center for the facility and will contain 3 – 30K PPH 250 psi Cleaver Brooks high efficiency boilers. The condensate receiver and de-aeration tanks along with all controls will be integrally located here. The boiler house will be located approximately 30 meters north of the dehydrating facility and 300 meters east of the Windalco property line.

Safety Measures Proposed for the Boiler House

Fire detection and fire suppression systems will be installed throughout the boiler house. High pressure, high velocity foam/water hose nozzles will be located external to the boiler house.

Emergency fuel, feed-water and steam shut-off valves are an integral part of the design and will serve as another safety backstop in the event of an emergency.

1.2.5.4 Boiler Fuel (Bunker C) and Water Tank Yard

This area is located 10 meters east of the Windalco property line. 170, 000 gallons of Bunker C fuel will be stored at site. The yard will be bermed and have capacity exceeding the standard 125% of the largest fuel tank.

Cooling tower and boiler feed water totaling 170,000 gallons will also be stored in this area.

Safety Measures Proposed for the Boiler Fuel and Water Tank Yard

Fire detection and fire suppression systems will be strategically installed throughout this area. High pressure, high velocity foam/water hose nozzles will be located external to this area.

Emergency fuel shut-off valves are an integral part of the design and will serve as another safety backstop in the event of an emergency.

1.2.5.5 Power Building

The proposed ethanol plant will consume only nominal power. The power supply will require 24kV, 3-phase, and will be supplied by JPSCo. to be reduced via transformers to 440 Volts 3-phase for plant consumption. A back-up generator with 100% capacity will be a part of the design.

The building will be located 300 meters east of the Windalco property line, along the north eastern section of the property.

Safety Measures Proposed for the Power Building

Fire detection and fire suppression systems will be strategically installed throughout this area. A dry chemical system will serve as the suppression system in this building.

1.2.5.6 Import/Export Facilities

Feedstock and pure ethanol will be conveyed to and from ships via pipelines to the Windalco dock. The proposed size of the supply and return pipes are 14 inches in diameter and the pipes will be carbon steel. These lines contain product and are pressurized during the on-loading and off-loading process only. The two lines will traverse the property above ground. The routing of the pipelines is given in Appendix III.

Safety Measures Proposed for Import/Export

High pressure, high velocity foam/water hose nozzles will be located in this area. No loading or offloading of ethanol will be conducted without the presence of trained fire marshals.

Emergency fuel shut-off valves are an integral part of the design and will serve as another safety backstop in the event of an emergency.

As the dock will be jointly used by Windalco and Jamaica Broilers, a coordinated effort will be

made to establish protocols and training for both companies' personnel in dock usage and fire fighting techniques as it relates to ethanol handling.

1.2.6 Process Safety Management

A written safety plan will be developed for the facility using 29 CFR 1910.119 and established safety procedures for the ethanol industry as guideline.

1.2.6.1 Employee Involvement

Employees will be intimately involved with the development of the process hazard analysis and on the development of other elements of process safety management required. Access to this data and all other pertinent information will be made readily available to all employees and onsite contractors.

1.2.6.2 Process Hazard Analysis

Process safety analyses will be a continuous process, will be revalidated every two years, and be retained for the life of the process.

1.2.6.3 Operating Procedure

Clear written operating procedures for safely conducting activities within the plant will be developed. This includes steps for each operating phase, operating limits, safety and health considerations and safety systems and their functions. This document will be readily accessible to employees who work on or maintain a covered process, and will be reviewed as often as necessary to assure they reflect current operating practice. Safe work practice will be implemented and will provide for special circumstances such as lockout/ tagout and confined space entry and training limits.

1.2.6.4 Employees

Employees will be trained in the overview of the process and in the operating procedures addressed previously. This training will emphasize specific safety and health hazards, emergency operations and safe work practices.

Employee initial training will occur before assignment. Documented 3-year refresher training will be a requirement.

1.2.6.5 Contractor

Each contractor onsite will be required to comply with the established safety standards of the facility before they are permitted to do any work. Contract employers are required to train their employees to safely perform their jobs, and document that employees received and understood training, and assure that contract employees know about potential process hazards and the work site employer's emergency action plan. Similarly to assure that employees follow safety rules of the facility, and advise the work site employer of hazards contract work itself poses or hazards identified by contract employees.

1.2.6.6 Pre-Start-up Safety Review

A mandatory safety review of the facility to confirm that the construction and equipment of the process are in accordance with design specifications; to assure that adequate safety, operating, maintenance and emergency procedures are in place; and to assure process operator training has been completed.

1.2.6.7 Mechanical Integrity

Written procedures will be developed for the ongoing integrity of process equipment particularly those components which contain and control the dehydrating plant and tank farm.

1.2.6.8 Management of Change

Written procedures to manage changes to the facility will be established. All employees will be trained to the new procedure standards re all changes. Process safety information and operating procedures will be updated as necessary.

1.2.6.9 Incident Investigation

All incidents and accidents will be investigated as soon as possible (but no later than 48 hours after) for incidents which did result or could reasonably have resulted in severe injury, death or spillage of fuel or ethanol. An investigation team, including at least one person knowledgeable

in the process involved, and a contract employee when the incident involved contract work and others with knowledge and experience to investigate and analyze the incident. A written report on the incident will be compiled and retained for five years.

1.2.6.10 Emergency Planning and Response

An emergency action plan that includes the procedures for handling leaks and spillage will be developed.

1.2.6.11 Compliance Audit

Compliance audits of the process safety will be conducted every two years. Prompt response to audit findings and documentation that deficiencies are corrected will be a requirement. The two most recent audits will be retained for 5 years.

1.2.7 Wastewater Treatment

A sewage treatment plant has been designed for construction and will produce tertiary treated effluent that will meet NEPA effluent discharge standards. The sewage treatment plant will handle both domestic and process waste streams (Fluid Systems, 2006, Appendix IV).

Based on the outcome of a treatment matrix analysis and the general discussion, the following options for sewage treatment for the proposed Jamaica Broilers Ethanol Processing Plant have been reviewed.

1. Stabilization Ponds lined (AFM), if a suitable site adjacent to the development area can be found. Land area required 0.3 ha.

2. Recirculation enhanced stabilization pond system (AFM^{3}r) with appropriate lining, if a suitable site adjacent to the development area can be found. Land area required 0.22 ha.

Both options will produce effluent parameters that are within the NEPA Effluent Discharge Guidelines.

1.2.8 Drainage

All of the perimeter roads are designed to drain towards the outside of the property by earth drains. The northern and eastern drains will flow towards a gully in the south of the property, whereas the southern and western drains will flow towards an existing open channel drain on Windalco's property. There are earthen drains on either side of the access road and the drain on the western side of the road flows into a concrete drain. The layout of the roads is given in Appendix V (Wallace Evans Consulting Engineers Ltd.).

The tank farm is enclosed within earthen bunds and drainage will be controlled by lock off valves. The two fuel oil tanks TKFU501 and TKFU502 will be enclosed within concrete bunds. They will have individual lock off valves.

1.2.9 Site Office, Construction Yard and Materials Sourcing

The site office and construction yard will be located to the south of the footprint of the plant within the property boundary. This area will be used for off-loading and storage of plant components and assembly as required. The site office and construction yard will occupy approximately 1 acre of the property. During the construction phase a work force of approximately 100 labourers will be required, and will include skilled and unskilled workers. Supervision will be provided by overseas and local engineers.

The ethanol plant construction site will not require the establishment of a batching plant as the volumes of cement required will not warrant this. Approximately 20,000 cubic yards of cement will be required. This will be provided by Islandwide Co. Concrete Ltd., 9c Retirement Crescent, Kingston 5. DEDINI, the supplier will bring in plant components for assembly.

1.2.10 Timing and Duration of Construction Phases

The pre-construction phase in particular, road construction, started in September 2006 and is expected to be completed in October 2006. Permission for this access road was granted by NEPA (Appendix I and XVII). Other pre-construction activities such as foundations are expected to take three to four months after permit approval is received. The construction phase

is largely based on assembly of plant components and is scheduled to take four months after pre-constriction activities are completed. Post construction and operation phase is based on a plant design of 25 years.

2.0 Terms of Reference

In this section the Terms of Reference for the EIA are presented along with an indication of the project specific considerations that apply. The Terms of Reference for the EIA are based on the NRCA EIA Guidelines and the Generic Terms of Reference for Industrial Projects: Petroleum Production, Refinery, Storage and Stockpiling, as provided by NEPA. They have been modified to reflect the specific aspects of the project and issues of the site, including those raised by NEPA.

The Terms of Reference for conducting the EIA have been approved by NEPA, after their review and input. These TOR's are given below:

Sites of special consideration applicable to the proposed development include:

Coastal Areas: Issues such as coastline stability, potential direct impacts to coral reef, mangrove and wetland, seagrass systems, unique coastal environments, nutrient loading and the sedimentation of coastal waters and consequent impact on coastal commercial fishing should be examined. The handling of raw materials, waste and wastewaters and their impact on coastal waters should be closely examined as well.

Freshwater/ Riverine/ Wetland Areas: Important Issues include the possibility of leachate being introduced to the water column, erosion and siltation, nutrient loading, and macro-invertebrate habitat destruction. The possible increase in mortality rate of overall aquatic life due to improper waste handling should be considered.

Sites located within and adjacent to areas listed as protected or having protected species: The main issue(s) of concern are determined by the statutes of the convention in question and what the convention speaks to. The site is located within the Portland Bight Protected and as such any impact of the development on the specific sensitivities of the protected area will be

considered. Mitigation of impacts should assess if the post mitigation status would be acceptable in the protected area context.

The socio – economic aspects of the development will be highlighted as the type and location of processing facilities frequently have an impact on property values and on communities' perceptions of a healthy environment.

Special consideration will be given to the risk factors associated with fires, oil spills and spills of hazardous materials. Management of oil spills and their immediate and long term impacts on the environment will be considered.

Terms of Reference

The Environmental Impact Assessment will:

1) Provide a comprehensive description of the existing site proposed for project implementation. Detail the elements of the project, highlighting areas to be modified and the areas which are to be preserved in their existing state.
2) Identify the major environmental issues of concern through the presentation of baseline data which should include social and cultural considerations. Assess public perception of the proposed development.
3) Outline the Legislation and Regulations relevant to the project.
4) Predict the likely impacts of the development on the described environment, including direct, indirect and cumulative impacts, and indicate their relative importance to the design of the development's facilities.
5) Identify mitigation measures to be taken to minimise adverse impacts and quantify associated costs.
6) Design a Monitoring Plan which should ensure that the mitigation plan is adhered to.
7) Describe the alternatives to the project that could be considered at that site

To ensure that a thorough Environmental Impact Assessment is carried out, it is expected that the following tasks be undertaken:

Task #1- Description of the Project

Provide a comprehensive description of the project, noting areas proposed for refining operations and waste management. Detail the elements of the project, highlighting areas to be reserved for construction, areas for raw materials and product storage, areas to be preserved in their existing state as well as activities and features which will introduce risks or generate impact (negative and positive) on the environment. This should involve the use of maps, site plans, aerial photographs and other graphic aids and images, as appropriate, and include information on location, general layout and size, timing and duration as well as pre-construction, construction, and post construction plans. A description of the processes to be utilized in the production of the ethanol will be given. If the project will be done on a phased basis all phases will be clearly defined, the relevant time schedules provided and phased maps, diagrams and appropriate visual aids will be included.

Task #2- Description of the Environment

Baseline data will be generated to describe the existing site and study area as follows:

i) physical environment
ii) biological environment
iii) socio-economic and cultural environment

Methodologies employed to obtain baseline and other data will be clearly detailed.

Baseline data should include:

(A) Physical

i) A detailed description of the existing **geology** and **hydrology.** Special emphasis should be placed on storm water run-off, drainage patterns, effect on groundwater and availability of potable water. Depth to ground water and subsurface flow regime will be discussed. Any slope stability issues that could arise should be thoroughly explored.

ii) **Water quality** of any existing wells, rivers, ponds, streams or coastal waters in the vicinity of project activities. Quality Indicators should include but not necessarily be limited to nitrates, phosphates, faecal

coliform, oil and grease, and suspended solids. Historical data will be referred to where appropriate and current data will be generated in order to establish baseline conditions.

iii) **Climatic conditions and air quality** in the area of influence, including particulate emissions from stationary or mobile sources, NO_x, SO_x, wind speed and direction, precipitation, relative humidity and ambient temperatures,

iv) **Noise** levels of the undeveloped site and the ambient noise in the area of influence, including influences from neighbouring and adjacent facilities.

v) Obvious sources of existing pollution and extent of contamination.

vi) Availability of solid waste and wastewater management facilities.

(B) Biological

Present a detailed description of the flora and fauna (terrestrial and aquatic) of the area, with special emphasis on rare, endemic, protected or endangered species. Migratory species should also be considered. Species dependence, niche specificity, community structure, species richness, and biodiversity will be discussed.

(C) Socio-economic & cultural

Present and projected population; present and proposed land use; planned development activities, community structure, employment, distribution of income, goods and services; recreation; public health and safety; cultural peculiarities, aspirations and attitudes should be explored. The historical importance of the area should also be examined. Infrastructure and utilities will be assessed including the existing road network, water supply and electricity. While this analysis is being conducted, an assessment of public perception of the proposed development will be conducted. This assessment may vary with community structure and may take multiple forms such as public meetings or questionnaires. A consultation will be held with the medical officer

(Health) St. Catherine Health Department to apprise him of the proposed development, to discuss the public health implications of the development and to identify strategies for protecting public health.

Task #3 - Legislative and Regulatory Considerations

Outline the pertinent regulations, policies 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 legislative and regulatory instruments should include at minimum, legislation such as the NRCA Act, the Wild Life Protection Act, Watershed Protection Act, the Public Health Act, the Clean Air Act, the Town and Country Planning Act, the Petroleum Act, the National Solid Waste Management Authority Act the St. Catherine Coast Development Order, the South Coast Sustainable Development Master Plan and the appropriate international conventions/protocols/treaties where applicable. The National Energy Policy will also be considered.

Task #4 - Identification of Potential Impacts

Identify the potential impacts of the proposed development on environmental and public health issues and indicate their relative importance to the design of the project and the intended activities. A description will be given of the types and characteristics of input chemicals, their byproducts and other chemicals and the impact on public health and the environment.

Potential impacts will be identified for the construction and operation phases, as they relate to, (but are not restricted by) the following:

- change in drainage pattern
- flooding potential
- landscape impacts of excavation and construction
- loss of natural features, habitats, niches and species
- pollution of surface and ground water
- air pollution
- socio-economic and cultural impacts.

- risk assessment
- noise
- change in soil pH
- possible improper or accidental waste disposal via discharge into drainage lines, sewers and water bodies
- capacity and design parameters of waste treatment facilities
- proper disposal/treatment of potentially hazardous compounds
- handling and storage of raw materials and product
- solid waste management
- liquid waste management
- traffic
- infrastructure

Distinguish between significant positive and negative impacts, direct and indirect, long term and immediate impacts. Identify avoidable as well as irreversible impacts, and cumulative impacts, including the cumulative impact of gaseous discharge on air quality within the area of influence. Characterize the extent and quality of the available data, explaining significant information deficiencies and any uncertainties associated with the prediction of impacts.

The impact of the development on health, including the potential public health risks associated with the development, and the potential long-term impact on community health status will be discussed and mitigation measures presented. A risk assessment will be presented to include fires and explosions, and plant safety will be discussed in the context of an accident analysis. Coastal impacts will be discussed and include the potential for storm surge, pollution of the marine environment, and spill management (as it affects the terrestrial and marine environment).

Task #5- Mitigation

Prepare guidelines for mitigating, as far as possible, any adverse impacts due to proposed usage of the site and utilising existing environmental attributes for optimum development where practical and feasible. Mitigation methods will include response mechanisms to ensure that potential spills are quickly cleaned up and ensure limited introduction of ethanol to the

environment in the case of spills, and site remediation in the case of spills, if required. Reference will be made to potential spills or accidents during the transportation stage. Recommendation will be made for the preparation of a Fire Management Plan to be submitted to NEPA before the operational phase of the project. Quantify and assign financial and economic values to mitigation methods where appropriate.

Task #6 - Monitoring

Design a plan to monitor the implementation of mitigation or compensatory measures and project impacts during construction and operation. An Outline Environmental Management Plan for the long term operations of the site should also be prepared, and should include monitoring for leak detection and response.

Air shed monitoring may be required to predict air quality where emissions of significant quantities of air pollutants are anticipated. This will be guided by the NRCA draft air quality regulations.

An Outline Monitoring Programme will be included in the EIA, and a detailed version 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 should include:

- Introduction outlining the need for a monitoring programme and the relevant specific provisions of the permit license(s) granted.
- The activity being monitored and the parameters chosen to effectively carry out the exercise.
- The methodology to be employed and the frequency of monitoring.
- 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.
- Frequency of reporting to NEPA

The Monitoring report should also include, at a minimum:

- Raw data collected. Tables and graphs are to be used where appropriate

- Discussion of results with respect to the development in progress, highlighting any parameter(s) which exceeds the expected standard(s).
- Recommendations
- Appendices of data and photographs if necessary.

Task #7 - Project Alternatives

Examine alternatives to the project including the no-action alternative. This examination of project alternatives should incorporate the use history of the overall area in which the site is located and previous uses of the site itself.

All Findings will be presented in the **EIA report** and will reflect the headings in the body of the TORs, as well as references. Eight hard copies and an electronic copy of the report should be submitted. The report should include an appendix with items such as maps, site plans, the study team, photographs, and other relevant information.

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3.0 Legislation and Regulatory Considerations

This section presents the legislation and regulations pertinent to the proposed Ethanol Plant. Comments are made where they are felt to be helpful in relating the project to the existing regulations, policies and legislation.

3.1 National Legislation – Natural Environment

3.1.1 Natural Resources Conservation Authority Act (1991)

The Natural Resources Conservation Authority Act was passed in the Jamaican Parliament in 1991 and provided the basis for the establishment of the Natural Resources Conservation Authority (NRCA) with primary responsibility for ensuring sustainable development in Jamaica through the protection and management of Jamaica's natural resources and control of pollution. Sections 9 and 10 of the NRCA Act stipulate that an Environmental Impact Assessment (EIA) is required for new projects and existing projects undergoing expansion.

The body is also responsible for investigating the effect on the environment of any activity that may cause pollution or which involves waste management. Sections of the Act that relate specifically to pollution control state that:

(i) No person shall discharge on or cause or permit the entry into waters, on the ground or into the ground, of any sewage or trade effluent or any poisonous noxious or polluting matter.

(ii) No person is allowed to construct or reconstruct or alter any works designed for the discharge of any effluent.

The Act also empowers the authority to require of any owner or operator of a pollution control facility information on the performance of the facility, the quantity and condition of effluent discharged and the area affected by the discharge of such effluent.

The Authority has the right to consult with any agency or department of Government having functions in relation to water or water resources to carry out operations to:

(a) Prevent pollutants from reaching water bodies.

(b) Remove and dispose of any polluting matter or remedy or mitigate any polluted water body in order to restore it.

3.1.2 Environmental Review and Permitting Process (1997)

The Environmental Permit and License System (P&L), introduced in 1997, is a mechanism to ensure that all developments in Jamaica meet required standards in order to minimize negative environmental impacts. The P&L System is administered by NEPA, through the Applications Section (formerly the Permit and License Secretariat). Permits are required by persons undertaking new development which fall within a prescribed category. Under the NRCA Act of 1991, the NRCA is authorized to issue, suspend and revoke permits and licences if facilities are not in compliance with the environmental standards and conditions of approval stipulated. An applicant for a Permit or License must complete an application form as well as a Project Information Form (PIF) for submission to the NRCA.

3.1.3 Wildlife Protection Act (1945)

The Wildlife Protection Act of 1945 prohibits removal, sale or possession of protected animals, use of dynamite, poisons or other noxious material to kill or injure fish, prohibits discharge of trade effluent or industrial waste into harbours, lagoons, estuaries and streams, and authorizes the establishment of Game Sanctuaries and Reserves. Protected under the Wildlife Protection Act are six species of sea turtle, one land mammal, one butterfly, three reptiles and several species of birds including rare and endangered species and game birds.

3.1.4 The Endangered Species (Protection, Conservation and Regulation of Trade) Act (2000)

This Act deals with restriction on trade in endangered species, regulation of trade in species specified in the schedule, suspension and revocation of permits or certificates, offences and penalties, and enforcement. Many species of reptile, amphibian and birds that are endemic to Jamaica but not previously listed under national protective legislation, or under international legislation, are listed in the Appendices of this Act.

3.1.5 The Natural Resources (Prescribed Areas)(Prohibition of Categories of Enterprise, Construction and Development) Order (1996)

The island of Jamaica and the Territorial Sea of Jamaica have been declared a Prescribed Area. No person can undertake any enterprise, construction or development of a prescribed description or category except under and in accordance with a permit. The Natural Resources Conservation (Permits and Licenses) Regulations (1996) give effect to the provisions of the Prescribed Areas Order.

3.1.6 Water Resources Act (1995)

The Water Resources Act of 1995 established the Water Resources Authority (WRA). This Authority is authorized to regulate, allocate, conserve and manage the water resources of the island. The Authority is also responsible for water quality control and is required under Section 4 of the Act to provide upon request to any department or agency of Government, technical assistance for any projects, programmes or activities relating to development, conservation and the use of water resources.

It is the responsibility of the WRA as outlined in Section 16 to prepare, for the approval of the Minister, a draft National Water Resources Master Plan for Jamaica. Areas to be covered in this Draft Master Plan of 1990 included objectives for the development, conservation and use of water resources in Jamaica with consideration being given to the protection and encouragement of economic activity, and the protection of the environment and the enhancement of environmental values.

Section 25 advises that the proposed user will still have to obtain planning permission, if this is a requirement, under the Town and Country Planning Act. In addition, Section 21 of the Act stipulates that if the water to be used will result in the discharge of effluents, an application for a license to discharge effluents will have to be made to the Natural Resources Conservation Authority or any other relevant body as indicated by the Minister.

With regard to underground water, Section 37 states that it is unlawful to allow this water to go to waste. However, if the underground water "interferes or threatens to interfere with the

execution or operation of any underground works", it will not be unlawful to allow the water to go to waste in order to carry out the required works provided that there is no other reasonable method of disposing of the water. The Authority also has the power to determine the safe yield of aquifers (Section 38).

The soils test report produced by Jentech Ltd. (2004) states that in all eleven (11) boreholes tested water was present at a depth of 0.8 m (2.5 ft.) indicating a high water table.

3.1.7 Country Fires Act (1942)

Section 4 of the Country Fires Act of 1942 prohibits the setting of fire to trash without prior notice being given to the nearest police station and the occupiers of all adjoining lands. In addition, a space of at least fifteen feet in width must be cleared around all trash to be burnt and all inflammable material removed from the area. Section 6 of the Act empowers the Minister to prohibit, as may be necessary, the setting of fire to trash without a permit.

Offences against this Act include:

- Setting fire to trash between the hours of 6.00 p.m. and 6.00 a.m. (Section 5a);
- Leaving open-air fires unattended before they have been completely extinguished (Section 5b);
- Setting fires without a permit and contrary to the provisions outlined in Section 6 (Section 8);
- Negligent use or management of a fire which could result in damage to property (Section 13a);
- Smoking a pipe, cigar or cigarette on the grounds of a plantation which could result in damage to property (Section 13b).

Vegetation clearance will be required but no burning is anticipated to facilitate this; however, the Developer should note the legal requirements for burning of vegetation.

3.1.8 Quarries Control Act (1983)

The Quarries Control Act of 1983 established the Quarries Advisory Committee, which advises the Minister on general policy relating to quarries as well as on applications for licenses. The Act provides for the establishment of quarry zones, and controls licensing and operations of all quarries. The Minister may on the recommendation of the Quarries Advisory Committee declare as a specified area any area, in which quarry zones are to be established and establish quarry zones within any such specified area.

Section 5 of the Act states that a license is required for establishing or operating a quarry though this requirement may be waived by the Minister if the mineral to be extracted is less than 100 cubic metres. Application procedures are outlined in Section 8. The prescribed form is to be filed with the Minister along with the prescribed fee and relevant particulars. The applicant is also required to place a notice in a prominent place at the proposed site for a period of at least 21 days starting from the date on which it was filed.

Any quarries used to provide material for the project should be licensed.

3.1.9 The Pesticides (Amendment) Act (1996)

The Pesticides (Amendment) Act of 1996 amended sections of the principal act, which came into effect in 1975 and established the Pesticides Control Authority. This Act gives the Authority the responsibility of controlling the importation, manufacture, packaging, sale, use and disposal of pesticides. Section 11 states that the Authority is required to keep a register or record of all relevant information such as registered pesticides, restricted pesticides, pest control operators and persons licensed to import or manufacture pesticides. Under Section 16 of the Act, the Authority may also, with the approval of the Minister, make regulations which relate to areas such as:

- Aerial application of pesticides;
- Supervision required for the use of pesticides, the prescribed protective clothing to be worn and other precautionary measures;
- The permissible levels of pesticides to be used;

- The periods during which particular pesticides may or may not be used on certain agricultural crops;
- The disposal of pesticides and packages.

3.1.10 Clean Air Act (1964)

This act refers to premises on which there are industrial works, the operation of which is in the opinion of an inspector likely to result in the discharge of smoke or fumes or gases or dust in the air. An inspector may enter any affected premise to examine, make enquiries, make tests and take samples of any substance, smoke, fumes, gas or dust as he considers necessary or proper for the performance of his duties.

Exhaust and Emissions should meet the National Standards.

3.1.11 The Natural Resources Conservation Authority (Air Quality) Regulations, 2002

Part I of this Act stipulates license requirements and states that every owner of a major facility or a significant facility shall apply for an air pollutant discharge license. Part II speaks to the stack emission targets, standards and guidelines.

The Act states that no person shall emit or cause to be emitted from any air pollutant source at a new facility, any visible air pollutants the opacity or pollutant amount of which exceeds the standards.

Every owner of a facility with one or more air pollutant source or activity shall employ such control measures and operating procedures as are necessary to minimise fugitive emissions into the atmosphere, and such owner shall use available practical methods which are technologically feasible and economically reasonable and which reduce, prevent or control fugitive emissions so as to facilitate the achievement of the maximum practical degree of air purity.

Under this Act a "major facility" is described as any facility having an air pollutant source with the potential to emit:

(a) one hundred or more tonnes/y of any one of total suspended particulate matter (TSP);
(b) particulate matter with a diameter less than ten micrometres (PM10);
(c) sulphur oxides measured as sulphur dioxide (SO2);
(d) carbon monoxide (CO);
(e) nitrogen oxides (NOx) measured as equivalent nitrogen dioxide;
(f) five or more tonnes/y lead;
(g) ten or more tonnes per year of any single priority air pollutant; or
(h) twenty-five or more tonnes per year of any combination of priority air pollutants;

Based on the definition of a major facility and the emission specification for the proposed boiler at the JB ethanol plant which exceeds 100 ton per year for many of the listed air quality pollutants, this facility would be considered a major facility. Emissions from the Ethanol Plant will have the potential to influence ambient air quality. The accumulated impact of emissions from the Ethanol Plant and the other major contributors to the airshed (Windalco, Jamaica energy Partners and Jamaica Public Service) may impact air quality in the airshed. These impacts will be influenced by meteorological conditions (precipitation, wind direction and speed, etc). The regulations define primary and secondary ambient air quality standards. The standards for those pollutants of particular relevance to the operations at the ethanol plant are shown in Table 3.1.11.

The stack emission standards specified in the Twelfth Schedule shall apply to all new facilities with air pollutant sources.

Table 3.1.11: Standards for Air Pollutants

POLLUTANT	AVERAGING TIME	STANDARD µg/m^3	
Total suspended particulates	Annual	60	
	24h	150	
PM10 (particulates with diameter <10 microns)	Annual	50	
	24h	150	
Sulphur dioxide		Primary	Secondary
	Annual	80	60
	24h	365	280
	1h	700	
Carbon Monoxide	8h	10,000	
	1h	40,000	
Nitrogen Dioxide	Annual	100	

3.1.12 Noise Standards

Jamaica has no national legislation for noise, but World Bank guidelines have been adopted by the National Environment and Planning Agency (NEPA), and are used for benchmarking purposes along with the draft National Noise Standard that is being prepared. The guidelines for daytime perimeter noise is 75 decibels and 70 decibels for nighttime noise.

3.1.13 Trade Effluent and Sewage Regulations (1996) (Draft)

Jamaica has draft regulations governing the quality of the effluent discharged from facilities to public sewers and surface water systems. These draft regulations should be gazetted sometime in 2006. The draft guidelines require the facility to meet certain basic water quality standards for trade effluent including sewage. The requisite permits and licenses are required to install and operate sewage treatment facilities.

The site contains several streams and is adjacent to a gully. During the construction and operation phases the integrity of the water quality in these systems should not be compromised.

Jamaica Broilers Group Ltd. will apply for a permit to construct a sewage treatment facility and a licence to discharge sewage effluent. The proposed sewage treatment facility will be designed to meet NEPA standards for effluent discharge.

Table 3.1.13: NRCA Sewage Effluent Standards

Immediate Technology Based Effluent Standards - Existing Plants	
Parameter	**Effluent Standard**
BOD_5	20 mg/l
TSS	30 mg/l
Nitrates (as Nitrogen)	30 mg/
Phosphates	10 mg/l
COD	100 mg/l
pH	6-9
Faecal Coliform	1000 MPN/100ml
Residual Chlorine	1.5 mg/l
Proposed Sewage Effluent Standards – New Plants	
BOD_5	20 mg/l
TSS	20 mg/l
Total Nitrogen	10 mg/l
Phosphates	4 mg/l
COD	100 mg/l
pH	6-9
Faecal Coliform	1000 MPN/100ml
Residual Chlorine	1.5 mg/l
Natural Resources Conservation Authority (NRCA) Interim Sewage Effluent Irrigation Standards	
Parameter	**Standard Limit**
Oil & Grease	10 mg/L
Total Suspended Solids (TSS)	15 mg/L
Residual Chlorine	0.5 mg/L

Immediate Technology Based Effluent Standards - Existing Plants	
Parameter	**Effluent Standard**
Biochemical Oxygen Demand (BOD)	15 mg/L
Chemical Oxygen Demand (COD)	<100 mg/L
Faecal Coliform	12 MPN/100mL

3.1.14 The Natural Resources Conservation (Portland Bight Protected Area) Regulations (1999)

These regulations apply within the area declared to be the Portland Bight Protected Area as described in the Schedule of the Natural Resources Conservation (Portland Bight Protected Area) Declaration Order 1999, and in addition to any other regulation relating to said Protected Area. The regulations give the activities that can be undertaken within the protected area, activities that can be undertaken with a license/permit, activities that can be undertaken with the written permission of the Protected Area Manager, enforcement and exemptions.

The project site lies within the boundary of the Portland Bight Protected Area (PBPA). The PBPA co-management entity Caribbean Coastal Area Management (CCAM) has been contacted verbally and in writing regarding the project.

3.1.15 Watershed Protection Act (1963)

This Act provides for the protection of watersheds and areas adjoining watersheds and promotes the conservation of water resources. The entire island however is considered to be one watershed, but for management purposes is divided into smaller units. There are 26 watershed management units declared under the Act. The Act makes provision for conservation of watersheds through the implementation of provisional improvement schemes whereby soil conservation practices are carried out on land. No regulations have ever been prepared under this Act and therefore voluntary compliance and training have been the only measures available to ensure appropriate management practices in watersheds in Jamaica.

3.2 National Legislation – Social Environment

3.2.1 Town and Country Planning Act (1958)

Section 5 of the Town and Country Planning Act authorizes the Town and Country Planning Authority to prepare, after consultation with any local authority, the provisional development orders required for any land in the urban or rural areas, so as to control the development of land in the prescribed area. In this manner, the Authority will be able to coordinate the development of roads and public services and conserve and develop the resources in the area.

Any person may, under Section 6 of the Act, object to any development order on the grounds that it is:

- impractical and unnecessary;
- against the interests of the economic welfare of the locality.

However, if the Minister is satisfied that the implementation of the provisional development order is likely to be in the public interest, he may, under Section 7 (2) of the Act, confirm it with or without modification by publishing a notice in the Gazette. Section 8 of the Act also gives the Minister the authority to amend a confirmed development order.

Section 10 of the Act states that a development order must include:

- clearly defined details of the area to be developed;
- regulations regarding the development of the land in the area specified;
- formal granting of permission for the development of land in the area.

If the provisions of section 9A of the Natural Resources Conservation Authority (NRCA) Act apply to the development, the application can only be approved by the Planning Authority after the NRCA has granted a permit for the development (Section 11 (1A)). The Authority may impose a "tree preservation order" under Section 25 of the Act if it considers it important to make provision for the preservation of trees and woodlands in the area of the development. This order may:

- prohibit the cutting down, topping, lopping or willful destruction of trees;

- secure the replanting of any section of the woodland area in which trees were felled during the forestry operations permitted under the order.

The tree preservation order is not applicable to the cutting down of trees which were already dead, dying or had become dangerous and the order can take effect only after it has been confirmed by the Minister.

The Minister can, under Section 26 of the Act, make regulations to restrict and regulate the display of advertisements in any area to be developed if he considers this to be in the interest of public safety. Section 28 of the Act empowers the local authority to require the owner or occupier of land in the development area to take the steps necessary to ensure its proper maintenance.

3.2.2 Land Development and Utilization Act (1966)

Under Section 3 of the Land Development and Utilization Act (1966), the Land Development and Utilization Commission is authorized to designate as agricultural land, any land which because of its "situation, character and other relevant circumstances" should be brought into use for agriculture. However, this order is not applicable to land, which has been approved under the Town and Country Planning Act for development purposes other than that of agriculture. Among the duties of the Commission outlined in Section 14 of the Act is its responsibility to ensure that agricultural land is "as far as possible, properly developed and utilized".

The proposed project site adjacent to Windalco at Port Esquivel in St. Catherine, is zoned for industrial development.

3.2.3 Public Health Act (1976)

The Public Health (Air, Soil and Water Pollution) Regulations 1976, aim at controlling, reducing, removing or preventing air, soil and water pollution in all possible forms. Under the regulations given:

i. No individual or corporation is allowed to emit, deposit, issue or discharge into the environment from any source.
ii. Whoever is responsible for the accidental presence in the environment of a contaminant must advise the Environmental Control Division of the Ministry of Health and Environmental Control, without delay.
iii. Any person or organization that conducts activities which release air contaminants such as dust and other particulates is required to institute measures to reduce or eliminate the presence of such contaminants.
iv. No industrial waste should be discharged into any water body which will result in the deterioration of the quality of the water.

3.2.4 The National Solid Waste Management Authority Act (2001)

The National Solid Waste Management Authority Act (2001) is "an act to provide for the regulation and management of solid waste; to establish a body to be called the National Solid Waste Management Authority and for matters connected therewith or incidental thereto". The Solid Waste Management Authority (SWMA) is to take all steps as necessary for the effective management of solid waste in Jamaica in order to safeguard public health, ensure that waste is collected, sorted, transported, recycled, reused or disposed of, in an environmentally sound manner and to promote safety standards in relation to such waste. The SWMA also has responsibility for the promotion of public awareness of the importance of efficient solid waste management, to advise the Minister on matters of general policy and to perform other functions pertaining to solid waste management.

Solid waste management will be generated during both the construction and operation phases of the ethanol plant and will require the removal and proper disposal of vegetative matter, which is cleared for construction, construction rubble and operational wastes.

3.2.5 Jamaica National Heritage Trust Act (1985)

The Jamaica National Heritage Trust Act of 1985 established the Jamaica National Heritage Trust (JNHT). The Trust's functions outlined in Section 4 include the following responsibilities:

- To promote the preservation of national monuments and anything designated as protected national heritage for the benefit of the Island;
- To carry out such development as it considers necessary for the preservation of any national monument or anything designated as protected national heritage;
- To record any precious objects or works of art to be preserved and to identify and record any species of botanical or animal life to be protected.

Section 17 further states that it is an offence for any individual to:

- willfully deface, damage or destroy any national monument or protected national heritage or to deface, damage, destroy, conceal or remove any mark affixed to a national monument or protected national heritage;
- alter any national monument or mark without the written permission of the Trust;
- remove or cause to be removed any national monument or protected national heritage to a place outside of Jamaica.

The JNHT has been contacted officially to advise them of the project and to determine if there are any relevant listings on their Sites and Monuments Records (Appendix XI). No written response has been received. Staff of the JNHT visited the site with members of the EIA Professional Team.

3.2.6 Land Acquisition Act (1947)

Section 3 of the Land Acquisition Act (1947) empowers any officer authorized by the Minister to enter and survey land in any locality that may be needed for any public purpose. This may also involve:

- Digging or boring into the sub-soil;
- Cutting down and clearing away any standing crop, fence, bush or woodland;
- Carrying out other acts necessary to ascertain that the land is suitable for the required purpose.

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The Minister is authorized under Section 5 of the Act to make a public declaration under his signature if land is required for a public purpose provided that the compensation to be awarded for the land is to be paid out of the:

- Consolidated Fund or loan funds of the Government;
- Funds of any Parish Council, the Kingston and St. Andrew Corporation or the National Water Commission.

Once the Commissioner enters into possession of any land under the provisions of this Act, the land is vested in the Commissioner of Lands and is held in trust for the Government of Jamaica in keeping with the details outlined in Section 16. The Commissioner shall provide the Registrar of Titles with a copy of every notice published as well as a plan of the land. The Commissioner will also make an application to the Registrar of Titles in order to bring the title of the land under the operation of the Registration of Titles Act.

3.2.7 Registration of Titles Act (1989)

The Registration of Titles Act of 1989 is the legal basis for land registration in Jamaica, which is carried out using a modified Torrens System (Centre for Property Studies, 1998). Under this system, land registration is not compulsory, although once a property is entered in the registry system the title is continued through any transfer of ownership.

3.2.8 The Factories Act (1973)

Under Section 4 of the Factories Act, the Minister may make regulations generally for giving effect to the purposes of this Act, and for the purposes of ensuring the safety, health and welfare of persons who are employed in any factory or in connection with machinery, and in particular, and without prejudice to the generality of the foregoing provisions, any such regulations may provide for:

- the safe means of approach or access to, and exit from, any factory, or machinery;
- the fencing and covering of all dangerous places or machines;
- life-saving and first aid appliances;

- securing safety in connection with all operations carried on in a factory;
- securing safety in connection with the use of all engines, machinery, and mechanical
- the proper ventilation of any factory, having regard to the nature of the process carried on therein;
- the sanitation, including the provision of lavatory accommodation (having regard to the number of workers employed) at any factory;
- the provision and maintenance of appropriate facilities for the welfare of persons employed at any factory.

In Section 5 of the Act the Chief Factory Inspector may enter upon the premises and inspect the factory and machinery, at *all* reasonable times by day and night, and take materials used or samples of the products *of* such factory.

Where any accident occurs in a factory which

(a) causes loss of life to a person employed in that factory; or

(b) disables any such person for more than two days from earning full wages at the work at which he was employed, the manager of the factory or person having control of the machinery in such factory shall forthwith report the occurrence of such accident to the Chief Factory Inspector and in connection therewith he shall furnish such particulars as the Chief Factory Inspector in any case from time to time may require.

The provisions as laid out under the Factories Act will be relevant to the Jamaica Broilers Group Ltd. and the establishment of the Ethanol Plant.

3.2.9 Jamaica's Energy Policy

The Jamaican economy is not well endowed with petroleum based energy resources and therefore, depends heavily on imports. The policy seeks to diversify Jamaica's energy base with the aim of ensuring adequate and secure energy supply for Jamaica. The Energy Policy addresses issues relating to energy sources such as petroleum, renewables and other fuels. In keeping with the Government of Jamaica's commitment to deregulate and liberalize the Jamaican economy, the involvement of the private sector on a competitive basis is chosen as

the best way to modernize and expand the energy sector, so as to achieve the required growth in energy supplies and to improve efficiencies in energy production.
There are several objectives of the Energy Policy a few of which are to:

- diversify the energy base
- encourage efficiency in energy production, conversion and use with the overall objectives of reducing the energy intensity of the economy;
- complement the country's Industrial Policy recognizing the importance of energy as a critical input to industrial growth and stability;
- minimize the adverse environmental effects and pollution caused by the production, storage, transport and use of energy, and minimize environmental degradation as a result of the use of fuelwood; and
- establish an appropriate regulatory framework to protect consumers, investors and the environment.

These objectives will be achieved by creating and enabling the environment to:

- encourage private sector participation and investments through a policy of divestment and an appropriate regulatory framework conducive to new investment;
- encourage energy conservation/efficiency on the supply side as well as demand side management;
- fully protect the environment while ensuring that adequate energy supplies are available to the country and to sustain the desired rate of economic growth.

The protection of the environment is a primary objective of this Energy Policy and therefore, the environmental guidelines of the Natural Resources Conservation Authority (NRCA) relating to the energy sector will be strictly enforced.

With the establishment of the Ethanol Plant, Jamaica Broilers Group Ltd. will act in keeping with the provisions under the Energy Policy. The objectives under the policy including the encouragement of the private sector to participate in the provision of energy sources, the diversification of Jamaica's energy base and the protection of the environment are all applicable to this proposed project.

3.2.10 The Town and Country Planning (St. Catherine Coast) Provisional Development Order, 1964

This order is to make provision for the orderly and progressive development of the southern part of the parish of St. Catherine excluding Spanish Town but including the areas to the east, south and southeast. This will also include the whole parish coast from the Kingston and St. Andrew Corporate Area Boundary on the east to the parish of Clarendon boundary on the west.

No development will be permitted which would conflict with the proposals outlined in the Order. Land use proposals are not made for the whole of the area contained within the boundary of the Order. The areas are zoned for: urban development, roads, commercial areas, beaches, seaside parks, roadside parks, areas of natural beauty and historic interest, industrial area, amenity, zoning related to use classes, public services and miscellaneous.

3.2.11 South Coast Sustainable Development Master Plan

The South Coast Development Master Plan (SCSDMP), 1999 was developed to facilitate a planned approach to the expected growth in the tourism industry and to explore environmentally sustainable pathways to economic growth. The plan area runs from the east of Hellshire in St Catherine to Little London in Westmoreland, extending approximately 11km inland and offshore to a depth of 20m.

The Plan aims to provide a framework for the management of the natural and man-made environment and to achieve orderly and sustainable development of the South Coast. It includes land use designation to promote: best use and sustainable development of natural resources; protection and conservation of the terrestrial and marine environment; conservation of the cultural heritage; community development and improved health conditions; and diversification of economic activities.

The SCSDMP identified projects and programs in each of the key development sectors for the South Coast. The projects aim to address critical infrastructure and human resources constraints, as well as to secure the environmental assets of the region and promote economic growth. The projects were evaluated taking into consideration economic, social and

environmental criteria, as well as consistency with the concept of sustainable development and stakeholder support. Appropriate development of infrastructure is a prerequisite for economic growth and diversification.

The Plan envisages sustained development based on adding value to the natural and human resources of the region through the growth of community-based services. The high quality of coastal and upland landscapes; the rivers and groundwater resources; the prime agricultural land; extensive forests and wetlands; the beaches, reefs and fish nursery areas; and the distinctive cultural heritage of the region are the key environmental assets which will support sustainable growth. Building on these resources, strong protection and management of critical natural resources is at the core of the Plan's vision.

The project is consistent with the aims and objectives of bringing development to the South Coast region.

3.3 International Legislative and Regulatory Considerations

3.3.1 Cartagena Convention (Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region) (1983)

Adopted in March 1983 in Cartagena, Colombia, the Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region, also known as the Cartagena Convention, is the only legally binding environmental treaty for the Wider Caribbean. The Convention came into force in October 1996 as a legal instrument for the implementation of the Caribbean Action Plan and represents a commitment by the participating governments to protect, develop and manage their common waters individually and jointly.

Ratified by twenty countries, the Cartagena Convention is a framework agreement which sets out the political and legal foundations for actions to be developed. The operational Protocols, which direct these actions, are designed to address special issues and to initiate concrete actions. The Convention is currently supported by three Protocols. These are:

- *The Protocol Concerning Co-operation in Combating Oil Spills in the Wider Caribbean Region* (The Oil Spills Protocol), which was adopted and entered into force at the same time as the Cartagena Convention;
- *The Protocol Concerning Specially Protected Areas and Wildlife in the Wider Caribbean Region* (The SPAW Protocol), which was adopted in two stages, the text in January, 1990 and its Annexes in June, 1991. The Protocol entered into force in 2000;
- *The Protocol Concerning Pollution from Land-based Sources and Activities in the Wider Caribbean Region* (LBS Protocol), which was adopted in October, 1999.

3.3.2 Convention on Biological Diversity

The objectives of the Convention on Biological Diversity are "the conservation of biological diversity, sustainable use of its components and the fair equitable sharing of the benefits arising out of the utilization of genetic resources". This is the first global, comprehensive agreement which has as its focus all aspects of biological diversity: genetic resources, species and ecosystems. The Convention acknowledges that the "conservation of biological diversity is a common concern of humankind and an integral part of the development process". In order to achieve its goals, the signatories are required to:

- Develop plans for protecting habitat and species.
- Provide funds and technology to help developing countries provide protection.
- Ensure commercial access to biological resources for development.
- Share revenues fairly among source countries and developers.
- Establish safe regulations and liability for risks associated with biotechnology development.

Jamaica's Green Paper Number 3/01, entitled *Towards a National Strategy and Action Plan on Biological Diversity in Jamaica,* speaks to Jamaica's continuing commitment to its obligations as a signatory to the Convention.

4.0 Methodology and Approach

4.1 General Approach

A multi-disciplinary team of experienced scientists and environmental professionals was assembled to carry out the required resource assessment, generation and analysis of baseline data, determination of potential impacts and recommendation of mitigation measures. The members of the EIA Professional Team are given in Appendix VI. An iterative approach among the environmental team members and other project professionals was adopted and was facilitated by team meetings as required.

The team utilized the Charette-style approach to data gathering, analysis, and presentation whereby team members conducted the reconnaissance investigations together to determine the critical elements for analysis and the issues to be highlighted for the design and planning process. Team meetings were held to discuss the progress of investigations and analyses and facilitate integration of data toward an understanding of the systems at work in both the natural and built environment.

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

- Field studies
- Analysis of maps, plans, aerial photos
- Review of engineer's reports and drawings
- Review of background documents
- Structured Interviews
- Laboratory analyses
- Internet Searches
- Agency requests and document searches

4.2 Physical Environment

4.2.1 Site and Situation

A definition of the study area for the physical environment was prepared, based on the drainage area of which the project site forms a part. These boundaries were demarcated based on a desktop review of available topographical maps and field reconnaissance along open and traversable access ways. Baseline data collection on the study area was conducted and included climate, hydrology, geology, hydrogeology and topography. Information on soils was provided by Jentech Ltd. (Jentech, 2004, Appendix VII).

Information on rainfall, groundwater pollution incidents, flooding incidents, mains supply facilities and other relevant facilities were reviewed within a 1km radius of the site.

The Office of Disaster Preparedness and Emergency Management (ODPEM) was not contacted for reports of natural disasters as there are no residential areas on the site, and the ODPEM reports are usually generated on such areas.

Information was also obtained from the Water Resources Authority (WRA), the National Water Commission (NWC) and internet searches.

Data was garnered from field reconnaissance in August 2006, aerial photographs, previous site reports and intrusive site reports done and current public domain reports held within various governmental and non-governmental organisations.

4.2.2 Climate

Climate data including rainfall was collected from the National Meteorological Services.

4.2.3 Topography, Hydrogeology and Drainage

The site assessment conducted was to visually verify the geology, ascertain the hydrogeology and investigate any scale-related events that may not have been captured in the previous studies.

The hydrological assessment was made using WinTR-55 storm run-off model which is a robust, single-event rainfall-runoff small watershed hydrologic model. The model generates hydrographs from both urban and agricultural areas and at selected points along the stream system. The model was developed and is currently used extensively in the USA for catchments between 1 and 6,500 ha.

Existing reports and data were reviewed with a view to determining the following:

1) Water demand based on population and consumption rate for the proposed site.
2) Pre and post project runoff rates for 25 yr return period
3) Possibility for contamination of the water courses as a result of the proposed project.

An assessment of the quantity of water available from the well owned by Windalco as well as a privately owned well, was done through an estimation of the potential demand for the proposed project, both for domestic and industrial use.

4.2.4 Stormwater Runoff

A comparative evaluation of the site using Rational Equation indicated storm runoff of similar orders of magnitude, though less than that calculated by WinTR-55. The difference is mainly due to the sophistication of the WinTR-55 model compared to the Rational Equation as well as the areal limitations of the Rational Method.

4.2.5 Natural Hazard Risk

Assessment of the natural hazard risk was accomplished through a review of relevant literature pertaining to history of flood events, seismicity and hurricane impacts. Anecdotal reports on historical events were recorded from residents in the surrounding communities. In particular Windalco was consulted to ascertain the natural hazard history of the site particularly as it related to flooding, stormwater run-off, high winds and storm surge.

The stormwater run-off analysis provided a basis for evaluating flood risk, and canals and gullies in the project area were examined in terms of level of maintenance and historical performance. The Office of Disaster Preparedness and Emergency Management (ODPEM)

was not contacted as their disaster reports are usually generated for sites with residents. The WRA Report is given in Appendix VIII.

4.2.6 Air Quality

The air quality assessment involved the determination of ambient levels of respirable particulates, PM10 (<10µm). Particulate measurements PM 10 were conducted using Sensidyne BDX 530^{CFT} personal high flow portable vacuum pumps. These pumps were calibrated to a suction rate of 3 litres/ minute then attached to pre-weighed filters fitted to cyclones. The cyclones separate the respirable from the non-respirable particulates by centrifugal forces. Air drawn into the cyclone is accelerated by circular motion which causes the lighter particles to be separated from the heavier ones. The lighter particulates are collected on the filters and the heavier >10 microns fall to the bottom of the cyclone.

The pumps with the cyclones were placed at the approximate respiratory height of pedestrians. After the period of sampling was completed (24 hours) the pumps were turned off, the filters removed, stabilized and re-weighed to give the concentration of particulates collected.

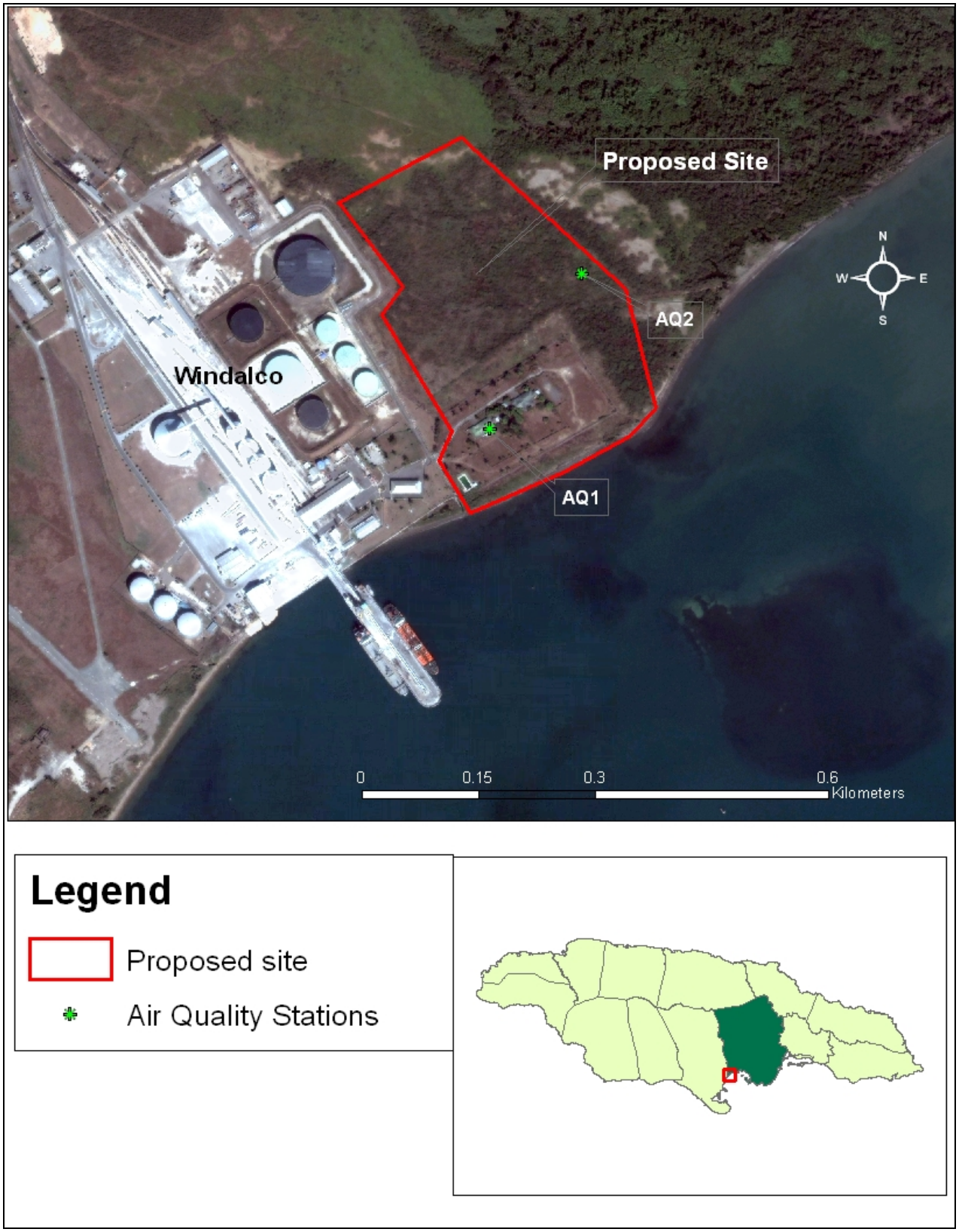
Note: This methodology does not use the high volume area samplers as recommended by USEPA. The consultants have conducted an inter-laboratory comparison using high volume samplers and the Sensidyne samplers, and the results obtained were similar. The station locations are shown in Table 4.2.6 and Figure 4.2.6 and identified.

Table 4.2.6: Location of Air Sampling Stations

Station Code	Locations
AQ1	Western end of property
AQ2	Eastern property boundary

Calibration certificates are given in Appendix IX.

Figure 4.2.6: Air Quality Sampling Stations



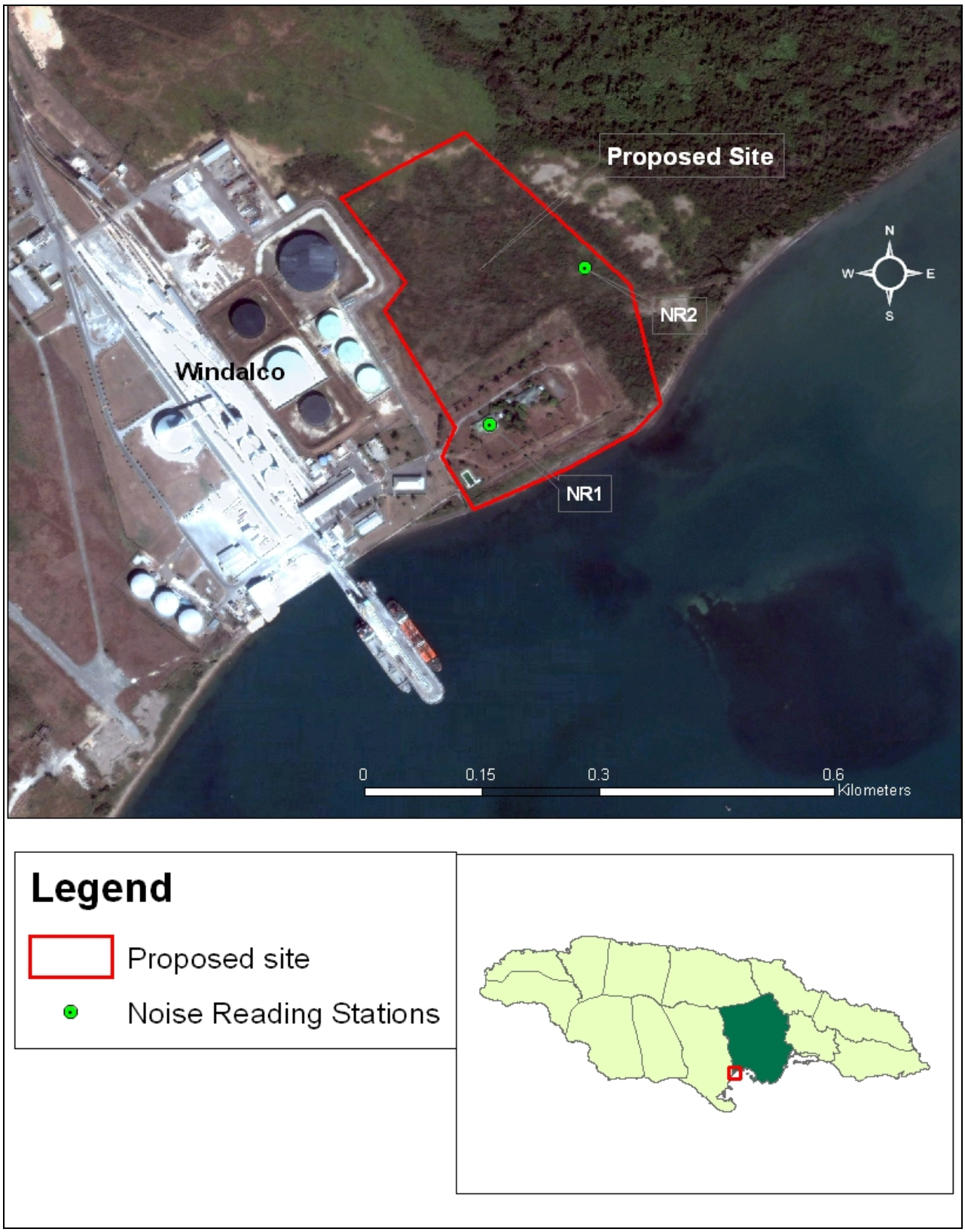
4.2.7 Noise

Two sites that coincided with the air quality sampling stations (Figure 4.2.6) were selected for monitoring noise. Noise level readings, wind direction and any unusual local noise sources were recorded. In addition, before and after the survey, the instrument was calibrated with an ANSI calibrator, which was pre-calibrated at the factory. Noise measurements were averaged across half hour intervals for a four-hour period.

Measurements were taken using Quest Electronics sound level meters, which conform with ANSI S1.4 - 1983, TYPE 2 and IEC 651 - 1979, TYPE 2 standards. The meter was calibrated before and after each set of readings. Measurements were taken at the perimeter of the plant.

Calibration certificates are given in Appendix IX.

Figure 4.2.7: Noise Reading Sampling Stations



4.2.8 Water Quality Methodology

Water quality determinations, an important component of any environmental assessment, provide critical data on the condition of the water resource. The major objectives of the present water quality sampling programme were:

- ◊ To determine baseline water quality conditions of the major surface water systems in the project area.
- ◊ To determine the nature and extent of existing land use impacts,
- ◊ To determine compliance with local water quality standards.

These objectives were largely met through the conduct of water quality sampling exercises on May 4 2006; July 4, 5 and 6, 2006.

Four coastal water sampling stations were selected for investigation (fig 4.2.8). Station JB1 is located west of the project site and upwind of the Windalco pier. Station JB2 is situated in the middle of the bay across from the project site, whereas Station JB3 is located in the coastal waters just off the eastern property boundary. Station JB4 the control station sited offshore.

Table 4.2.8: Location of Water Quality Stations

STATION NUMBER	STATION LOCATION
JB1	West of the project site
JB2	Middle of the bay
JB3	Off the eastern property boundary
JB4	Control station offshore

Samples were collected using a motorized boat. Care was taken at each site to prevent any mixing at the site by the boat engine prior to sample collection. Grab samples were collected at the sampling sites at a depth of between 0.5 and 1m from the surface using a "weighted bottle" sampler. All samples were collected in pre-cleaned 2 litre polyethylene sample bottles. Bacterial samples were collected in sterilized 100 ml glass bottles and BOD samples were taken in opaque polyethylene containers. The samples were placed on ice after collection and transported to the ESL Laboratory at 20 West Kings House Road, Kingston 10.

The following parameters were analysed on all of the water samples:

◊ pH

◊ Salinity/conductivity/temperature

◊ Dissolved Oxygen

◊ Nitrate

◊ Phosphate

◊ Biochemical Oxygen Demand (BOD_5

◊ Total and Faecal Coliform

◊ Total suspended solids

◊ Copper

◊ Lead

◊ Manganese

◊ Iron

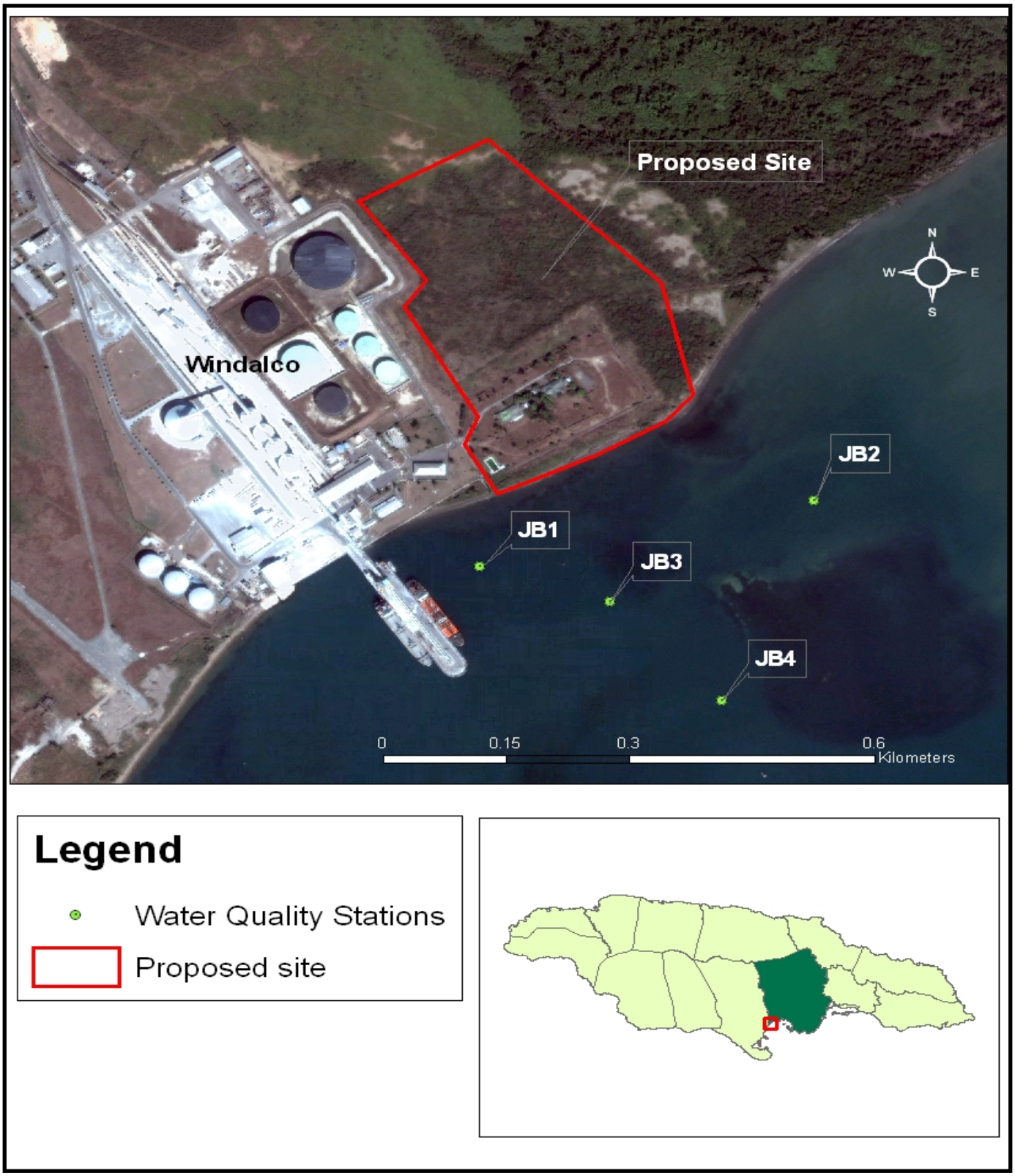
◊ Oil and grease

Salinity, temperature, and dissolved oxygen were measured *in situ* at all sampling stations using a YSI Model 57 Salinity/Conductivity/Temperature (SCT) meter and YSI Model 33 oxygen meter respectively. Measurements were taken at the surface (0.5m depth) of the water column.

Laboratory Analyses were performed at the Environmental Solutions Laboratory Division using certified methodology from Standard Methods for Water and Wastewater Analyses (Eaton *et al*, 1995).

Calibration certificates are given in Appendix IX.

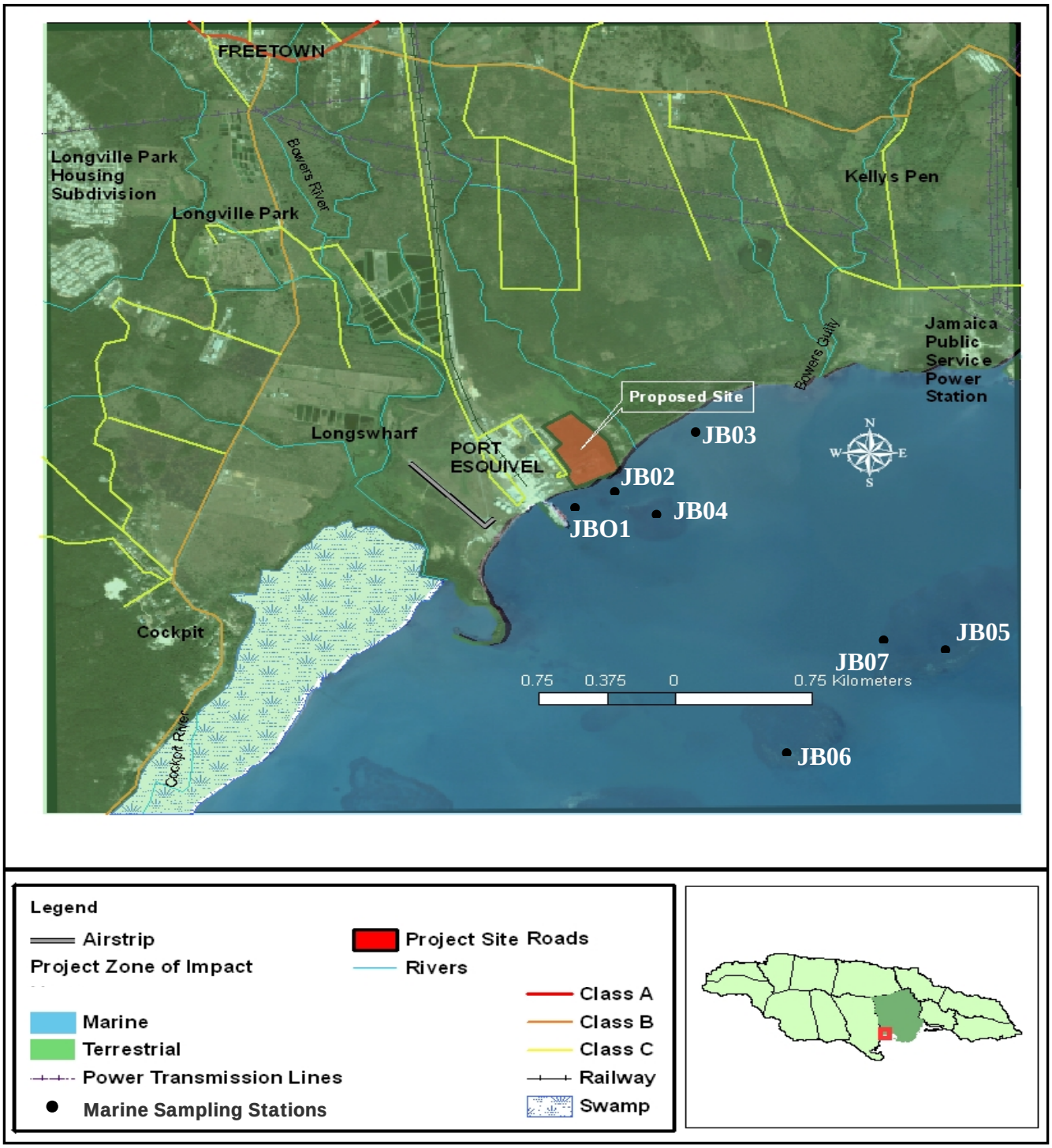
Figure 4.2.8: Coastal Water Quality Stations



4.2.9 Marine Sediment Analysis

Marine sediment samples were taken at seven stations using a Vanveen® grab sampler. The samples were collected at approximately 0.5 metre below the sediment surface. Four inshore and three offshore stations that were randomly selected and coincided with the locations of benthic fauna assessment (Figure 4.2.9). The sediment samples were analysed for manganese, copper, iron and lead using the atomic absorption spectroscopy procedure from Standard Methods for Wastewater Analysis.

Figure 4.2.9: Marine Sediment Sample Stations



4.3 Biological Environment

4.3.1 Terrestrial Flora

Surveys of the flora of the proposed site for the Ethanol Dehydration Plant at Port Esquivel were conducted between August 17th, 21st and 22nd 2006. Notes were made of the relative abundance of plants. Specimens of unidentified plants were collected and taken to the University of the West Indies Herbarium for identification.

4.3.2 Terrestrial Fauna

Surveys of the flora and selected faunal groups of the proposed site for the Ethanol Dehydration Plant at Port Esquivel were conducted between August 17th, 21st and 22nd 2006. Standard methodology for bird surveys using point counts in this type of assessment involves using a minimum of ten sampling points. Sample points would be distributed either on a regular grid if the area is largely homogenous or in a stratified random distribution if it includes several distinct habitat types. This site had several problems which created difficulties for application of either approach. Sampling points for bird surveys must be located a minimum of 200m apart (depending on vegetation type and species surveyed), in order to minimize the possibility of double-counting individual birds. This commonly occurs with species that are highly visible or vocal.

The average canopy height for the vegetation was less than three metres and the species composition of the wooded area was dominated by a few species. This meant that relatively few species would find the habitat suitable and highly detectable species such as flycatchers were detected across most of the site. The small size of the site meant that it was impossible to accommodate enough sample sites in each zone to provide sufficient data. Attempts were made to conduct six minute point counts at various locations across the site indicated that the same individual birds were being detected at several points and so this was abandoned.

All surveys were therefore conducted as walking transects in each zone. The road was used as the survey line through the thorn scrub zone. All bird and plant species were identified (or sampled for later identification) along the transect lines. The number of individuals of each bird species encountered was noted.

The site was also sampled on August 21st between sunset and 8:30 p.m. to determine which nocturnal species might be present on the site.

Observations of butterflies and other wildlife were also recorded. Unidentified butterflies were photographed for later identification.

4.3.3 Parks and Protected Areas

The situation of the project site within the Portland Bight Protected Area (PBPA) was identified. The assessment of the flora and fauna of the project site included an identification of any species of significance to the PBPA. The Caribbean Coastal Area Management Foundation (CCAM), the entity responsible for co-management of the park (along with NEPA) was contacted to advise them of the project and to determine whether there were any issues they wanted to raise.

4.3.4 Marine Environment

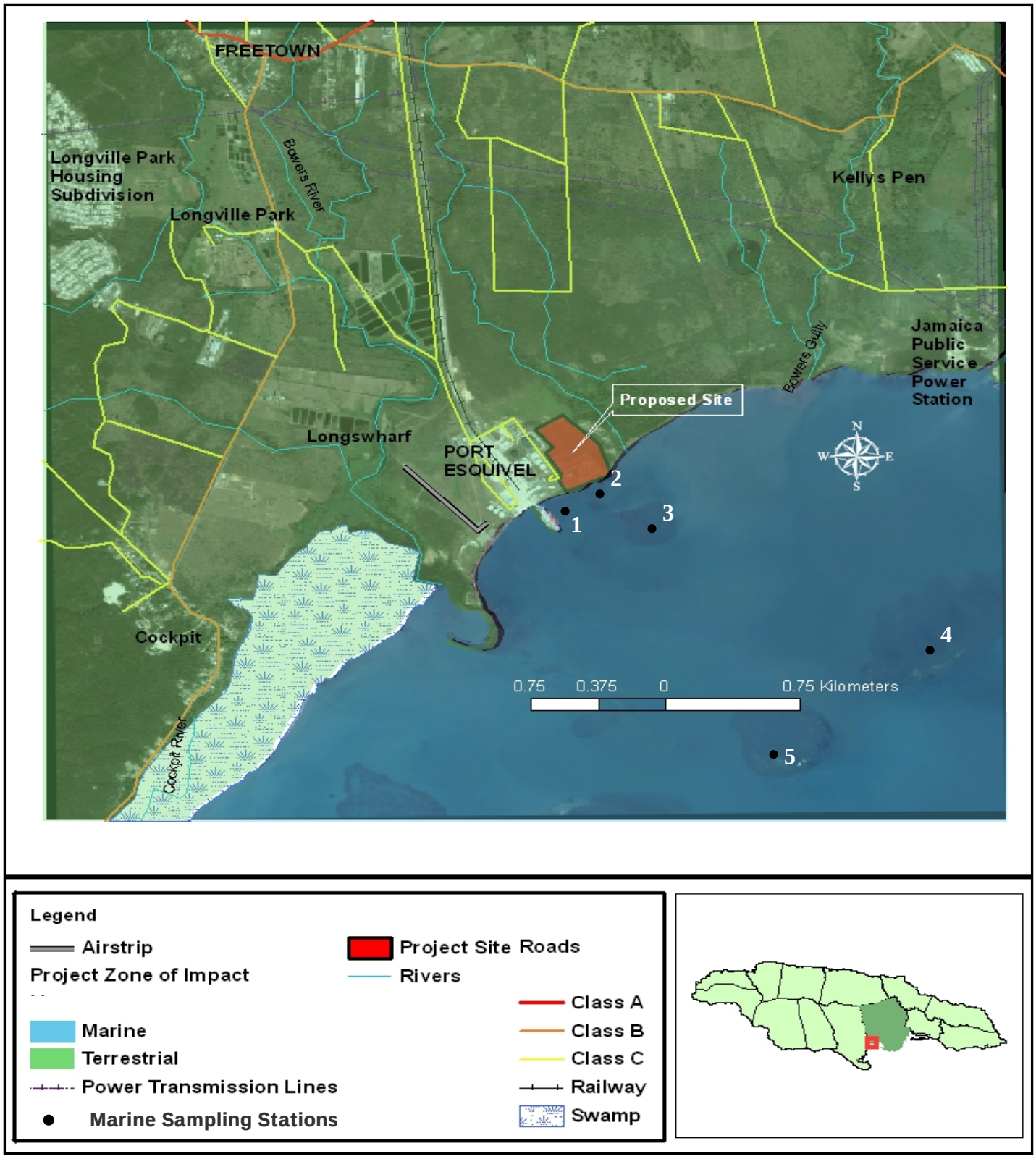
The seagrass and benthic communities were investigated in an effort to determine the status of the marine environment and the possible impacts the proposed development might pose to this environment. This assessment was conducted by snorkeling.

4.3.4.1 Benthic Communities

Three inshore sites and two offshore sites were chosen for sampling (Figure 4.3.4.1). The inshore and offshore sites were chosen randomly 3 km from the shore, in areas of suitable depths for sampling by snorkeling. Quantitative data was obtained using five (5), fifty (50) metre long transects, and $1m^2$ quadrats thrown at ten (10) metre intervals so as to determine benthic percentage cover.

A visual, qualitative assessment of epifauna and pelagic fauna was conducted using roving swims, aided by underwater photography. Grab samples were taken at each site so as to assess the sediment infauna, and to determine substrate type and particle size.

Figure 4.3.4.1: Marine sampling stations



4.4 Socio-economic Environment

Rapid appraisal techniques were used in communities neighbouring the project and likely to be impacted by the project. The process involved windshield observations of the general project area, as well as structured and semi-structured interviews with approximately 90 respondents. The interview instrument is given in Appendix X. Non-structured interviews were also held with a number of key informants and members in community leadership.

Analysis of the socio-economic environment focused mainly on livelihoods, public health and safety, land use, population and employment, and public perception of the project.

4.4.1 The Project's Zone of Immediate Influence

Given the nature and location of the proposed ethanol plant, the main potential negative impacts on the neighbouring communities, within the zone of influence were identified as having to do with health, safety and livelihoods. Specifically, plant gas vapor emissions and odor in relation to health; fires in relation to safety; and the release of effluent with high BOD in relation to marine life and fisheries.

These issues were used to define the project's zone of immediate influence and select where stakeholder interviews were conducted. The focus of this section is limited to this zone, since it is here that impacts are likely to be first experienced and the respondents canvassed, felt a stake in how these impacts would affect them.

4.4.2 Communities surveyed

The communities in which interviews were conducted are given below:

i. Old Harbour Bay Fishing Beaches: The center of fisheries in this area.
ii. Rodons Pen : A small non growing low income enclave of a few houses lying NE of the site.

iii. Bodles Junction: A squatter community north of the site.

iv. Bodles Crescent: An unplanned large community NW of the site.

v. Free Town: A roadside community bordering Bodles Crescent.

vi. Rasta Gully: An unplanned community started around an earlier vibrant cottage industry in mainly Rasta craft & pottery.

vii. Longville Park Estate: A large residential housing development NW of the site.

viii. Cockpit: An unplanned community almost due West of the site and the settlement closest to the site.

Plate: 4.4.2 Eastern end of Main Fishing Beach at Old Harbour Bay

4.4.3 Demographics and Livelihoods

Demographic data was sourced from STATIN.

4.4.4 Land Use and Zoning

The Highway 2000 Corridor Development Plan was reviewed to determine the suggested land use and zoning requirements. (PIOJ, 2004) Current land use and zoning was obtained by observations and interviews, review of maps and aerial photographs, as well as from Ministerial and Agency communication to the developer.

4.4.5 Physical Infrastructure

Existing physical infrastructure on the site was determined and includes the existing house and utilities. Requirements for infrastructure for the project were also identified.

4.4.6 Traffic Pattern, Transportation and Access Roads

Information on traffic was obtained through observations and interviews.

4.4.7 Archaeological and Cultural Heritage

Data bases in the National Library were consulted to understand the historical context of the site. Preliminary discussions were held with Jamaica National Heritage Trust and a letter was also sent to the JNHT with a location map, formally advising them of the project and requesting information on any listing on the Sites and Monuments Record that may be relevant to the site (Appendix XI). No written response was received from the JNHT but verbal communication with them indicated no listed heritage elements sited on the project property. Members of staff from the JNHT participated in a site visit with members of the EIA Professional Team.

4.4.8 Public Consultation Process

The public consultation process included the serving of Public Notice # 1, which appeared in the Daily Gleaner on Friday, August 25 (Appendix XII). The Public Notice provided the public with notification of the proposed development and also invited the public to review and comment on the Terms of Reference for the EIA. Additionally, NEPA circulated the TOR's to stakeholders and sister agencies for comments. Additionally, a letter was sent to Caribbean

Coastal Area Management (CCAM) the entity given responsibility for co-management of the Portland Bight Protected area along with NEPA. Verbal discussions were also held with CCAM and the Jamaica Environment Trust (JET) to determine any issues they wished to raise for inclusion in the EIA.

A Public Meeting in the form of a large community meeting is to be arranged after submission of this EIA report to NEPA.

Public consultation has been included as part of the data gathering exercises through interviews in communities and the application of interview instruments.

4.4.9 Consultations with Regional Health Authority/ Medical Officer in St. Catherine Health Department.

Discussions were held with the Medical Officer of Health and the Chief Public Health Inspector for St. Catherine, (Southwest Region), in order to investigate the present and potential public health risks that may be associated with the development and the long term impact on community health status.

4.5 Prediction of Potential Impacts

The various aspects of the project and their potential impacts on the physical, biological or socio-economic environment were identified and are presented and discussed in an Impact Matrix.

The selected aspects were highlighted for consideration in depth:

1) Loss of vegetation and loss or alteration of habitat for fauna
2) Drainage, especially with respect to existing natural drainage channels or man-made drainage/water features
3) Increased surface runoff and sediment loading
4) Natural hazard risk

5) Technological hazard risk

6) Coastal water quality

7) Treatment and disposal of domestic and industrial (process) waste

8) Solid waste disposal

9) Public health and safety of neighbours

10) Other proposed developments

Impacts were identified as follows:

Duration:	short, medium or long term
Direction:	positive or negative
Magnitude:	major of minor
Type:	reversible or irreversible

Where applicable the impact of the existing environment on the proposed project has been discussed.

Cumulative Impacts of the proposed project in the context of other projects in the area were also assessed.

4.6 Limitations to the Study

Some limitations to the study were identified and are recorded here to ensure that there is complete understanding of the methodology used, the data generated and the application of impact prediction. These limitations are:

a. The comments made on storm water runoff and groundwater conditions are based on observations made at the time that available site work was carried out or documents reviewed. It should be noted that storm water runoff and ground water levels will vary owing to seasonal, tidal and weather related effects.

b. The Soil Investigation Report was prepared in 2004 for the same site but with a different project concept. The information presented is detailed enough to be used in the presentation on baseline conditions of the site and the age of the data is not significant, as the site has not been modified. However, the interpretation of the potential impacts as relates to the components of the other project (a grain facility) are not completely applicable. The information for Boreholes 9, 10 and 11 is applicable to this project as these are on the area of the 4 storage tanks. Boreholes 1 – 8 are in the area proposed originally for the green sites and the current project concept does not have any facilities in this location. The project engineers have stated that the geotechnical interpretations for the weight bearing capacity of the site are applicable to the ethanol plant project.

c. Water quality data was collected over a 3 day period during July. The period was relatively dry and so no rainy period data was collected.

d. Standard methodology for bird surveys using point counts in this type of assessment involves using a minimum of ten sampling points. Sample points would be distributed either on a regular grid if the area is largely homogenous or in a stratified random distribution if it includes several distinct habitat types. This site had several problems which created difficulties for application of either approach. Sampling points for bird surveys must be located a minimum of 200m apart (depending on vegetation type and species surveyed), in order to minimize the possibility of double-counting individual birds. This commonly occurs with species that are highly visible or vocal. The small size of the site meant that it was impossible to accommodate enough sample sites in each zone to provide sufficient data. Attempts were made to conduct six minute point counts at various locations across the site indicated that the same individual birds were being detected at several points and so this was abandoned. All surveys were therefore conducted as walking transects in each zone.

Additionally, the assessment of birds was conducted in the summer and the number of migratory species observed would not be reflective of the total possible species count in the winter months.

5.0 The Existing Environment

5.1 Physical Environment

Data sets for physical baseline assessments are given in Appendix XIII.

5.1.1 Site and Situation

The site (N17° 53' W77° 07') is located immediately east of Windalco's Port Esquivel site (otherwise known as Longswharf) and accessed via the Windalco property (Plate 1.2.1, Section 1.2.1 and Figure 5.1.1). The site is bound by undeveloped lands to the north and east, and by the Caribbean Sea to the south. The site is for the most part undeveloped with only two small concrete dwellings on the property.

The proposed site is 25 acres of land located in the parish of St. Catherine, on the outskirts of Old Harbour. The site is also part of the Vere Plains Region and is within the boundary of the Portland Bight Protected Area, a protected area along the south coast of Jamaica rich in wildlife and natural resources. The footprint of the Ethanol Plant will occupy approximately 6 acres of the entire site.

The project area is also part of 339 hectares of land zoned for Heavy Industries. Existing industries in the general area include Windalco, Jamaica Public Service Company Power Plant, Jamalco and Hi Pro Feeds. The site is also close to the area proposed for the development of a Liquid Natural Gas (LNG) Plant.

Several communities are in the geographical sphere of influence of the project area, these include: Free Town, Old Harbour, Old Harbour Bay, Salt River, Longville Park, Cockpit, Bodles, and Bushy Park (Fig 1.2.1a).

Figure 5.1.1: Project site and situation

5.1.2 Climate

The meteorological station nearest to the study area is located at Longswharf (Figure 5.1.2a), immediately west of the site. The Meteorological Service 30-year long-term mean monthly rainfall (1951 – 1980) for Longswharf, St. Catherine ranges between 33 – 216mm. This is broken-out monthly in the Table 5.1.2 a.

Table 5.1.2a: Mean Monthly Rainfall, Longswharf, St. Catherine (1951-1980) (source: Meteorological Service)

	Jan	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Longswharf	33	38	127	97	64	107	150	216	71	41

All results in mm.

Monthly mean maximum temperature is likely to be similar to that encountered at Bodles ranging between 18°C in the cooler months to 34°C in warmer months.

The Meteorological Service 30-year long-term mean monthly rainfall (1951-1981) for Old Harbour, St. Catherine ranges between 41 – 213 mm. 24-hour rainfall data was obtained from the Old Harbour station over the 48 year period 1937-1985 and is presented in Table 5.1.2b.

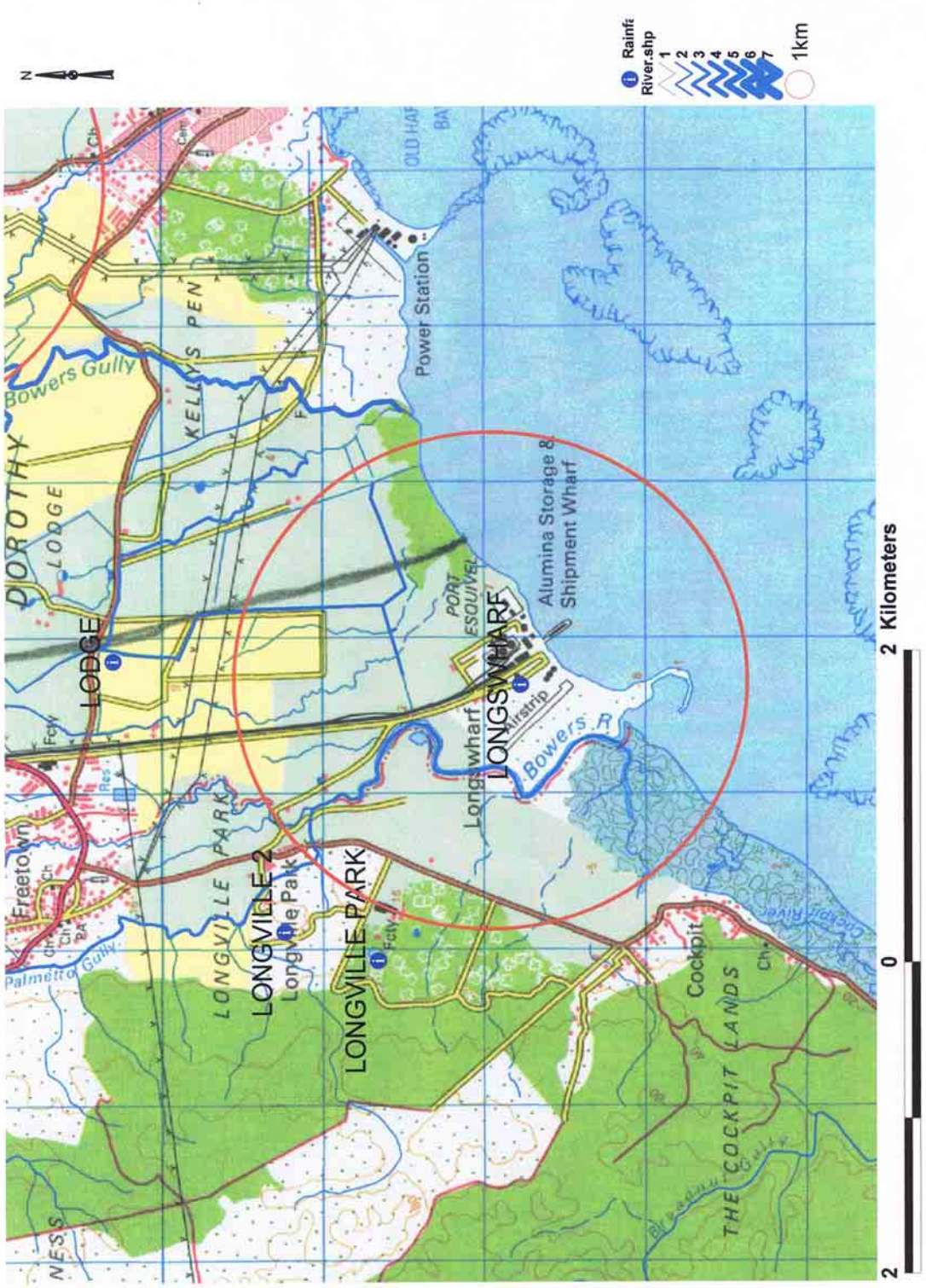
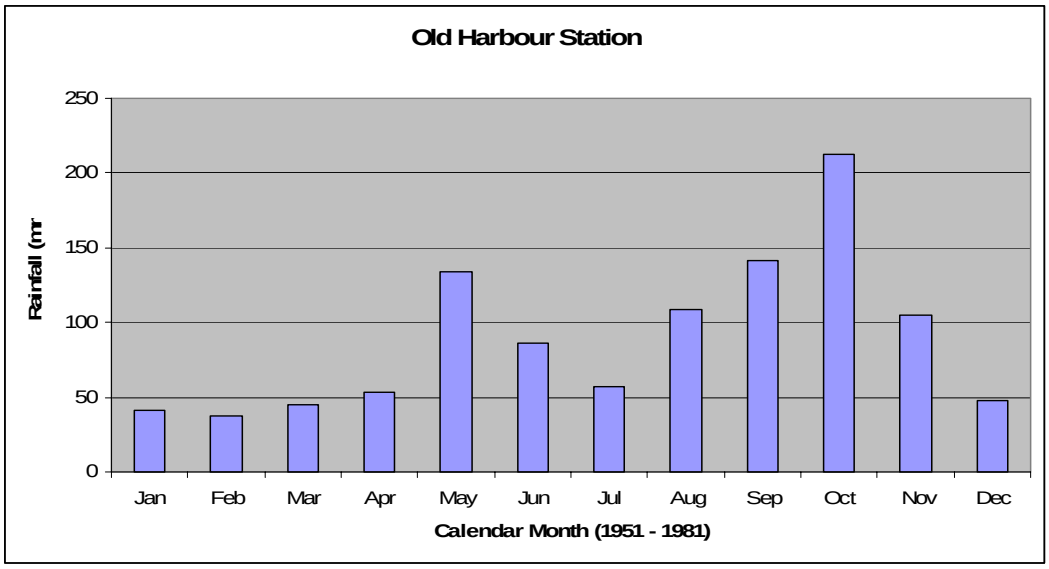


Figure 5.1.2 a: Location of Longswharf Meteorological Station

Table 5.1.2b: 24-hr rainfall intensity for Old Harbour Station (obtained from the Met Office & WRA)

Exceedance Probability	100% (1yr return)	50% (2yr return)	20% (5yr return)	10% (10yr return)	4% (25yr return)	2% (50yr return)	1% (100yr return)
24-hr rainfall (mm) –	-	105	164	203	252	288	324

Figure 5.1.2 b: 30 year mean rainfall in mm (Source: Meteorological Services)



The profile is bi-modal with a peak in May and again in October indicating two periods of heavier precipitation. This is consistent with the regional precipitation events across Jamaica.

The mean daily evaporation for the Bodles Station ranges from 4.1 mm in January to 7.1 mm in July.

Wind data was received from Windalco for June and July and is given in Appendix XIV. Air Quality is influenced by both local and regional climatic conditions. The rate of deposition of air pollutants is dependent on the size and density of the particle as well as atmospheric

conditions. An understanding of the prevailing long-term climatic patterns and the short term, site-specific meteorological conditions will help to assess the likely impact of emissions from the ethanol plant on local air quality. Table 5.1.2c and Table 5.1.2d summarises the wind speed and direction values recorded for June and July 2006 at the Windalco Port Esquivel Meteorological Station.

Table 5.1.2c: Wind Data for June 2006 at the Port Esquivel Weather Station

Day	Wind Speed (12am - 8am)	Wind Speed (9am - 11pm)	Wind Direction (12am - 8am)	Wind Direction (12am-8am)	Wind Direction (9am-11pm)	Wind Direction (9am-11pm)
1	3.56	8.95	334.11	NNW	126.33	ESE
2	3.66	9.79	298.22	WNW	148.60	SE
3	5.29	6.11	291.56	WNW	103.87	E
4	2.67	3.35	333.89	NNW	190.80	S
5	2.52	9.27	187.33	S	155.93	SSE
6	11.09	11.24	126.44	SE	151.07	SSE
7	4.24	5.10	115.11	ESE	133.80	SE
8	7.28	9.97	133.11	SE	117.40	ESE
9	5.97	10.33	76.56	ENE	119.00	ESE
10	9.90	11.47	93.44	E	117.67	ESE
11	9.27	11.13	93.11	E	110.13	ESE
12	5.54	11.59	95.44	E	113.73	ESE
13	2.87	13.20	244.33	WSW	112.27	ESE
14	4.42	14.81	268.56	W	112.67	ESE
15	11.19	9.18	95.00	E	114.53	ESE
16	3.03	4.12	328.11	NW	143.13	SE
17	2.78	6.44	330.22	NNW	135.73	SE
18	3.50	7.85	327.11	NW	151.33	SSE
19	2.77	10.20	335.11	NNW	103.40	E
20	3.04	5.62	330.67	NNW	117.67	ESE
21	1.87	6.17	290.33	WNW	91.47	E
22	2.29	10.40	238.56	SW	106.00	E
23	2.32	5.45	334.78	NNW	205.67	SSW
24	4.18	4.40	326.33	NW	192.67	S
25	3.80	6.22	330.44	NNW	156.20	SSE
26	2.31	12.98	266.78	W	113.73	ESE
27	2.28	13.45	300.00	WNW	119.67	ESE
28	3.52	8.55	332.44	NNW	166.73	SSE
29	1.21	10.11	334.44	NNW	100.73	E
30	2.38	11.89	337.67	NNW	128.33	ESE

Figure 5.1.2c: The Average Wind Speed Data for June 2006 at the Port Esquivel Weather Station

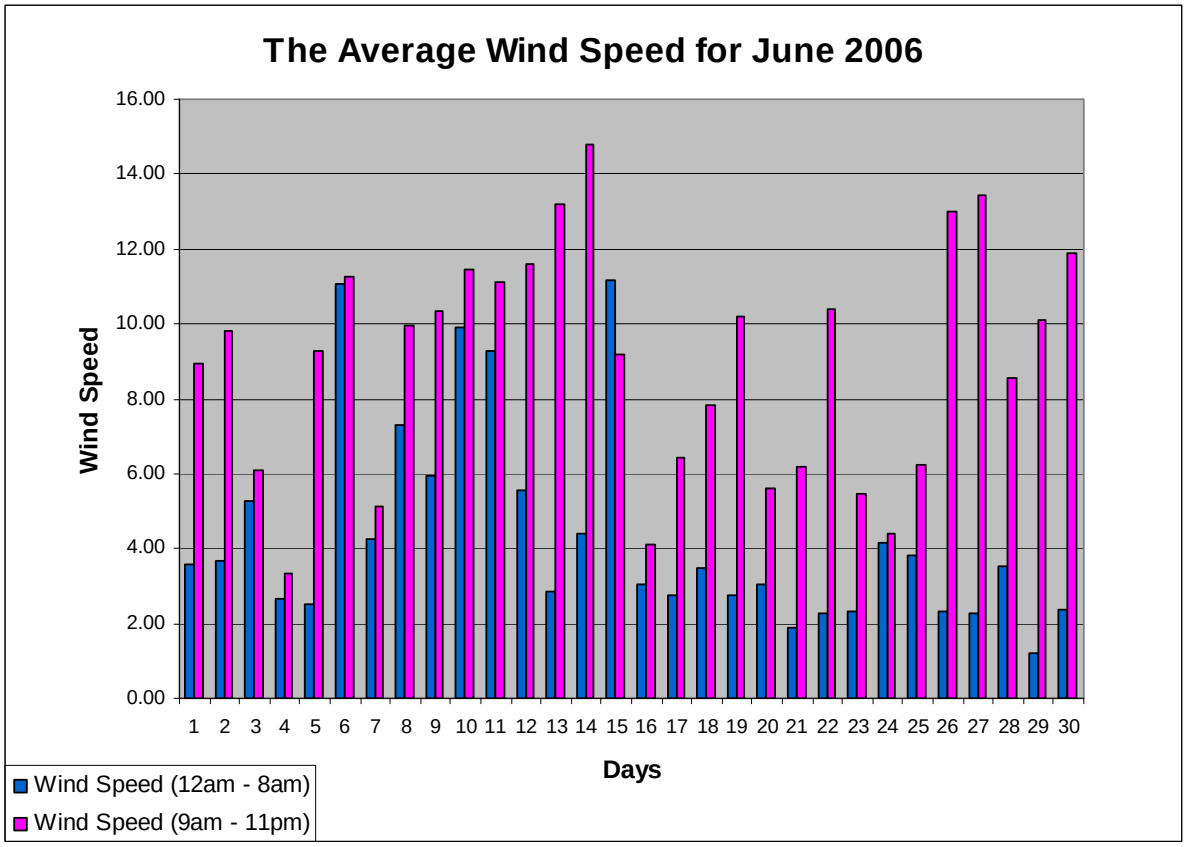


Figure 5.1.2d: The Average Wind Direction Data for June 2006 at the Port Esquivel Weather Station

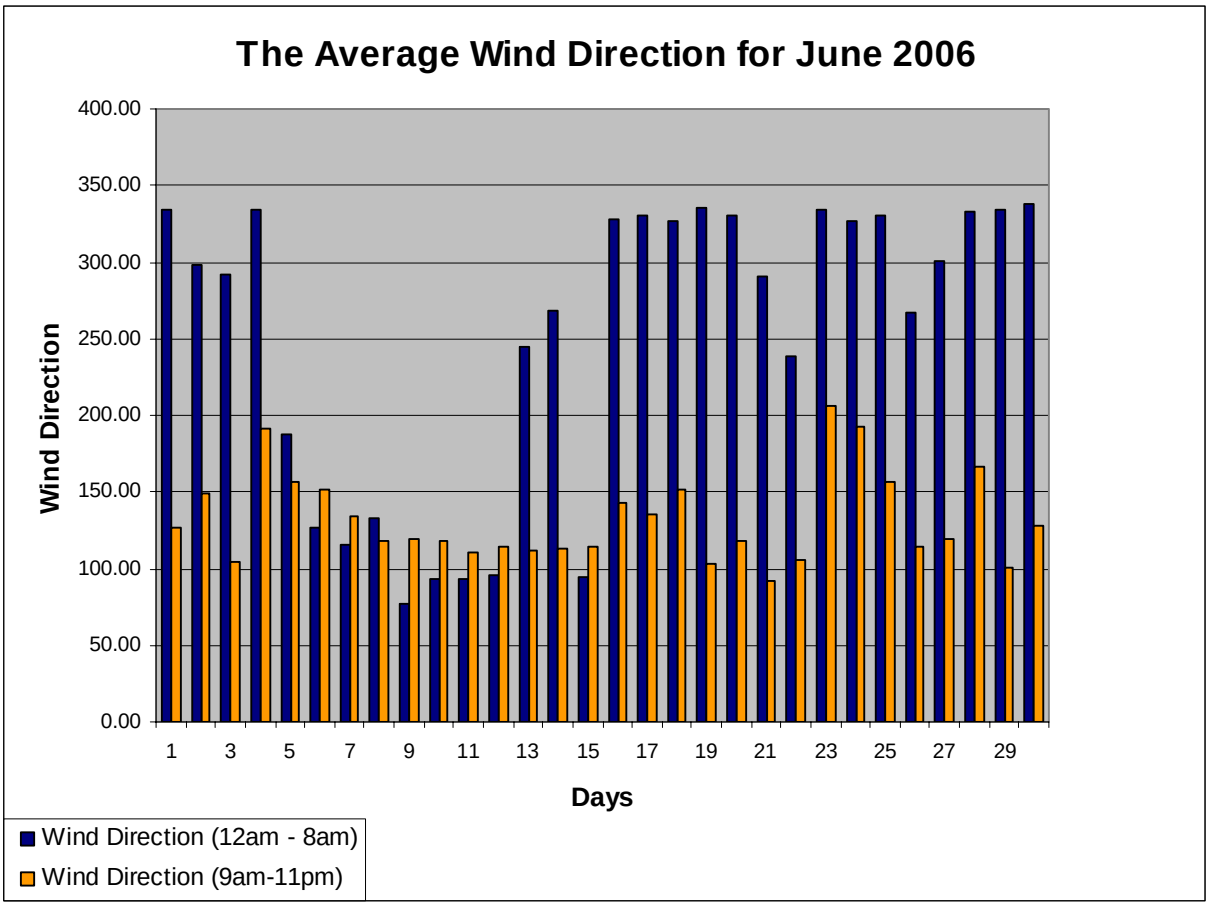


Table 5.1.2d: Wind Data for July 2006 at the Port Esquivel Weather Station

Day	Wind Speed (12am - 8am)	Wind Speed (9am - 11pm)	Wind Direction (12am - 8am)	Wind Direction (12am-8am)	Wind Direction (9am-11pm)	Wind Direction 9am-11(pm)
1	3.43	17.49	251.67	WSW	100.40	E
2	8.94	14.37	170.11	S	106.93	E
3	3.16	10.11	330.78	NNW	108.47	E
4	3.12	8.06	334.22	NNW	121.93	ESE
5	9.42	13.05	94.22	E	110.47	ESE
6	14.28	16.74	99.56	E	106.13	E
7	12.57	13.11	95.89	E	136.20	SE
8	1.31	10.51	321.33	NW	122.20	ESE
9	2.87	10.79	298.22	WNW	109.87	E
10	2.91	10.56	332.33	NNW	126.07	ESE
11	2.92	13.38	335.22	NNW	106.40	E
12	5.44	12.37	258.78	WSW	116.00	ESE
13	2.62	6.65	289.56	W	187.60	S
14	3.69	9.51	332.56	NNW	116.07	ESE
15	4.18	7.75	272.22	W	180.47	S
16	3.02	10.37	242.89	WSW	181.80	S
17	2.19	13.35	226.67	SW	109.60	E
18	4.74	4.72	329.00	NW	164.53	SSE
19	3.40	8.76	331.89	NNW	125.33	ESE
20	2.57	14.91	138.24	SE	111.32	ESE
21	8.14	8.78	178.78	S	164.00	SSE
22	2.17	9.56	292.33	WNW	108.93	E
23	2.89	13.12	269.44	W	113.47	ESE
24	5.29	13.07	282.67	W	145.33	SE
25	3.61	6.33	324.67	NW	156.07	SSE
26	2.79	4.79	331.44	NNW	217.60	SSW
27	5.19	5.85	323.78	NW	205.00	SSW
28	4.32	11.24	329.33	NW	140.13	SE
29	4.11	3.83	322.89	NW	138.07	SE
30	2.07	5.75	332.33	NNW	221.20	SW
31	1.32	5.05	198.22	S	105.27	E

Figure 5.1.2e: The Average Wind Speed Data for July 2006 at the Port Esquivel Weather Station

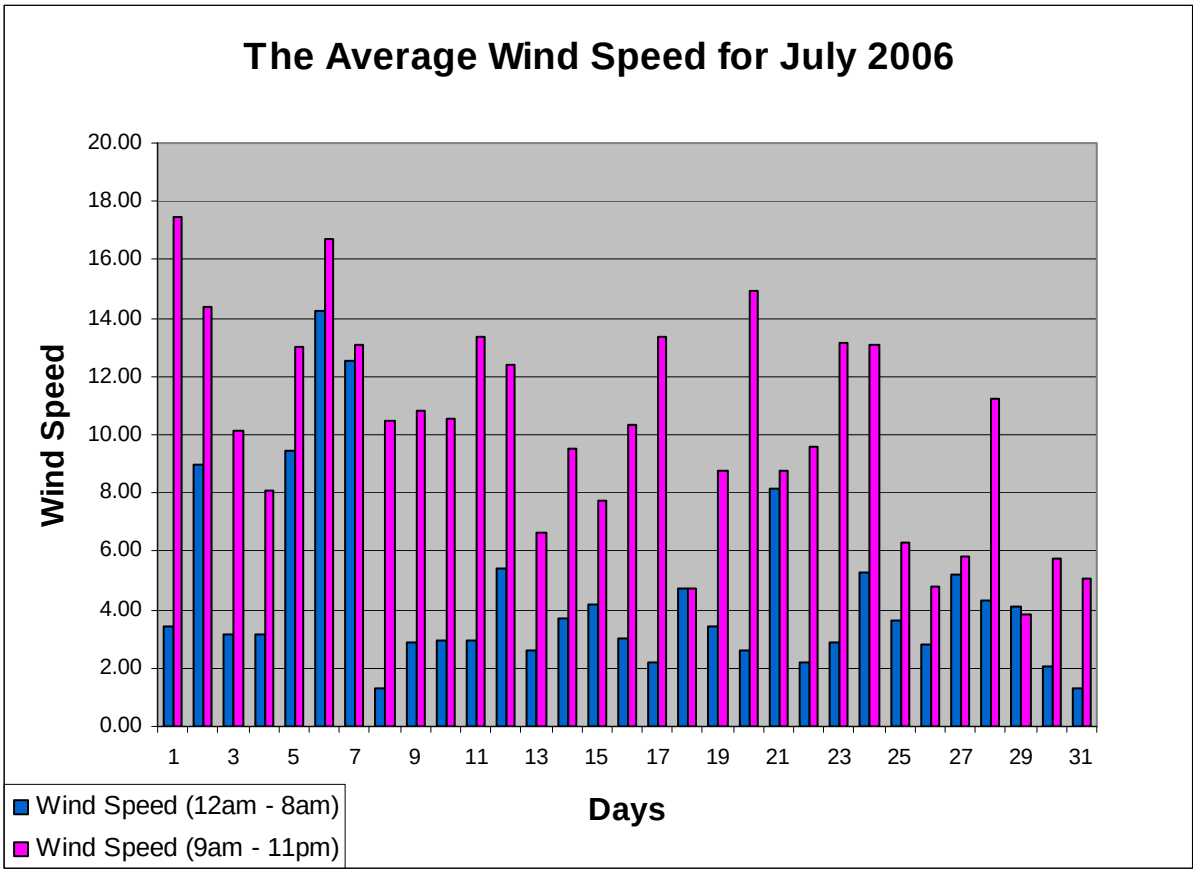
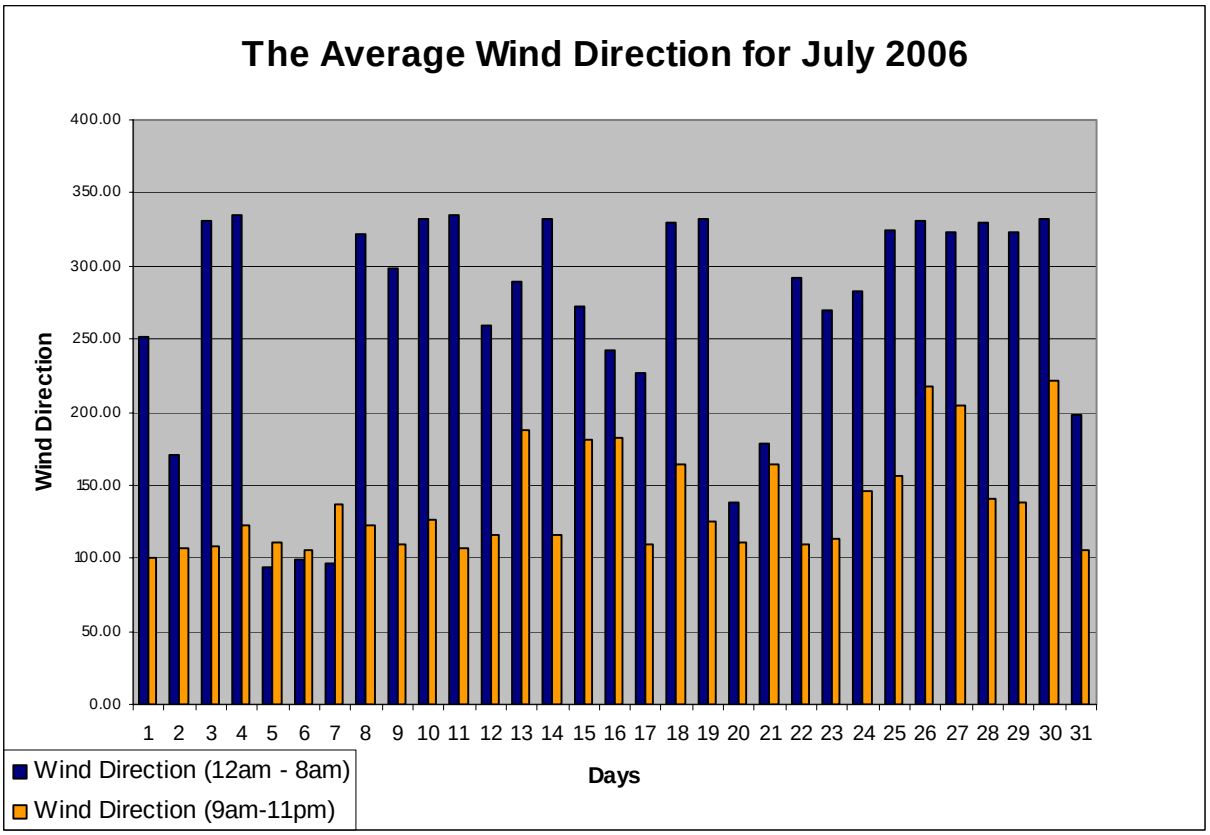


Figure 5.1.2f: The Average Wind Direction Data for July 2006 at the Port Esquivel Weather Station



The dominant winds over Jamaica are the northeast trade winds. The wind data for the two month review period show that the most predominant wind directions are from the northwest and north north west in the night and south south east during the day, (Tables 5.1.2c & d, Figures 5.1.2c, d, e and f). This is consistent with the historic patterns as reported by Windalco.

Analysis of the meteorological data generated in the project area over the period of investigation reveals that the neighboring properties north west of the site will be influenced during the daytime. During the night the winds are blowing in a southern direction and therefore should not impact any communities. The wind speeds ranged between 2.00 and 15 m/s.

5.1.3 Topography

The site is located on the western side of the Port Esquivel Alumina Storage and Shipment Wharf in St. Catherine. The landscape is flat and generally featureless to the shore where it meets the Caribbean Sea (Fig 4.2.6).

Elevation ranges from approximately 10-15 feet above sea level. The site is characterized by loamy soil and sandy soil, interspersed with gravel at some locations.

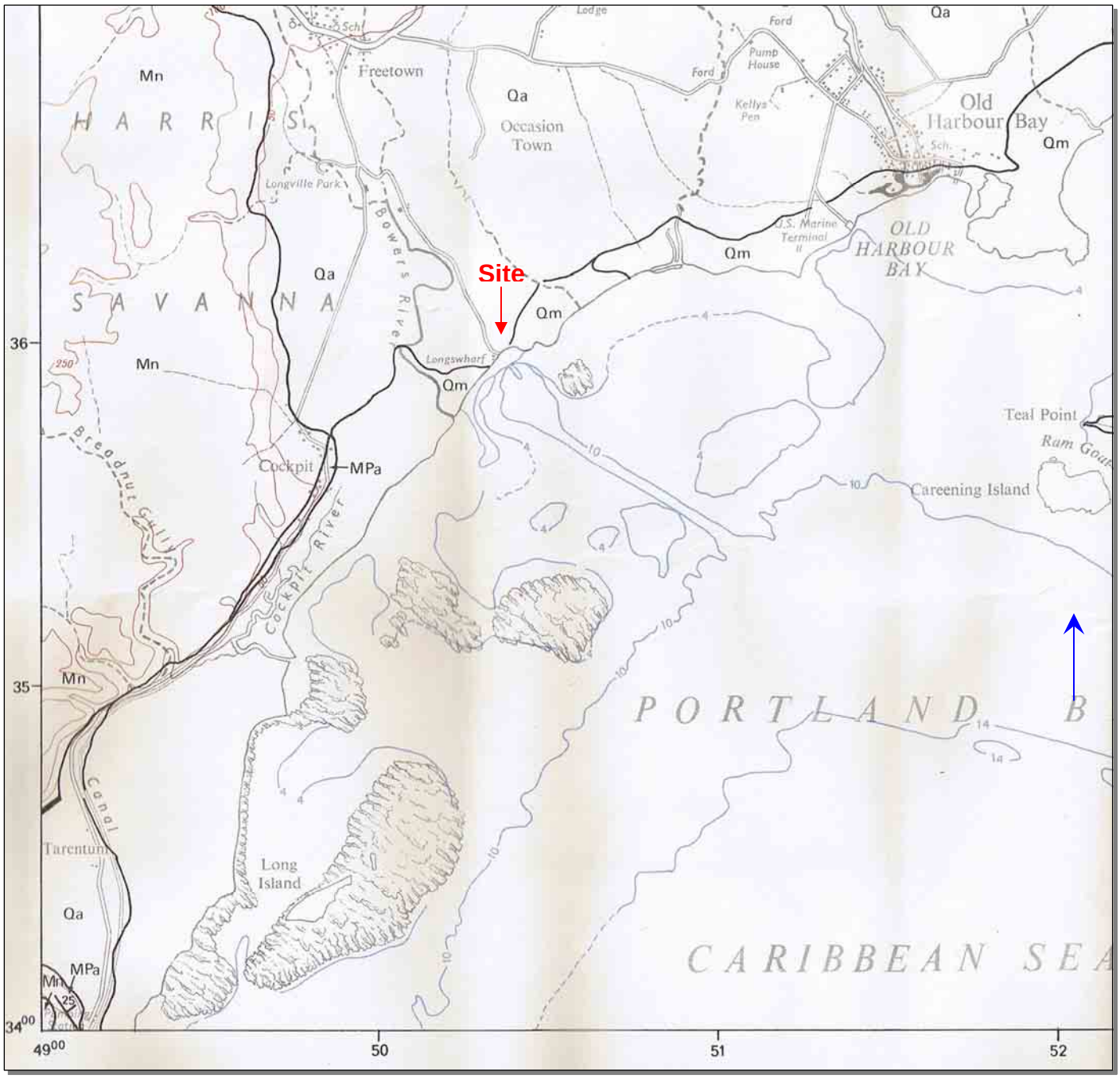
Plate 5.1.3 a: South view of site

Plate 5.1.3 b: South-easterly view of site

5.1.4 Geology and Hydrostratigraphy

Published geological information (Geological Map Sheet 20, 1:50,000 Imperial Series; Figure 5.1.4) indicates the oldest solid geology as Mid-Eocene Albert Town Member of the Yellow Limestone Group, followed by the Troy-Claremont Formation and the Newport Formation of the White Limestone Group.

Figure 5.1.4: Geology of Site (extracted from Geological Map Sheet 20, 1:50,000 Imperial Series).



Legend:
Qa – Alluvium
Qm – Mangrove and Swamp
Mn - Newport Limestone Formation
MPa – August Town Formation

The overlying superficial Plio-Pleistocene deposits, in the vicinity of the site, comprise coarse gravels, sand and clay derived from the Rio Cobre River that historically discharged sediments onto the St. Catherine Plains. The Alluvium is reported as ranging in thickness from a few metres near the contact with the surrounding hills to several hundred metres in the central areas of the alluvial plain.

The soils map of St. Catherine (1:50,000 Series) obtained from the Ministry of Agriculture indicated that the site is underlain by artificially made ground. Anecdotal evidence suggests that the site is comprised of material recovered from offshore dredging activities, which may explain the "made ground" determination on the soils maps. The twelve boreholes that were advanced during the July 2004 intrusive soil investigation did not clarify whether the material encountered was introduced or virgin. The details of each boring are summarized in the table below. The deeper limestone was not encountered in any of the borings. Groundwater was observed in all boreholes at around 4 – 7m bgl. Though no ground elevation were given for the borings, these are required in order to made a meaningful determination of the direction of groundwater flow, it is likely that the principal groundwater flow regime will be toward the south, i.e. toward the coastline. No groundwater analysis was reported.

Figure 5.1.5 presents all the well records held by the WRA within a 1km of the site. WRA records indicate no abstraction wells located within 1km of the site.

The WRA classifies both the solid geology and the superficial Alluvium deposits as aquifers. In the area water abstractions are generally obtained from the alluvial deposits with the deeper limestone aquifer being tapped in areas were the alluvial deposits are absent of too thin to be viable sources.

Table 5.1.4: Summary of Borehole Logs (Source: Jentech, 2004)

Borehole No.	Interpreted GEOLOGY
1	0-2m: Alternating gravel, clay and sand; 2-12m: Dark Brown silty clay; 12-18m: Alternating clay and Sand layers; 18-25m: Brown sandy Clay. Final GWL 7m bgl
2	0-1m: Made Ground (Fill); 1-6m: Brown Clay; 6-9m: Sand; 9-12m: Brown Clay; 12-14m: Brown Sand; 14-21m: Brown Clay with some sand; 21-23m: Brown Coarse Sand; and Clay to termination at 25m. Final GWL: 3.7m bgl
3	0-1.5m: Made Ground (Fill); 1.5-25m: Brown clay with sand and the bottom of borehole. Final GWL: 3.7m bgl
4	0-4.5m: Brown Clay and sand; 4.5-8m: Brown Clay with sand at 8m; 8-16m: Brown Clay; 16-22m: Unstable Sand; 22-25m: Brown and Grey Clay. Final GWL: 3.7m bgl
5	0-1.5m: Clay and Sand; 1.5-8m; Brown Clay; 8-9m: Clayey Sand; 9-12m: Brown Clay; 12-15m: Fine Sand; 15-18m: Brown Clayey Sand; 18-25m: Brown Sand. Final GWL: 6.1m bgl
6	0-5m: Brown Sand and Clay; 5-6m: Organic Material (Peat?); 6-17m: Brown Clay with occasional sand incorporated; 17-25m: Brown Sand with more clay at 25m. Final GWL: 6.1m
7	0-11m; Most Brown Clay; 11-14m: Brown Clay and Sand; 14-17m: Brown Clay; 17-25m: Brown Sand with more clay at 25m. Final GWL: 7.0m bgl
8	0-9m: Brown Clay with some sand; 9-12m: Brown Clay and Sand; 12-17m: Brown & Grey Clay; 17-20m: Clayey Sand; 20-25m: Brown Coarse Sand with clay at 25m. Final GWL: 7.0m bgl
9	0-9m: Clay; 9-14m: Brown Clay and Sand; 14-15m: Coarse Sand; 15-19m: Grey Clay with some sand. Final GWL: 6.7m bgl
10	0-8m: Brown Clay; 8-11m: Clayey Sand; 11-19m: Brown Clay. Final GWL: 7.0m bgl
11	0-8m: Brown Clay; 8-9m: Clayey Sand; 9-12m: Brown Coarse Gravel and Sand; 12-19m: Brown Clay. Final GWL: 7.0m bgl
12	0-6m: Brown Clay; 6-16m: Brown Clayey Sand. Final GWL: 5.5m bgl

5.1.5 Hydrology and Hydrogeology

The nearest, named surface watercourse to the site is the Bowers River, which lies approximately 1000m to the west. An intermittent watercourse (Bowers Bully) is located approximately 1500m east of the site (Figure 5.1.5) and drains into the Caribbean Sea. Neither water course impinge on the site, and therefore neither of them is considered material to the site's contributing drainage system.

Rainfall intensity data for the site was obtained from Longswharf station and are tabulated below:

Table 5.1.5: 24-hr Rainfall Intensity Data from Longswharf Station (Source: Water Resources Authority)

Exceedance Probability	100% (1yr return)	50% (2yr return)	20% (5yr return)	10% (10yr return)	4% (25yr return)	2% (50yr return)	1% (100yr return)
24-hr rainfall (mm) –	50 (est.)	62	95	123	159	185	210

The two wells proposed for use (Windalco and private individual owner) are outside the 1 km radius.

5.1.6 Sewerage Facilities

There is one record of a sewage treatment facility within 1000m of the site as held by the WRA. The treatment facility is located at the Windalco site is owned by Alcan Jamaica Co. and licensed by the NRCA (Licence No. 014L00; Permit No. 105P00 both issued March 30, 2001). Its design capacity is 18,000 L/day, however, there is no indication of the level of treatment i.e. whether secondary or tertiary treated effluent discharges from the plant.

No central sewerage system is available in the immediate area. The existing houses on the property have plumbing with their own existing septic tanks.

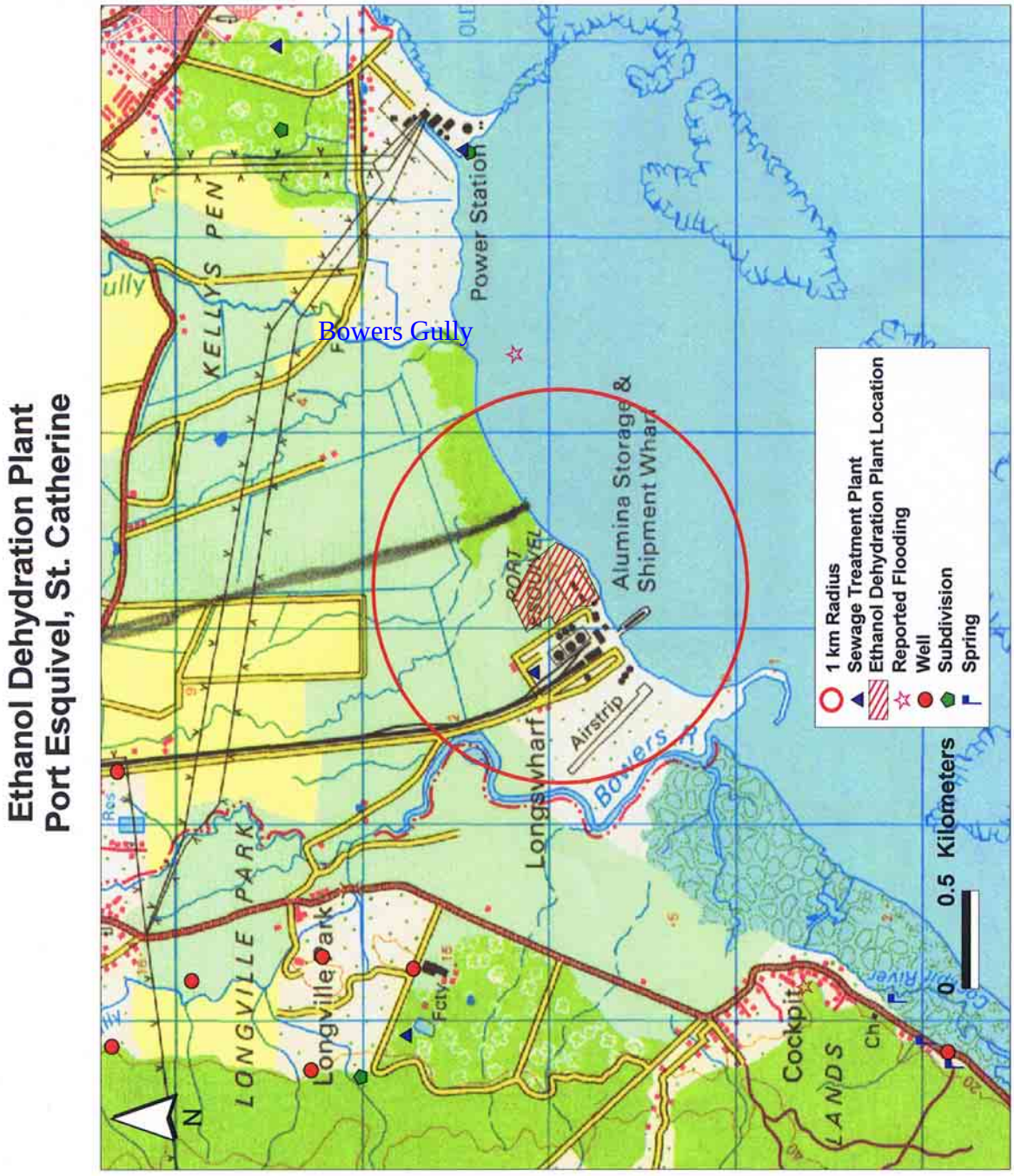


Figure 5.1.5: Drainage Systems in Proximity to the Project Site

5.1.7 Known Pollution Incidents

According to the WRA groundwater in the area is impacted by saline intrusion. Water quality from the Longville Park Farm A well, over 2km northwest of the site, recorded chloride levels between 324 – 368 mg/l in 1998. The normal expected ambient water quality range for chloride is 5 – 20 mg/l.

No other pollution incidents were reported.

5.1.8 Stormwater Runoff

For determining the storm runoff in Jamaica the 24-hour, 25-year return period storm is normally accepted as the design flow period. However, instead of return period, it is more accurate to think in terms of the exceedance probability (*p*), where *p*=1/T. Thus, a "25 year storm" actually designates a rainfall event which has a 4% chance of occurring in any given year. The predicted flows were obtained using Win-TR55. 24-hr rainfall was obtained from the WRA and a Type III curve was deemed most appropriate.

Given that the site is being developed near to lands that have been developed in the past, existing drainage controls have already been implemented as evidenced by the main site drain that borders the eastern boundary of the Windalco site. This drain is lined with masonry material comprising stone and cement and is trapezoid in shape. It is approximately 1m wide at its invert which tapers to 0.5m at its base by 1.5m deep. During the site walkover the drain was dry, as expected, with flow expected only during rainfall events.

5.1.8.1 Pre-Development Runoff

No upper contributory catchment could be easily defined for the site. It is likely that the main masonry drain effectively controls stormwater runoff from the lands north of the site. No over-topping of the drain has been reported. Therefore it is likely that run-off will be generated for the site footprint and no other up-gradient source.

The total storm runoff due to the site from a storm event with a 4% chance of occurring in any

one year is approximately 1.4 m^3/s. This assumes no ponding or retention and flows directly into the Caribbean Sea.

5.1.8.2 Post-Development Runoff

For post development storm runoff land use determinations were interpreted from the site layout plan which shows the site with the tank farm to the north, and office and staff quarters to the south. The table below presents the interpreted land-use.

Table 5.1.8.2 a: Proposed Site Land-Use Expressed As a Percentage of Total Site Area

Interpreted Land-use	% of total site catchment
Impervious areas (process facility, roofs, etc)	44%
Grassed areas (open green space)	66%

Post-development the predicted runoff with a 4% chance of occurring in any given year is estimated to be 1.95 m^3/s.

Table 5.1.8.2 b: Predicted Pre-And Post- Development Runoff Comparison

Site Catchment Area	Storm Runoff with a 4% exceedance probability
Pre-development (i.e. existing land use)	1.4 m^3/s
Post-development (i.e. proposed land use)	~1.9 m^3/s
Increase above existing	0.5 m^3/s

The complete pre- and post-development WinTR-55 reports are presented in Appendix XIII (Physical Baseline Data).

5.1.9 Stormwater Management

At ethanol plants, stormwater discharges may occur as part of construction activities or as part of ongoing industrial activities. During construction activities, stormwater runoff may come

into contact with bare soils, or pollutants such as oil and grease. During industrial activities, stormwater may come into contact with potential pollutants such as oil, grease, and other chemicals and contaminants from rooftops, roads, parking lots.

5.1.10 Marine Sediment Analysis

Table: 5.1.10: Grab Sediment Sample Data for the Jamaica Broilers Ethanol Project Site May 4, 2006

LOCATION	*PARAMETERS*			
	NEPA Standards			
	0.10	3	0.10	1
	Copper (ppm)	Iron (ppm)	Lead (ppm)	Manganese (ppm)
JBO1	1.60	4.83	0.036	3.48
JBO2	11.4	6.34	0.066	3.87
JBO3	9.42	11.4	0.0026	1.55
JBO4	0.951	1.49	0.00096	0.333
JBO5	1.70	3.74	0.029	2.20
JBO6	0.742	12.8	0.0027	1.23
JBO7	2.38	25.0	0.032	3.02

For this study, bottom sediment samples were collected from seven coastal sites in proximity to the proposed Jamaica Broilers Ethanol Plant project site (Figure 4.2.9). Bottom-sediment samples were collected and analyzed for four metals: copper, iron, lead and manganese and are compared with the concentrations of these elements in unpolluted northeastern US soils (no available local soil data). The samples were collected from the near shore (JB01, JB02 & JB03) and approximately one mile offshore (JB04, JB05, JB06 & JB07).

NEPA does not have any guidelines for the concentration of metals in sediments or soils. The results were also compared with the NEPA guidelines for metals in trade effluent. It is expected that the corresponding sediment standard should be greater than the effluent standard.

Onsite observations revealed that the sampling stations were all quite turbid. The coastal zone receives a considerable amount of runoff carrying high solids loading from the town via Bowers Gully resulting in the need to dredge the bay quite frequently.

The data presented in Table 5.1.10 above show that the concentration of copper, iron and manganese significantly exceed the respective NRCA trade effluent guidelines at all sites except JB04. The recorded metal levels are however well within the natural concentrations of these elements in US soils (Appendix XIII).

5.1.11 Noise

The noise measurements recorded for the present study are presented in Table 5.1.11.

Table 5.1.11: Noise measurements conducted at the Ethanol Plant Project Site, July 5-7, 2006

LOCATION	Results Noise dBA	Comments	NEPA Guideline dBA
Western End at the Coast	96.7	Strong prevailing winds at the coastline and rough seas.	75
Eastern End of Property	95.3	Strong prevailing winds at the coastline and rough seas.	

The noise levels recorded at the stations monitored are currently above the NEPA guideline for perimeter noise. The site is being impacted by the industrial activities at Windalco as well as high winds and high wave action.

5.1.12 Air Quality

Particulate matter (PM) refers to discrete particles in ambient air that exist either as solid particles, or as liquid droplets. The sources of PM are: natural, e.g. pollen; a combination of natural and man-made in variable proportions, e.g. dust in a park, roadside dust, smoke from vegetation and wood burning; and wholly man-made, either: - naturally, e.g. household dust from skin shedding; or - activity-related, e.g. smoking, cooking and barbecuing, vehicle use, industrial activities, etc.

The sizes of PMs cover a very wide range: from the tiniest in smokes and aerosols (e.g. perfumes), through the maximum respirable size 10 microns (µm) up to 'grit in the eye' sizes of 100 µm and upwards.

Many particles do not maintain a constant form during their lifetimes in the atmosphere: many agglomerate to become fewer, larger particles whilst others react chemically to become something different altogether. The normal fate of PM is deposition. The rate of deposition depends upon the size and density of the particle as well as atmospheric conditions. The deposition rate in still air approaches 90 to 100 per cent for particles that are larger than 0.5 µm, whilst particles smaller than 0.5 µm will tend increasingly to remain suspended in the air. Atmospheric turbulence is an important factor and can have opposite effects, ventilation and turbulence. On the one hand, ventilation disperses concentrations of PM, while on the other hand turbulence reduces the rate of deposition. Hence, the PMs' size distributions, their other physical and chemical properties and their concentrations in ambient air are highly variable, depending on the particular characteristics of the biosphere at issue (e.g. which geographic region, urban or rural) and the ecosystem involved (e.g. indoor, outdoor, roadside, street, etc.).

The ambient air quality data generated for the present study are presented in Table 5.1.12.

Table 5.1.12: Ambient Respirable Air Quality Data for the Jamaica Broilers Proposed Ethanol Plant Site, July 6-7, 2006.

LOCATION	Results extrapolated to 8 hrs/μg/m^3	NEPA 24 Hr Guideline μg/m^3
Western End of Property	11.3	150
Eastern End of Property	0.5	

Respirable particulates levels were well within the recommended ambient air quality PM10 guidelines established by NEPA. The stations are also subject to a significant amount of fugitive dust from the shipping activities at the port. Historical data (Appendix I) indicate that PM10 and total suspended particulate (TSP) measurements taken in at the site were generally within the established national ambient air quality guidelines. The TSP levels at the main gate were however considerably elevated on several occasions.

5.1.13 Natural Hazards

The WRA has no reports of any flooding incidents within 1km of the site. The low permeability of the upper soils, however, does occasionally cause shallow ponding after heavy precipitation. But this is not a material concern as the main plant will be located on concrete pads which will preclude any future ponding.

The WRA, with reference to the National Irrigation Developme nt Master Plan, indicates that the site is vulnerable to storm surges (quantities not given) as they have occurred in the past.

The site is flat hence the potential of landslides will be non-existent. Any constructed slopes or berms should be carefully designed to prevent slippage especially during heavy and prolonged precipitation events.

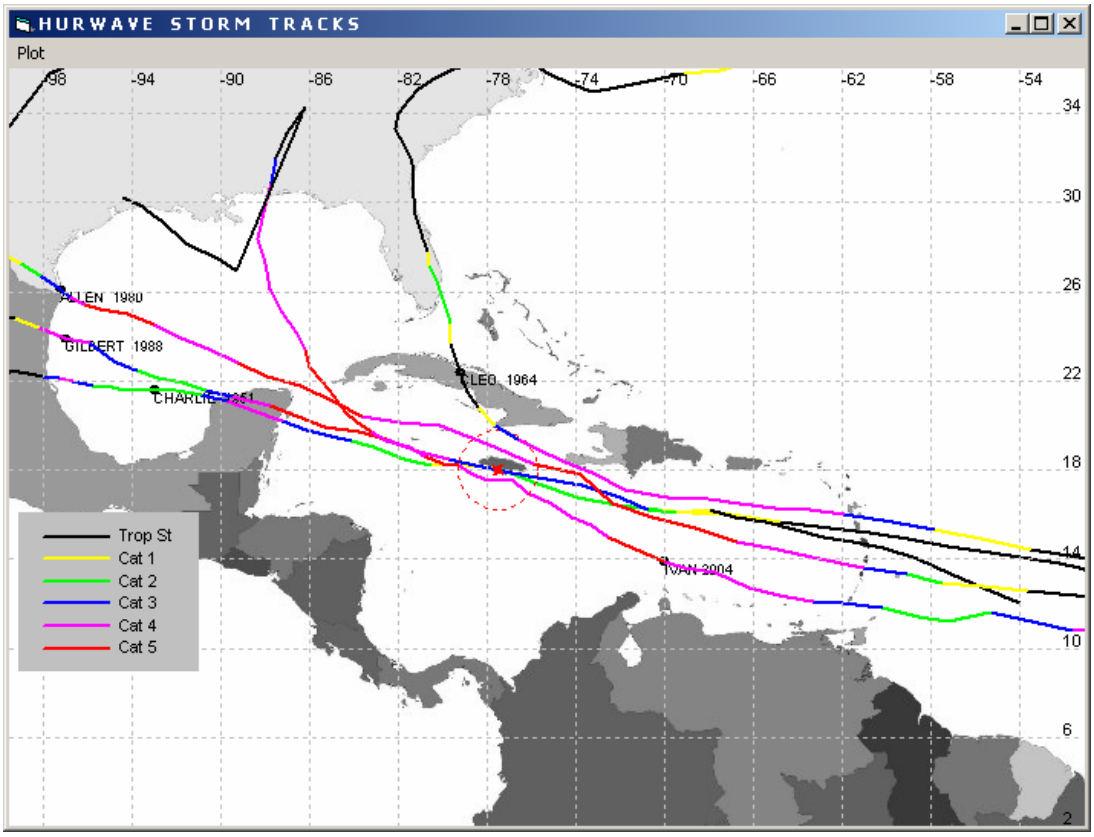
5.1.13.1 Flooding

Flood history was ascertained from discussions with Windalco as well as with data from ODPEM. Windalco reported no flooding incidents on the site.

5.1.13.2 Hurricanes

Jamaica is susceptible to hurricanes and other storm events as indicated by the historic hurricane tracks (Figure 5.1.13.2). The rainy season is from May to October, with peaks in May and October, and tropical depressions, storms and hurricanes can occur any time during this period. These systems usually bring large volumes of rain with or without flash floods, slow inundation and high winds.

Figure 5.1.13.2: Historic Hurricane Tracks Across Jamaica – 1880-1988

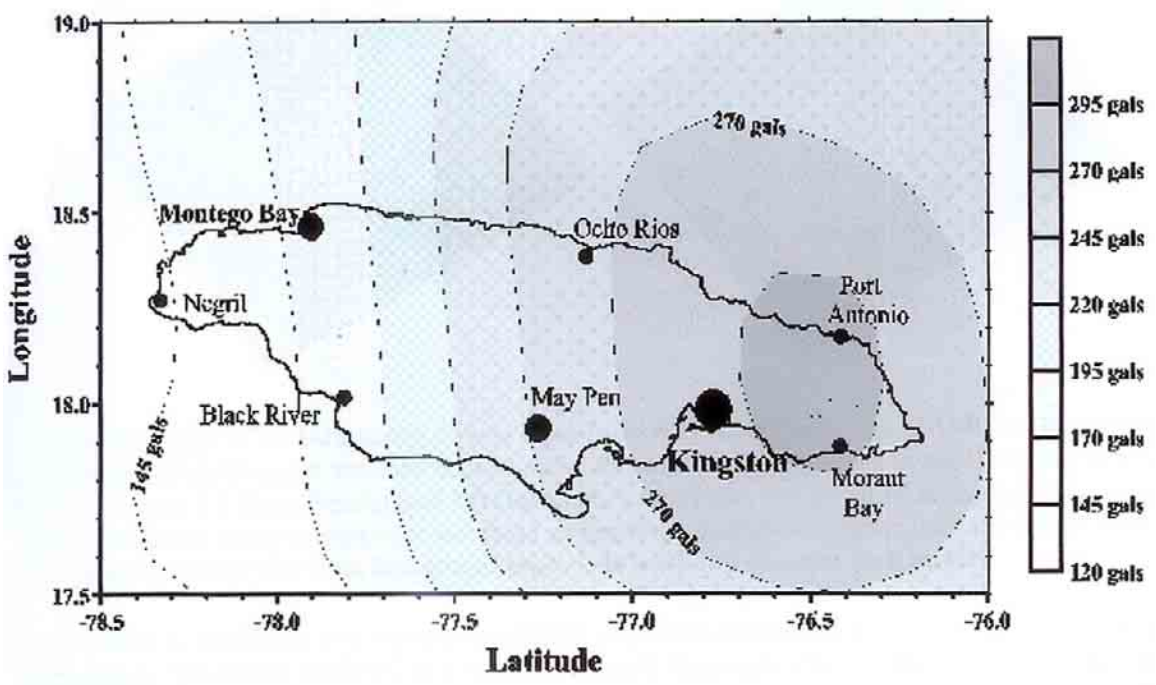


Given that the Windalco plant has withstood several recent major hurricanes including Hurricane Ivan, 2004, Hurricane Rita, 2005 and Hurricane Wilma, 2005. The main plant, including the tank farm, is setback 800m from the shoreline, which will reduce the impact of storm surges.

5.1.13.3 Earthquakes

The main effect from earthquakes on land is the impact of ground shaking on structures. The impact on buildings in turn depends on the nature of the soils at the site and the design of the building. In general high rise buildings are more vulnerable to ground shaking than low rise buildings. The potential for earthquake related ground shaking throughout Jamaica was studied by Shephard, 1997. Figure 5.1.13.3 shows the range of peak horizontal ground acceleration that can be expected across Jamaica.

Figure 5.1.13.3: Expected Peak Horizontal Ground Acceleration (Source: Shephard, *et al*, 1997)



The project site lies to the west and just outside the two maximum zones of highest expected peak horizontal ground acceleration.

5.1.13.4 Landslides

Landslides are not applicable to the site, as it is relatively flat.

5.2 Biological Environment

Data sets for biological baseline assessed are given in Appendix XIV.

5.2.1 Terrestrial Flora and Habitats

In general the project site was highly disturbed and influenced by the activities occurring at the neighboring Port. It exhibited some natural zonation due mostly to the influence of the sea. The low canopy height and plant species diversity did not readily support a great diversity of other wildlife. The beach zone showed signs of significant disturbance but this may be related to recent hurricane activity although this damage was more obvious in the mature mangrove forest to the east of the site. The vegetation suggested that the site may have been cleared in the past and been re-colonised by many of the naturally occurring species along the beach but inland areas are dominated by a few introduced or pioneer species. The high soil salinity and air would have prevented many other invasive species from occupying the site although it had been cleared.

5.2.1.1 Beach Zone

The beach was populated by typical coastal pioneer species such as beach grass *Sporobolus virginicus*, Beach Pea (*Canavalia maritima*), Seaside Purslane (*Sesuvium portulacastrum*), Seaside Mahoe (*Thespesia populnea*) and Black Mangrove trees (*Avicennia germinans*).

There were some small pools in the vicinity of two pipelines near the eastern border of the site. These pools could have been part of an old drainage feature. They were surrounded by mangrove trees and showed evidence of being regularly flooded by incoming waves from the sea. There was a small salt pond located behind these pools that was separate from the extensive flats on the north of the site. Several sandpipers and other wading birds were seen on the beach but they were few in number. However the number and diversity of waders on the beach would be expected to increase in a September and October when neotropical migratory birds begin their fall migration to the area. The Yellow Warbler (*Dendroica petechia*) was common in the mangroves of this zone and its distinctive call could be heard from neighboring zones. Frigatebirds (*Fregata magnificens*) and Brown Pelicans (*Pelecanus occidentalis*) were also common along the beach but could often be seen from anywhere on the site.

5.2.1.2 Coastal Thorn Scrub

The dominant plants in this zone are Cashaw (*Prosopis juliflora*) and Acacia (*Acacia tortuosa*) which are interspersed with coastal (salt tolerant) shrubs and herbs such as Crab Withe (*Alternanthera ficoidea*) and cacti (*Opuntia jamaicensis).* The vegetation here is very thick and could not easily be traversed except by the road, the canopy height was typically 2 – 2.5 metres with the Cashaw trees being the tallest plant. The various species of cacti were all found in this zone mixed among the Cashaw and Acacia trees. The vegetation became less dense along the northern edge where there is a transition to the more open salina to the north.

There was a strip of cleared vegetation up to thirty metres wide along the eastern edge of this zone running next to the fence between the port and the housing area. This strip was recently cleared and was beginning to be regenerated by Cashaw and Acacia. The clearing of the thick vegetation provide space for many other herbs, shrubs, vines and grasses and this made it the best habitat for butterflies which mainly feed on the flowers of those shrubs and herbs. Some of the preferred flowers included Scorpionweed (*Heliotropium indicum)*, Coralita (*Antigonon leptopus*) and Lantana (*Lantana camara*).

The Opuntia (*Opuntia jamaicensis*) and the Prickle Withe (*Hylocereus triangularis*) are endemic to Jamaica. The Prickle Withe is widespread and common in thickets, on rocks and on large old trees. The Opuntia is described as being very abundant locally in Manchester and St Catherine, forming pure stands near mangrove and logwood thickets and salinas in heavy silt alluvium near sea level (Adams 1972).

5.2.1.3 Salt Flats

The Salt Flats were mainly located to the north of the site. The only plant growing in that zone was the Jamaican Samphire (*Batis maritima*). There were many white butterflies in the area but they were mainly of a single species, the Cabbage Butterfly (*Ascia monuste eubotea*). They did not appear to be feeding on the Samphire but were swarming over the open area.

5.2.1.4 House and Gardens

The area within the chain link fence surrounding the houses includes gardens with fruiting and ornamental plants. The largest fruit tree was the mango tree and an Otaheite Apple tree (*Syzygium malaccense)*. There were also a few Orange (*Citrus sinensis*) and Sweet Sop trees (*Annona squamosa*). There were several planted hedgerows along the fences within the property and along the perimeter fence. Most of the hedges within the perimeter were made of Privet (*Pithecellobium unguis-cati*) but other species such as the June Rose (*Lagerstroemia indica)* were sometimes planted in rows. The larger ornamental trees in this area included Poinciana (*Delonix regia*), Cassia trees (*Cassia fistula*), African Tulip (*Spathodea campanulata*), Yellow Poui (*Tabebuia rufescens*), Norfolk Island Pine (*Araucaria heterophylla)* and Coconuts *(Cocos nucifera).*

The smaller ornamentals included Oleander (*Nerium oleander*), Crotons (*Codiaeum variegatum*), Ixora (*Ixora coccinea)* and Bougainvillea (*Bougainvillea glabra*).

A full list of the species of flora is given in Appendix XIV.

5.2.2 Terrestrial Fauna

The fauna observed on the site included native, endemic and migrant bird species, butterflies, reptiles, amphibians and mammals. No bats were observed. A list of the species birds, including migrants, and butterflies present is given in Appendix XIV.

Plate 5.2.1. 3a: Batis Salt Flats

Plate 5.2.1.3b: ***Canavalia maritime***

Plate 5.2.1.3c: *Cassia fistula*

Plate 5.2.1.3d: Cycad (Zamia)

5.2.2.1 Bird Species

There were only thirty five bird species observed during the survey. Many of these species were detected from the neighboring wetlands to the east or along the beach. The Thorn Scrub which was the largest habitat type was the poorest in species diversity. The relatively low diversity is a reflection of the highly disturbed nature of the site. The dominant bird species was the Grey Kingbird (*Tyrannus dominicensis)* which could be seen or heard from almost any part of the site. This species is an austral migrant which comes to Jamaica in the summer to breed and returns to the south (northern South America) in the winter. They are particularly aggressive and vocal and frequent open perches atop the taller trees or utility poles and perimeter fencing of the housing area.

Several waterbird and seabird species were detected, mainly at the seaside or from the nearby wetland. These included Royal Terns (*Sterna maxima*), Spotted Sandpipers (*Actitis macularia*), Great Egrets (*Ardea alba*) and Green Herons (*Butorides virescens*). Although no threatened or rare bird species were detected on the site during these surveys several uncommon migratory species would be expected to be found there during migration since the site is located on the south coast where neotropical migrants often congregate in large numbers particularly during the southbound (fall) migration.

5.2.2.2 Endemic Bird Species

Only two of Jamaica's 28 extant endemic bird species were observed – the Jamaican Woodpecker (*Melanerpes radiolatus)* which was heard in the mangrove forests adjoining the site and the Jamaican (*Vireo modestus*). These are two of the most common and widespread endemics and unlike the majority of Jamaican endemics they are not dependent upon well developed forests and are adaptable to many types of disturbed habitats as long as there is sufficient tree cover.

5.2.2.3 Migrant Bird Species

Neotropical migratory birds account for nearly half the total number of bird species occurring in Jamaica. This survey was conducted during the summer months when all such species are on the northern breeding grounds. This means that there are several potential species which

regularly occur on similar sites in Portland Bight and therefore would be expected to occur on the site that could not be surveyed. However there are a few migrants that come to Jamaica to breed in the summer months, the two most prevalent of these austral migrants is the Grey Kingbird (*Tyrannus dominicensis*) and the Black-whiskered vireo (*Vireo altiloquus*) both of which were common on the site. The table of species includes the most likely migrants that may be expected to utilize the site (based on knowledge of the typical prevalence of these species in comparable habitat). Most likely species include American Redstart (*Setophaga ruticilla),* Prairie Warbler (*Dendroica discolor)* and Palm Warbler (*Dendroica palmarum).* The Northern Waterthrush *(Seiurus noveboracensis*) may be expected to occur in the mangroves especially along the banks of the Bowers Gully and the small ponds near the beach.

The beach area can be expected to be used by migratory shorebirds particularly because it is located on the south coast, is surrounded by wetland areas and it is relatively undisturbed. Several uncommon migrant species such as Whimbrel (*Numenius phaeopus*), Dunlin (*Calidris alpina*) and Short-billed Dowitcher (*Limnodromus griseus*) are occasionally observed on nearby beaches such as Old Harbour Bay and Goat Islands.

5.2.2.4 Nocturnal Birds

Surveys were conducted at dusk until 8:30 p.m. on August 21st. No owls or nighthawks were observed. The only night bird detected was a Black–crowned Night Heron (*Nycticorax nycticorax*) - seen flying over the wetland areas and the beach.

5.2.2.5 Butterflies

Fifteen species of butterflies were observed on the site. Most were found in the strip of cleared vegetation next to the fence between the houses and the Port. The most common species was the Antillean Great White or Cabbage Butterfly (*Ascia monuste eubotea*) which was seen swarming over the open salt flats to the north of the site. The tiny Hanno Blue (*Hemiargus hanno ceraunus*) was also very abundant in the grasses along the cleared strip as well as around the houses. All the species identified were common and most were typical of disturbed open habitats. Only two endemic sub-species of butterfly were observed, they were the Jamaican Queen (*Danaus gilippus jamaicensis*) which is described as common in low lying

habitats and is known from this locality (Brown and Heineman 1972) and the Jamaican Peacock (*Anartia jatrophae jamaicensis*) which is also common island wide. Plates 5.2.2.5a-c show three of the species that were reported on the site.

Plate 5.2.2.5a: Checkered Skipper (Pyrgus)

Plate 5.2.2.5b: Hanno blue

Plate 5.2.2.5c: Cloudless Sulphur

5.2.2.6 Reptiles

There were several anolis lizards seen mainly in the garden, these were the species *Anolis lineatopus*. Geckoes (croaking lizards) (*Aristelliger praesignis*) were heard calling again mainly in the gardens but both species should occur throughout the site.

American Crocodiles (*Crocodylus acutus*) were not observed during these surveys but are known to frequent the area and have been recorded on the beach during crocodile surveys (C-CAM unpublished data). The crocodile is a locally and globally threatened and protected species. The Bowers River and Bowers Gully to the west and east of the site respectively are important habitat for this species and the Rolling Bay beach which is no more than a few hundred metres away is regarded as one of the most important nesting sites for crocodiles in the Portland Bight Protected Area (D. Kelly[1] pers. comm.).

[1] Deon Kelly is currently pursuing a Masters degree at the University of the West Indies examining the status of crocodiles in Jamaica. The and C-CAM have been involved in Crocodile surveys in the Portland Bight area for several years.

Since the site can be expected to be visited by crocodiles it is important that adequate perimeter fencing be installed to prevent the animals from entering the property and becoming a danger to the workers or themselves. Additionally efforts should be made to inform the management and workers of the appropriate procedures to take in the event that they encounter a crocodile on the site.

5.2.2.7 Mammals

The only mammal observed on the site was the Small Indian Mongoose (*Herpestes javanicus).* It is likely that there were rats on the site especially since the Port is used to import grain and spilled grains can often be seen along the roadway however none were observed. No bats were observed in the night.

5.2.2.8 Amphibians

The only frog seen or heard on the site was the introduced cane toad (*Buffo marinus*).

5.2.3 Parks and Protected Areas

This development is located within the boundaries of the Portland Bight Protected Area (PBPA). It is Jamaica's largest protected area and has been in existence since April 1999. The responsibility for managing Jamaica's proposed system of protected areas belongs to the National Environment and Planning Agency (NEPA) whose policy is to delegate some of this responsibility to local non-government organizations. The Caribbean Coastal Area Management (C-CAM) Foundation has been delegated some management responsibilities within the PBPA since 2003. ESL and Jamaica Broilers contacted C-CAM to advise them of the project verbally and in writing (Appendix XV).

The site is located in an area that is currently considered ecologically sensitive due to its wetlands and wildlife but has not been zoned for any sort of special protection under the PBPA management plan.

The American Crocodile is the only species of special concern in the PBPA that is found on the site of the proposed development. The evidence suggests that crocodiles may cross the property so it is important that this does not result in conflict.

Other areas of concern for the location of this development in the protected area relate to the measures for prevention and management of pollution. C-CAM and NEPA would need to be satisfied that adequate measures will be put in place for regular monitoring of environmental parameters around the site to ensure that they fall within the government standards for public health and environmental safety. They will want to be assured that where discharge is occasioned e.g. because of an accident or spill, that adequate containment procedures and equipment are maintained to mitigate any possible effects on the environment.

5.2.4 Marine Environment

The benthic community at all three inshore sites was similar, consisting of fine, silty, muddy sediment, and ranging from one to three (1 – 3) metres in depth. As a result, visibility was poor as the water was extremely turbid. Very small patches of sparsely growing seagrass (*Thalassia testudinum* and *Syringodium filiforme*) were occasionally seen at Site 3 (Plate 5.2.4a), but other than that, the entire inshore area was devoid of seagrass. Table 5.2.4a shows a species list of the benthic flora within Port Esquivel, obtained from past studies. Very few variegated urchins (*Lytechinus variegatus*) were seen interspersed along the seafloor. The sediment samples lacked any sort of life as well, however, numerous polychaete mounds and holes were observed in the muddy substrate throughout the entire inshore area (Plate 5.2.4b).

Both offshore sites, located about 3 km from the shore, are characterized by shallow (1.5m), flat pavement covered by a thin layer of white, medium grain sand. Here exists extensive, healthy, seagrass meadows comprised solely of *Thalassia testudinum*, with interspersed benthic macroalgae such as *Halimeda sp.*, *Caulerpa racemosa*, *Caulerpa sertularoides*, *Dictyota*, and *Padina* (Plates 5.2.4c,d,e). Mounds of dead coral heads overgrown by fleshy macroalgae, occurred sporadically amongst the seagrass bed, as well as patches of coral rubble (Plate 5.2.4f). Fish life is comprised of juvenile reef fish, namely damselfish and parrotfish,

while the benthic macroinvertebrate fauna consists of variegated urchins and sea stars. These extensive seagrass beds are clearly used by a number of animal species for feeding, and as nursery grounds for juvenile development. These lush, shallow, pristine areas provide ideal conditions for both activities. No coral reef communities were observed within the area.

The sediment grab samples revealed the likes of barnacles, gastropods, bivalves, polychaete worms, and flatworms.

The National Environment and Planning Agency (NEPA) has recorded sightings of green, hawksbill, and loggerhead turtles, crocodiles, and manatees in the Old Harbour Bay area, east of the proposed development site (CL Environmental Co. Ltd., 2005). All of these species are protected under the Wildlife Protection Act, and may be found throughout the Portland Bight Protected Area.

Table 5.2.4 a - Benthic Flora, Port Esquivel (Source: Lawrence, 1994)

TYPE	SCIENTIFIC NAME
Seagrass	*Thalassia testudinum*
	Syringodium filiforme
Algae	*Stypodium zonale*
	Padina jamaicensis
	Caulerpa racemosa
	Turbinaria turbinata
	Halimeda incrassata
	Dictyota sp.
	Acetabularia sp.
	Sargassum sp.

Table 5.2.4 b – Benthic Flora and Fauna at Sampling Sites

COMMON NAME	SCIENTIFIC NAME
Flora Turtle grass	*Thalassia testudinum*
Manatee grass	*Syringodium filiforme*
Flora Watercress alga	*Halimeda sp.*
Sea-grape seaweed	*Caulerpa racemosa*
Feather alga	*Caulerpa sertularoides*
White scroll alga	*Padina jamaicensis*
Y-branched alga	*Dictyota cervicornis*
Fauna Variegated urchin	*Lytechinus variegatus*
Dusky damselfish	*Stegastes fuscus*
Cocoa damselfish	*Stegastes variabilis*
Striped parrotfish	*Scarus croicensis*
Sea star	*Oreaster reticulatus*
Barnacle	
Gastropod mollusc	
Bivalve mollusc	
Flatworm	
Polychaete worm	

Plate 5.2.4 a: *Thalassia testudinum* at Site 3

Plate 5.2.4 b: Polychaete holes in muddy substrate

Plate 5.2.4 c: *Thalassia* bed at Site 4

Plate 5.2.4 d: *Thalassia* bed at Site 5

Plate 5.2.4 e: Macroalgae amongst Seagrass Bed (Site 5)

Plate 5.2.4 f: Coral Rubble amongst Seagrass Bed (Site 5)

Table 5.2.4 c: Mean Benthic % Cover for Inshore and Offshore Sites

	Seagrass	% Cover	Algae	% Cover	Sand/Mud	% Cover
Inshore						
	Thalassia	3	Turf algae	1	Mud	94
	Syringodium	2				
Offshore	*Thalassia*	86	*Caulerpa,*	14	-	-
			Padina,			
			Dictyota,			
			Halimeda			

The percentage cover of the inshore environment shows 94% cover of sand and mud. This indicates a highly disturbed coastal environment as evidenced by visibly high turbidity, occasional high wave action and the industrial influences acting on the site (Windalco Operations, JPS Operations and port activities).

5.3 Socio-economic Environment

As a general characterization, settlement communities within the zone have been experiencing population growth. Rhoden's Pen comprising 12 houses is at one extreme having remained at this size over the past several years. Old Harbour Bay and Cockpit appear to be growing slowly, whereas Bodles Junction and Bodles Crescent are both experiencing rapid growth as indicated by construction activity and attested to by residents and key informants. Longville Park housing estate built in 1991, is rapidly expanding its existing housing stock mainly through extensions to the original core units.

As a consequence of growing populations the communities collectively, are lagging behind in social infrastructure. The overcrowding and sprawl reflected in the environs of Old Harbour is to be found in the Old Harbour to May Pen main road communities NE of the site. Old Harbour has lost much of its light manufacturing sector and important sections of its agricultural economy, and has seen the services sector becoming a primary generator of jobs, if not income. Within the zone, formerly important farm centers such as Longville Park Farms have come out of dairy production and have switched to less labour intensive fish farming and goat rearing. Buying and selling, building skills and agricultural labour are the main avenues for employment. Enterprises such as Jamaica Broiler's Hi Pro Feed Mill, JAMALCO and Bodles provide the more stable employment.

In the wider geographic area agriculture, mainly poultry and fisheries, offers some stability. Crop farming is not intensive, except for a relatively small sugar belt, and considerable hectares of unused agricultural lands lie idle. Large scale agriculture such as was once represented by sugar and tobacco cultivation no longer exists. Bodles, once the center of the island's cattle breeding and livestock research program is a shadow of its former self and dairy farming, cattle rearing and pen-keeping are now on a much reduced scale. Century Farms, once a significant fresh milk producer, is now no longer in operation, its former location is no occupied by the Jamaica Dairy Farmers Federation.

Plate 5.3: Bodles Research Station

Large scale manufacturing in Old Harbour has declined. A major textile and pulp and paper factory (West Indies Pulp and Paper Ltd.) have long since closed and a once vibrant industrial park, just west of Old Harbour lies almost completely dormant.

However heavy manufacturing in the form of electricity generation (JPSCo.) and alumina (Windalco) still represent the areas major contributors to GDP. In this regards the Ethanol plant is expected to generate revenues of $4.4b annually and employment of about 35 persons during operations.

Social services for the communities in the zone, and for the Old Harbour area generally, are inadequate. Considerable building activity has taken place in recent years. There are 16 mostly completed schemes in a rough semi circle around the town. Others such as New Harbour Village (845 units) are well advanced in planning and the Hurricane Ivan shelter replacement project is nearing completion in Old Harbour Bay. Many of the existing built communities are becoming physically dilapidated. Roads have deteriorated and well kept homes are interspersed with abandoned buildings or houses in disrepair. Very poor housing conditions coexist chains

away from much better kept communities. In addition several squatter settlements can be identified.

The proposed ethanol plant however, will be relatively unaffected by these housing and social infrastructural challenges. Its small and mainly technical permanent work force will not constitute a discernable demand on housing or community based social services. Neither will this be the case during the construction phase. Old Harbour has developed a skilled construction labour force. Highway 2000 also facilitates the movement of such skills from other urban centers.

5.3.1 Land Use

The main land use in the zone is settlement. Manufacturing, mining, and agriculture combined, also utilize significant acreage. The Project is bounded to the north by Jamaica Dairy Farmers Federation. To the east it is bounded by marsh land and scrub. To the south is the sea and to the west by Windalco's port operations. The closest large human settlement is probably Cockpit, an unplanned community comprising about148 housing units and shops, as counted during the rapid appraisal survey.

Plate 5.3.1: The now defunct Century Farms to the north.

In addition to Windalco the zone contains several organizations and enterprises, the main ones being Bodles Research Station, Jamaica Dairy Farmers Federation, Jamaica Broilers Hi Pro Feeds Mill, Longville Farms, as well as the smaller Long Wharf Farm which is also into fish farming. Caribbean Broilers Ja. Limited, has downstream plans for utilizing the former pulp and paper plant at Longville, within their integrated poultry operations.

The residential communities are characterized by small food retail and entertainment shops intermingled with mechanical repair and other services activities. Free Town Primary School which has a student population of 450, is also located within this zone, as too are several churches.

South West of the Project site and across the Bay, wetlands run the length of the coast line. The limestone shelving and forest foothills bordering these wetlands, accommodate the relatively poor communities of Bratts Hill, Tarrington and Salt River.

The Project is on land zoned for industrial development. This is further to a plan that has been developed for the lands adjoining the Highway 2000 Corridor (PIOJ, 2005).

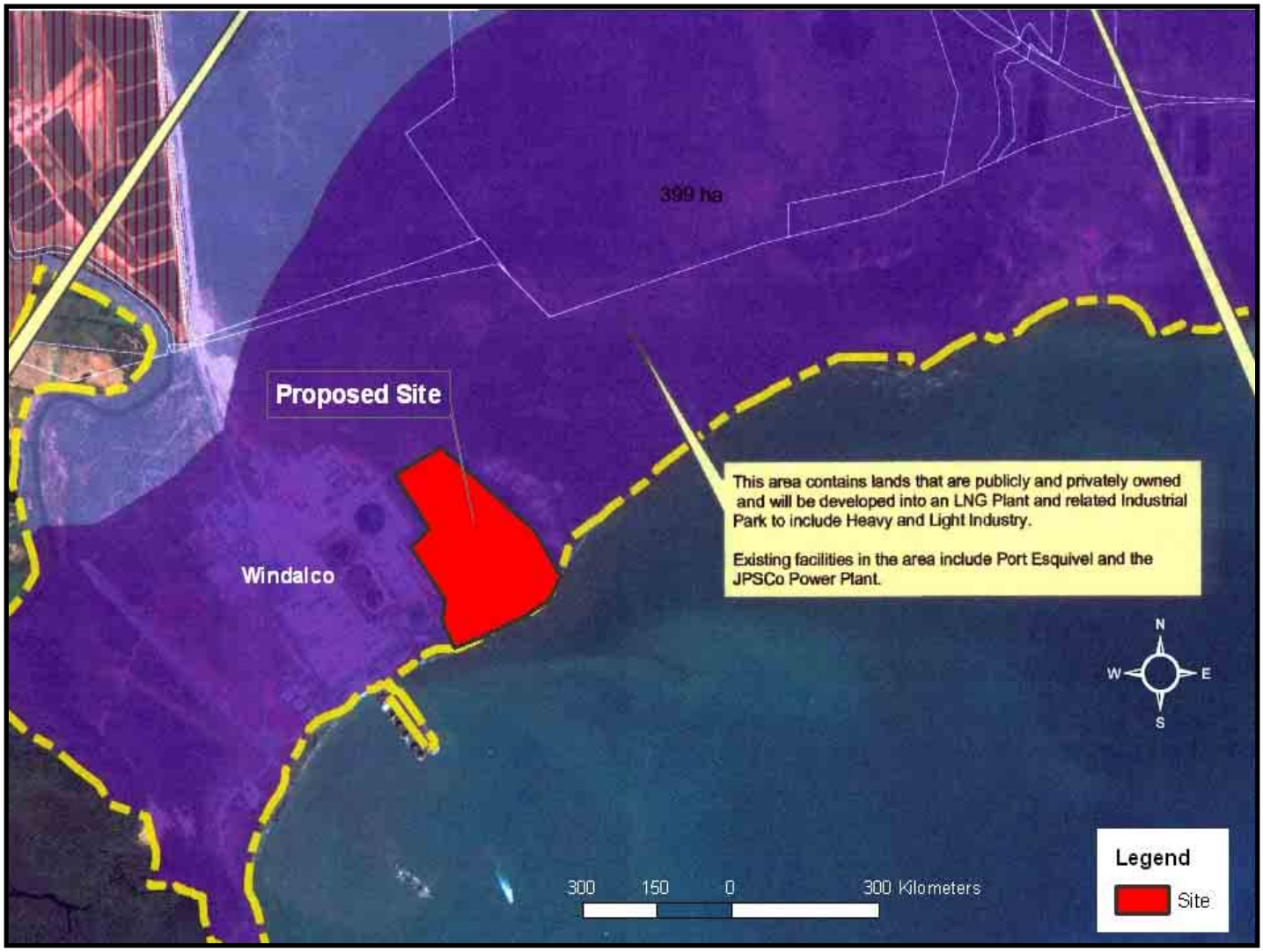
5.3.1.1 The Highway 2000 Development Corridor

The Highway 2000 (H2K) Corridor Development Plan is a comprehensive document outlining proposed infrastructural development between Portmore and Clarendon Park. The Development Plan is phased with the implementation of the Highway 2000 project, to ensure that the areas contiguous to the highway are "recognized spatially, physically, socially, institutionally and economically, in a manner that is efficient, stimulating and sustainable" (*Portmore to Clarendon Park – Highway 2000 Corridor Development Plan 2004-2025, Preliminary Draft – Volume I, 2004) (PIOJ, 2004).*

The Highway 2000 Development Plan covers an area of approximately 99,442 hectares. Approximately 42,000 hectares or forty-two percent (42%) of the land is located in the parish of St. Catherine and approximately 57,000 hectares or 58 percent lies in the parish of Clarendon, accounting for forty-eight percent (48%) of the Parish of Clarendon.

The proposed ethanol plant is within an area zoned for industrial development (Figure 5.3.1.1).

Figure 5.3.1.1: Zoning of Project Area within Highway 2000 Corridor Development Plan
(Source: PIOJ, 2005)



5.3.2 Demography, Employment & Social Infrastructure

The demographic characteristics of the zone are of little direct relevance to the proposed development, and the proposed ethanol plant is not likely to be impacted by the social context it is in. Nevertheless, it is likely, given the corporate identity, philosophy and track record of the developers, that the Project will seek to become involved in the social and economic betterment of these neighbouring communities.

At the time of the 2001 census the population of the Old Harbour special area was approximately 24,000 an increase of 30 % over the 1991 population, if electoral boundary changes are ignored. Current projections are that it could reach 78,000 by 2010. It is probable that for the larger communities in the zone around the Project, a similar growth rate occurred and might be maintained, particularly in those communities adjoining Free Town to include Bodles Crescent and Longville. The current population of Old Harbour is evenly split with respect to gender, and can be described as a predominately young one. Data for the parish's urban centers combined, suggests that female headed households could account for half of total households. The STATIN calculated parish dependency ratio was 68% in 2001, indicating generally, that two thirds of the parish population was economically dependent on the other one third. The zone's residential communities are mainly lower middle and low income but with important exceptions in almost all communities.

The project is very capital intensive generating projected annual revenues of $4.4b with an operating labour force of about 35 employees. Its contribution to income and employment in the local economy will be indirect and mainly through the national economy. The end product being an ethanol gasoline enhancer will make an overall contribution to reducing air pollution and green house gas emissions but will occur mainly to end user export markets.

Portions of the plant will be pre fabricated in Brazil and the US for erection locally. During the civil works activities at the site, employment is expected to be in the region of 40 personnel, ramping up to approximately 70 during the erection phase of the plant.

Local building skills being available in the Old Harbour area confers an advantage to the project and is an important means by which some construction employment benefits may be retained in the local economy.

5.3.3 Public Health & Safety

5.3.3.1 Fire Service

A fire brigade station located in Old Harbour (Area 3) provides services to both Old Harbour and Old Harbour Bay and back-up services throughout the parish as required. It has one unit which carries a limited supply of water, there being no water tender unit assigned to the station. Compounding their challenge is the variability in water pressure often encountered. There is a water tank at the station which carries sufficient water for about 4 trips. Staffing is reported to be below the assigned level, there being 24 firefighters currently out of a compliment of approximately 32.

The practical consequence of this is that in the event of a serious fire at the plant, the equipment and manpower capacity of the Old Harbour fire station would be totally inadequate to respond effectively. This, both in terms of number of units and the specialized equipment and training requirements for fighting chemical fires.

Plant personnel will be thoroughly trained in firefighting techniques specific to the plant. During this training process, the Old Harbour fire fighters will be invited to participate.
Ongoing plant safety is therefore an important component of the operations. Fire detention and fire suppression systems will be installed in various areas of the plant (Section 1.2.5).

5.3.3.2 Health Providers

Public health facilities available to Old Harbour and Old Harbour Bay comprise a single Type 3 clinic located in Old Harbour. A Type 3 clinic carries the full compliment of services offered by this category of facility and provides a medical doctor and a dentist and dental nurse daily. However four satellite clinics also serve the Old Harbour region. A satellite clinic is basically a

very limited service (one to three times weekly) of a mobile nature. The satellite clinics mainly function to offer child health care.

The nearest hospitals serving the Project are in May Pen (Type C – but in practical terms a Type B with 150 bed capacity) and Spanish Town (Type A with 275 bed capacity). Both are about equidistant in time, along the highway. Old Harbour is served by approximately 12 private medical practionners.

In any worse case scenario involving a plant catastrophe, Ministry of Health disaster contingency planning provides for involvement of the countries four regional hospitals with additional medical facilitation if necessary in Cuba and the United States.

National disaster management planning also envisages medical evacuations being facilitated by the Jamaica Defense Force.

First aid stations will be strategically located throughout the facility. The Red Cross will be consulted to provide CPR training for all staff members.

Due to the close proximity to Windalco, Jamaica Broilers Group Ltd. will explore getting a structure in place where they can have the use of Windalco's first aid facility on the occasions where emergencies cannot be handled by their team.

5.3.3.3 Security

The Project falls within Area 5 of the Constabulary Forces. The Divisional Headquarters for this Area is located in Portmore. Old Harbour police station is one of seven Out Stations within the Division. In relation to general security the Project seems at very low risk from either normal criminal acts or acts of sabotage due to riot or other public disturbances. This is partly as a result of its isolated location but also the internal security culture of plants of this nature and that of its immediate neighbour Windalco.

The crime rate within the Old Harbour area is not considered high by the police. Data provided by the Constabulary Communications Network, reflect that major crimes over the one year period 2004-2005 increased by 6%.

As a port facility, Port Esquivel's security mandate is high. Jamaica Broilers Group Ltd. will also be expected to maintain a high level of security so as not to compromise the port's operations and also to ensure the integrity of their own facility.

Table 5.3.3.3: Major Crimes Reported by Old Harbour Police Station 2004 & 2005

Station	**2004**	**2005**	**% Increase**
Old Harbour	123	130	6

The issue of security therefore is not considered a special threat to the project.

5.3.3.4 Utilities

5.3.3.4.1 Electricity

Electricity consumption for the Project is given below. The load profile of the Project includes the electricity needs for the main plant, the sewage treatment plant, water treatment plant, and other property requirements.

Table 5.3.3.4. 1: Project Electricity Profile.

Electricity Demand Per Annum

		KVA	KWH
1	Construction Supply	200	379,440
2	Permanent Load	824	5,526,480

5.3.3.4.2 Water

The current mains water is obtained from Windalco's well which will continue to serve both the Windalco plant and the Ethanol Plant.

The projected water demand for the proposed site is 1,364 m^3/d (300,000 US gal/d). Jamaica Broilers indicates that one-third of this daily demand will be met by Windalco and the balance will be obtained from an adjacent property (owned by Mr. Donaldson) or the National Irrigation Commission (NIC). The projected annual water demand over the life of the plant is below:

Table 5.3.3.4.2a: Projected Water Demand for the Life of the Ethanol Plant

Area	Projected Water Demand (m^3/yr)
Ethanol Dehydration Plant	498,000

The majority of this water will be used during the ethanol dehydration steam generation process. The recovered condensate from the evaporation section is a major source of process water. As an efficient ethanol dehydration plant requires clean process water to function efficiently several steps are normally employed to ensure that minimal problems are encountered during the life of the plant.

There are three main potential problems in steam generation systems: 1) deposition (which causes high metal temperatures and eventually equipment failures); 2) corrosion (which can eventually result in equipment failures); and 3) carryover (which causes contaminated steam).

Microbial growth can be a particular problem in heat exchangers and significantly reduce heat exchanger efficiency, in addition to forming localized corrosion areas. Oxidizing biocides such as chlorine dioxide, sodium hypochlorite bleach, hydantoins and sodium bromide are used to control microbes. Normally, non-oxidizing biocides such as are typically used to kill bacteria, algae and fungi of the input process water. These biocides also disrupt the metabolism within

the cell. It is recommended that such biocides, if used, are approved for cooling water systems. Additionally scale inhibitors, used to minimize deposition need to be approved.

Corrosion is normally reduced in cooling/evaporative systems by adding corrosion inhibitors such as phosphates, molybdates, zinc or organic phosphonates. Each of these inhibitors forms a molecular film over either the anode or cathode of a corrosion cell. It is recommended that checks be made with the NEPA to determine what types of inhibitors can and cannot be used in local cooling systems.

The Project will be receiving 100% of its water from Windalco and NIC. Although an agreement has not yet been finalized discussions are well under way. Domestic water will not be required from The National Water Commission. It is estimated that the water consumption of the property will be in the order of 300,000 US gallons per day.

The Rio Cobre Basin is the source of supply for the parish of St. Catherine and its resource and production profile is as follows:

Table 5.3.3.4.2b : Resources & Production -The Rio Cobre Basin

	RESOURCES (mm)			PRODUCTION (mm)			(mm)
	Average Yield	Reliable or Safe Yield	Water Use Suitability	Installed Capacity	Average Production **	Max Monthly	Unused Reliable or Safe Yield
Surface	186.8	14.5	All uses	-	18.6	-	0.0
Ground	453.8	403.8	Restricted use *	450.8	307.1	-	96.7
Total	640.6	418.3		450.8	325.7	-	96.7

* Water quality restrictions on use due to industrial or domestic effluents to localize overdevelopment of coastal aquifers.

** Production in excess of reliable or safe yields reflects the use of seasonal surface flows or seasonal river recharge to all the limestone aquifers.

Table: 5.3.3.4.2b indicates that the average annual production of surface water 18.6 MCM/Year is higher than the reliable or safe yield of 14.5 MCM/Year that the basin can produce. Therefore with respect to surface water, there is no unused reliable or safe yield to

be obtained from the basin. With respect to ground water, there are resources still available in the basin, but water quality and in particular saline intrusion makes its use for domestic purposes dependent on treatment.

5.4 Community Concerns

A rapid appraisal approach was used to canvass opinions about the project. Structured, semi structured and unstructured interviews were conducted with targeted and non targeted individuals. By untargeted is meant those respondents who were approached more or less on a random basis, but in selected locations. Whereas targeted individuals were those key informants, pre selected for interviewing, whether by appointment or otherwise. The total number of interviews conducted were 103 non targeted and 17 targeted comprising those in the Key Informants list appended.

There were no outright objections to the establishment of the project. As is normally the case with proposed projects, community members welcomed the implied economic benefits associated with a new plant. There was a degree of general awareness that ethanol represented a cleaner technology. There was also disappointment and resignation among several respondents to the realization that the plant would have almost no impact on their own personal employment prospects.

The operations of an ethanol plant were mostly outside of the experience or knowledge of the great majority of the respondents. Issues relevant to community concerns are presented below.

5.4.1 Effluent discharge in relation to fisheries.

The project will discharge approximately 15,000 gallons of effluent per day, arising from plant operations. A majority of the discharge will be used for irrigation purposes after appropriate treatment. This discharge can be expected to have a high BOD content, even though at levels that comply with NEPA's Trade Effluent Standards. Two groups of stakeholders, while not able to specifically identify high BOD as the particular threat, were concerned about potential "contamination" of the Bay by any pollutants discharged by the Plant. One group comprised

fishermen whose livelihoods are linked to the inshore and offshore fishing grounds that serve Old Harbour Bay and related fishing grounds in the Portland Bight Protected Area. The discharge of pollutants they feared would result in fish kills and diminished catch. The fishermen were also mindful of potential oil spills arising from Project shipping activities through the port. Based on experience they were of the opinion that repeated contamination of the Bay in the area of the plant, or in the shipping approaches to the port, would be felt in the wide area schematically represented in Figure 5.4.1

Several fishermen did acknowledge that based on their experience both the Old Harbour Bay Power Plant and Windalco (when operating under the previous owners ALCAN) were very efficient in containing and cleaning up the infrequent oil spills that occurred. They expressed some confidence in the proposed development performing similarly.

The second group were those informed residents in the communities of Longville and particularly Cockpit, for whom the protection of the wetlands along their coastline was an important concern. Any polluted effluent from the plant was seen by this group, as likely to add to the cumulative pollution loading of the Bay, with consequences for the wetlands and the ecosystems dependent on the wetlands.

Figure 5.4.1: Approximate Locations of Fishing Grounds Perceived by Fishermen to be at risk in Old Harbour Bay and areas of the Portland Bight Protected Area.

Plate 5.4.1 Looking due East towards Windalco from Cockpit

5.4.2 Odour

Gas vapor emissions associated with this type of plant are vaporized alcohol. However this being a very unstable compound, vapors dissipate almost immediately in air. There is no fermenting process associated with the proposed plant, and it is the fermentation in ethanol production that creates the pungent odor sometimes associated with ethanol plants. The molecular sieve technology being proposed is also the most modern technology. The prevailing winds are from the South East during the day and from the North East during the evenings. The nearest communities down wind of the plant are Longville Park and Cockpit and to a lesser extent Bodles Crescent. It is thought unlikely that any odor will reach these locations.

Plate 5.4.2 : An expanding Longville Park

5.4.3 Flooding

Flooding in the vicinity of the project site has not been reported. However the area to the east of the site comprises both marsh and scrub, with sizable ponding evident in several areas. The Bowers Gully a major drainage asset in this region of the parish, discharges to the sea 1500 m east of the project site and is not a potential threat.

Plate 5.4.3: The Bowers Gully to the East of the Site.

5.5 Heritage

The Project lies in a geographical area whose settlement dates back to the Spanish and early British colonial periods. It lies close to a historically important trade, commerce, communication and security axis between Old Harbour Bay, Old Harbour and the interior. The general area comprising Old Harbour to Old Harbour Bay was named by the Spanish as the District of Anaya. Over time a number of estates came to dominate cultivation in this wider area. The Whim (but more recently the Whim & Kelly Pen) is found on early maps of the area, as also Belmont. Records dating back to the late 19th Century confirm that sugar, cattle, bananas, tobacco and other livestock rearing were all well established activities at one time or the other in the wider area.

Important Taino settlements existed in the Old Harbour Bay area including on Great Goat Island. Sightings during one of Columbus's voyages of large Taino settlements in the Old Harbour Bay area have been taken to include the Port Esquivel area. Equally likely would have been settlements in the coastal hills in which Longville and Cockpit are located. Enquiries to

date by the consultants have not revealed knowledge of Taino settlements within immediate proximity to the project site.

Two field trips to specifically look for evidence of Taino presence or settlement were made to the site but yielded nothing, (Appendix XVI). It is theorized that the greater portion of the site was submerged at the time Taino's were present in the area.

Plate 5.4 Some Members of the Heritage Team Inspecting the Site

5.6 Consultations with Regional Health Authority/ Medical Officer in St. Catherine Health Department

The Medical Officer of Health, in collaboration with the Chief Public Health Inspector reviewed available documents on the site to determine if there are any likely public health risks associated with the site. The Public Health Inspector has indicated that a site visit is pending. The Medical Officer of Health indicated that she was unaware of any public health issues associated with the site, however she will reserve final judgment after the actual site visit by the Public Health Inspector and review of the EIA report.

5.6 Plant Safety, Risk Assessment and Accident Analysis

Plant safety for the proposed ethanol plant is a matter of high priority as evidenced by the safety aspects already incorporated into the project design and detailed in Section 1.2.5.
It should be noted that ethanol does not present any danger beyond that of other flammable products.

The risk assessment and accident analysis identifies the most significant risk as fire or explosion due to the highly flammable nature of both the hydrous feedstock and the anhydrous end product. The risks arise from the following areas of the plant's operations:

1. Transportation of material (inbound and outbound)
2. Conveyance, under pressure, of flammable liquid
3. Storage of flammable liquid
4. Dehydration process

Comprehensive information on Safety and Fire Fighting is given in the Renewable Fuels Association's (RFA) Recommended Practices # 930601 "Gasoline Ethanol Blends- Program Operations Guide". The risks arise not only as a result of the nature of the chemical but also due to man-made influences that may occur as a result of human error. The personnel with the highest risk level are as follows:

1. Terminal personnel
2. Transportation personnel (inbound and outbound)
3. Process personnel

A checklist for these personnel, to minimize the risk of accidents and fires is given in Appendix XVIII. In order to minimize the risks of spills, fires and explosions Process Safety Management has been incorporated in the plant design and a written safety plan will be developed that will utilize established safety procedures for the ethanol industry as a guideline. Information will be made available to all employees and on site contractors. Aspects of Process Safety Management are given in Appendix XVIII. Process Hazard Analysis will be conducted and this requires that Jamaica Broilers develop a thorough, orderly, systematic approach for identifying, evaluating and controlling processes involving highly hazardous chemicals. This is given in Appendix XVIII.

6.0 Issues Identified, Potential Impacts and Mitigation Measures

6.1 Issues Identified

Several issues have been identified for the proposed Ethanol Plant that must be taken into consideration at the design, construction and operation phases. These issues have been explored in light of the potential impacts of the project on the existing environment. It should be noted that some of the potential impacts that have been raised by the public during the consultation process have already been mitigated by the engineering design of the project and the type of technology being used. However, the main potential issues are discussed and the relevant mitigation measures presented.

The main issues that have been identified are:

Air Quality:	Construction phase dust and Operation phase emissions
Coastal Water Quality:	Terrestrial run-off, trade/sewage effluent disposal, Increased BOD and COD
Coastal Dynamics:	Storm surge
Geology:	Potential for soil erosion
Flooding:	Pre and Post stormwater runoff, Ponding
Ecology:	Loss of habitat
Parks and Protected Areas:	Species of special interest
Solid Waste Management:	Removal of vegetative matter, removal of domestic waste and construction waste to an approved disposal site
Liquid Waste Management:	Approval and licencing of Sewage Treatment Plant
Natural Hazards:	Storm surge, flooding
Technological Hazards:	Fires, Explosions, Accidents
Public Health and Safety:	Treatment and disposal of trade and sewage effluent, Worker training to ensure health and safety, Emissions during operation phase, Fisheries, Response mechanisms
Livelihoods:	Fisheries

Table 6.1: Environmental Impact Identification Matrix- Ethanol Plant

6.2 Potential Impacts and Mitigation Measures

6.2.1 Air Quality

Air quality impacts are one of the primary environmental impacts associated with ethanol plants. The proposed ethanol plant will utilize hydrous alcohol or rectified spirit as the feed stock and hence the key air pollutants associated with the fermentation and distillation steps will not be applicable to this project.

Potential Impacts – Construction Phase

During the construction phase the generation of fugitive dust from excavation, grading and associated earth works activities will result in an increase of ambient PM 10 levels. This is a short term reversible impact. However, the construction of the plant will mainly be assembly of pre-constructed components.

Mitigation Measures

- Watering of un-vegetated areas and stripped road surfaces along which construction vehicles and trucks travel, should control levels of fugitive dust by up to 70%
- A watering truck should be maintained on site for watering road surfaces as needed and to minimize levels of fugitive dust.
- Over-saturated conditions, which would cause outgoing trucks to track mud onto public streets, should be avoided. Watering would not be necessary on days when rainfall exceeds 2.5 mm.
- Stockpiles of earth materials for construction should be covered on windy days to prevent fugitive dust.
- Any vehicles transporting earth materials should be covered *en route*.
- Any mixing equipment should be sealed properly and vibrating equipment should be equipped with dust removing devices.
- Provide dust masks to operators in order to protect them from dust impacts.

Potential Impacts – Operation Phase

Air quality impacts are one of the primary environmental impacts associated with ethanol plants. The proposed ethanol plant will utilize hydrous alcohol or rectified spirit as the feed stock and hence the key air pollutants associated with the fermentation and distillation steps will not be applicable to this project.

The main air pollutants are likely to be:

- Volatile organic carbons or VOCs which will be emitted from the dehydration process, storage and filling of ethanol
- Particulates, sulphur oxides and nitrous oxides from stack emissions

Emissions will constitute a long term impact during the life of the plant. Emissions from the proposed boiler at the JB ethanol plant will generate over 100 tons per year of the major air quality pollutants as defined by the NAAQS. The stack emissions will therefore have the potential to influence ambient air quality.

The accumulated impact of emissions from the Ethanol Plant and the other major contributors to the airshed (Windalco, Jamaica Energy Partners and Jamaica Public Service) may impact air quality in the airshed. These impacts will be influenced by meteorological conditions (precipitation, wind direction and speed, etc).

Mitigation Measures

- The loss of volatile organic compounds such as ethanol vapours constitute the loss of valuable product and thus effective materials handling and product management will reduce the amount of VOCs emitted. Further, the dispersion of the aerosols will be short lived as during fall out they will be rapidly volatilized or will dissolve in the surface waters, reducing the likely impacts.
- The management of particulates and emissions of sulphur oxides and nitrous oxides (SOx and NOx) requires the collaboration of the operators and the equipment manufacturers to ensure that the emissions produced are compliant with the National Ambient Air Quality Standards.

- An ongoing systematic inspection and maintenance programme should be implemented during operations.

Responsible Parties: Developer, Manufacturers, Contractors, Employees

6.2.2 Noise

Potential Impacts – Construction Phase

The noise levels are expected to increase during site preparation and construction activities, with the use of heavy machinery, earth moving equipment, construction equipment and haulage vehicles. These noise levels are not expected to create significant impacts and the effects of increased noise during site preparation and construction will be a short term reversible impact. There are no communities in close proximity and the nearest neighbour, Windalco, is also an industrial operation. However, worker health and safety must be considered.

Mitigation Measures

- Appropriate workers should be equipped with ear muffs

Potential Impacts –Operation Phase

Noise within the plant operations will be higher in some areas than others and workers will be affected by noise from boilers etc. Long term exposure to high levels of noise can cause permanent damage to the hearing.

Mitigation Measures

- Occupational safety standards should be followed in terms of the provision of ear muffs for workers in appropriate areas.

Responsible Parties: Developer

6.2.3 Coastal Water Quality

Potential Impacts – Construction Phase

During the construction phase the main potential impact on coastal water quality is increased turbidity due to terrestrial wash down of earth and earth materials. Additionally, the coastal waters are already turbid and the construction of the ethanol plant is not expected to have any significant negative impacts.

Mitigation Measures

- Stockpiles of earth materials should be at least 30 m from the coast or any drainage channel.
- Vegetation should be cleared only within the footprints of the development.

Potential Impacts –Operation Phase

During the operation phase the disposal of both trade and sewage effluent will be necessary. The effluent will be discharged via a drain to the coastal waters. This will be a long term impact during the life of the plant. The effluent discharge stream should meet NEPA Trade Effluent Standards based on the design of the Sewage Treatment Plant design.

The impact on the coastal and water quality and marine environment from the proposed project could occur from three sources:

1. Run off of drainage water from the plant into the sea, affecting water quality.
2. Cooling water discharge. This too could affect water quality and the marine benthos.
3. Discharge of sewage effluent, nutrients and bacteria can reduce the quality of the receiving waters.

To avoid pollution of surface water or ground water, if the pollutants in the effluent exceeds the NEPA guidelines for trade effluent then it should be treated prior to discharge. The organic load in the effluent should undergo microbiological degradation.

This can be done anaerobically, aerobically or by a sequential combination of the two methods. Effluent degradation is usually done in a simple treatment pond, followed by a stabilization pond, if necessary. Alternatively, the effluent can be fed to biogas digesters, combining energy production with waste treatment.

Mitigation Measures

- The Wastewater Treatment Plant should be sited at a minimum of 20 m from any drainage line. Effluent discharge parameters are to be within the NEPA Trade Effluent Standards and/or Irrigation Standards.
- Solid waste should not be disposed of in the coastal waters. Any sludge handling should be facilitated by drying and removal from the site for disposal at an approved landfill.
- An ongoing coastal water quality monitoring programme should be implemented which will detect any unusual situations requiring mitigative action.
- The berm of the Bunker C and diesel storage tanks should be impermeable to both oil and water (and are expected to be made of concrete).
- The berms for the Bunker C tank and diesel storage tanks should be independent of those for the ethanol tanks.

Responsible parties: Developer, Engineers

6.2.4 Coastal Dynamics

Potential Impacts – Operation Phase

The proximity of the proposed ethanol plant to the coastline may put the plant at risk of storm surge during storms and hurricanes. Storm surge incidents have been reported at the site.

Mitigation measures:

- All components of the proposed ethanol plant should be set back at a minimum of 30 m from the coastline. The developer will be using an 800 m setback.

- All storage tanks should be contained within a earthen (clay liner) berm with a spill/overflow capacity of 125%

6.2.5 Geology and Potential for Soil Erosion

Potential Impacts - Construction Phase

The site is relatively flat and the potential for soil erosion is not high. However, during the construction phase grading, earthworks and removal of vegetation will expose the topsoil to erosion during heavy rainfall events. During construction improperly stockpiled earth materials can also be washed down to the coastal waters. The use of heavy equipment on unpaved areas can also lead to a decline in soil stability.

Mitigation Measures - Construction Phase

- The only areas to be cleared of vegetation should be those within the footprint of the development and any access roads.
- Vegetated areas outside the footprint of the development may be landscaped.
- Stockpiled earth material needs to be secured and covered against inadvertent removal during rainfall events.
- A setback of 800 m from the coastline is slated by the developer and will be maintained during the construction phase.

Responsible Parties: Engineers, Developers, Contractors

6.2.6 Drainage and Flooding

Potential Impacts – Construction and Operation Phases

No flooding impacts are expected as the site is not prone to flooding. However, the creation of impervious surfaces will increase run-off from the site and measures should be put in place as given in the drainage plan to ensure flooding on site does not occur.

Mitigation Measures – Construction and Operation Phases

- The proposed drainage system should be at least designed to accommodate a rainfall event with a 25 year return period.
- Stormwater facilities should be separate and independent of process water facilities to ensure no area contamination.

6.2.7 Liquid Waste Disposal

Potential Impacts

Liquid waste disposal will include boiler blow down, total suspended solid loading and domestic waste. The Wastewater Treatment Plant (WWTP) proposed is designed to treat both sewage and trade effluent. The WWTP does have the potential to release unpleasant and/or noxious odours in the event of malfunctioning, and also to release effluent below the required NEPA standard in the event of malfunction. The design engineers have included the main mitigation measures in the treatment process, to ensure that effluent standards meet NEPA's requirements.

Most package plants require electric power to operate and all will require regular maintenance and de-sludging in accordance with the manufacturer's instructions in order to ensure that the system operates effectively and the effluent complies with the consent conditions.

Mitigation Measures

- 240m^3 /day or 60,000 gallons per day is projected and the organic loading from the ethanol plant will not be high. Domestic sewage will be merged to support biological degradation of the water.
- The wastewater treatment system is designed to handle both the domestic and industrial waste stream and the effluent discharge parameters meet the NEPA trade effluent standards. The WWTP will have to receive its own permit for construction and licence for discharge.

- The final siting of the site Wastewater Treatment Plant should be setback at least 300 m from the coastline.
- Distribution lines that take the primary treated effluent to the central, cluster system should have suitably placed cleanouts so they can be flushed at least twice per year. Pumps, floats and alarms must be checked as part of the regular maintenance.
- Consideration should be given to effluent discharge re-use for non-potable activities such as greening of adjacent green spaces.
- A maintenance agreement with a suitable contractor is essential, and the installation of an alarm to warn of power or plant failure is recommended.

Responsible Parties: Engineer, Developer

6.3 Biological Impacts

6.3 .1 Clearing of Vegetation

Potential Impacts - Construction Phase

The clearing of vegetation will result in the modification or removal of existing habitats for fauna. However, there are no rare, threatened or endangered fauna reported from the site.

No species of particular interest within the Portland Bight Protected Area are expected to be impacted.

Mitigation Measures

- Landscaping in the development should occur to replace vegetation lost, and this could encourage new bird species. This is especially important for migratory species that are likely to use the habitat.

Responsible Party: Developer, Contractor

6.3.2 Crocodiles

The American Crocodile is the only species of special concern in the Portland Bight Protected Area (PBPA) that is found on the site of the proposed development. The evidence suggests that crocodiles may cross the property so it is important that this does not result in conflict.

Potential Impacts –Operation Phase

- The safety of the workers and the crocodiles can best be assured by not allowing the crocodiles to enter the plant facility. This can be done by constructing appropriate fencing around the entire site.
- The fence line along the beach should not extend further towards the waterline than the current fence around the houses.
- It would be advantageous to the wildlife and the protection of the facility from possible storm damage to place this fence as far inland as possible and to leave all the vegetation along the beach front in its natural state.
- The developers will be expected to work with the NEPA and/or C-CAM to improve the environmental awareness of staff as required.

6.4 Socio-economic Impacts

6.4.1 Economic Benefits

Potential Impacts – Construction and Operation Phases

The project is unlikely to contribute significant direct benefits to the communities neighbouring it. Neither will these communities adversely impact it. This is mainly because 1) the project will employ relatively few persons and these are likely to be drawn from pools of highly skilled industrial workers and 2) the plant will be somewhat physically removed from these communities.

It is within the context of the national and global economy that the projects main benefits can be identified.

The Jamaican Government has made the production and introduction of fuel ethanol an important component of its energy policy. It is intended that as soon as practicable, but within the short to medium term, fuel grade ethanol (containing no more than 0.01% water) will be introduced into motor gasoline. Since gasoline blended with up to 10% ethanol is approved by all auto manufacturers marketing vehicles in the USA, it entails no engine modification by vehicle owners. The fact that ethanol is produced from biomass feedstock makes it much more environmentally friendly than the traditional fossil fuels. Ethanol which produces oxygen and reduces carbon monoxide and other toxics in exhaust emissions helps reduce emissions of greenhouse gasses. It is also quickly biodegradable in surface water, groundwater and soils.

Some communities expressed concerns about the plant and this appears to be because of a lack of knowledge of the plant and an understanding the technology to be employed.

Mitigation Measures

- The developer should undertake a public education campaign within both the communities surveyed but also select larger communities within the Portland Bight Protected Area to explain and educate about issues of clean energy, fuel ethanol and their respective roles in park conservation and sustainability.
- Sub targeted groups could be 1) the fisher folk whose livelihoods are centered in the Park, and 2) the transport sector that serves the Park. CCAM the agency with co-management responsibility for the protection and development of the Park will need to be an integral part of any such initiative.
- The Public Meeting to be held for this project, will also serve to inform the public and provide an opportunity for questions to be answered.
- In relation to heritage protection the JNHT has already been advised of the proposed project on the site and have not responded with any issues

Responsible Party: Developer, JNHT

6.4.2 Water Supply and Demand

Potential Impacts – Operation Phase

The projected water demand is 200,000 gallons per day.

Mitigation Measures

- Water is to be supplied by National Irrigation Commission (NIC), Windalco and a private individual owner.

6.4.3 Storm Water Management

Potential Impacts – Operation Phase

Though the potential to pollute the coastal water may exist it can be completely mitigated through the implementation of structural and non-structural Best Management Practices.

Mitigation Measures

- Berming of stockpiles of earth materials during the construction phase.
- Setback of earth materials from the coastline (minimum 300m).
- Engineering design of drains.
- Sediment traps as necessary.

6.4.4 Water Contamination

Potential Impacts –Operation Phase

It does not appear that ethanol spills or leaks will pollute ground or surface water since ethanol is water soluble and readily biodegradable. Consequently, there should be no persistent pollution due to ethanol.

Overall, negative effects on surface or groundwater water are low as ethanol is readily biodegradable. Other process chemicals used in the dehydration process may pose potential risks, but the risk is fully mitigable.

Mitigation Measures

- The risks can be mitigated by separating process water from storm water, appropriate staff training and general safe house-keeping activities which are expected to be implemented at the site.
- Hydrogeologically, the presence of at least 4 – 7m of low permeability clayey soils above the static water table will provide ample secondary containment via its attenuative capacity should the primary containment device (i.e. the concrete bund and foundation) be compromised –the likelihood of this is remote.

6.4.5 Solid Waste

Potential Impacts- Construction Phase

Removal of solid waste from the site will include vegetative matter from site clearance, general construction waste during the construction phase, domestic and commercial waste, and sludge.

Mitigation Measures

- Jamaica Broilers Group Ltd should have dialogue with the National Solid Waste Management Authority (NSWMA), the agency responsible for collection and disposal of solid waste.
- These discussions should include the projected types and amounts of waste and the NSWMA should contain a scheduled collection and the approved site for disposal.
- Additionally, Jamaica Broilers Group Ltd. should have a contingency plan, as recommended by a member of the Technical Review Committee of the National Reserves Conservation Authority (NRCA), in a presentation to that body on September 26, 2006. This contingency plan should see Jamaica Broilers Group Ltd. identifying a site that could be used for solid waste disposal in the event that the NSWMA sites are unable to accommodate the waste. Any such site would have to be approved for this purpose by the NSWMA.

Responsible Party: Developer, NSWMA.

6.5 Technological Hazards

Potential Impacts – Operation Phase

Technological hazards are a potential impact during the operation phase of the plant. Worker health and safety, as well as the environment can be impacted by the improper storage and handling of hazardous material. Any spills during the transportation stage will be the responsibility of the supplier or his designated agent (for import of raw material) and the purchaser or his designated agent (for export of fuel grade ethanol).

Mitigation Measures - Operation Phase

- All safety measures as described in Section 1.2.5, for the design of the plant should be implemented.

Storage Tank Farm

- These include the appropriate setback and location of the Storage Tank Farm and venting of tanks via an integral flame and vapor arrestor vent cap.
- All tanks should be contained within a lined berm with a spill/overflow of 125%.
- All temporary fuel, oil and chemical storage must be sited on an impervious base within a bund and secured. The base and bund walls must be impermeable to the material stored and of an adequate capacity. Storage at or above roof level should be avoided. A 3,000 gallon foam proportioning fire fighting system and a 5,000 gpm diesel and electric driven fire water system must be implemented.
- Ten (10) 500 gpm high pressure fire fighting stations will be installed around the perimeter of the tank farm.
- Each tank will have three (3) high volume foam suppressor heads located around the circumference of each tank.
- Leaking or empty oil drums must be removed from the site immediately or stored appropriately and disposed of via a licensed waste disposal contractor.
- Washings from concrete mixers, paint or paint utensils should not be allowed to flow into any drain or watercourse.

The Dehydrating Plant

- All pressure vessels should be welded stainless steel units rated at multiples of the operating pressures and temperatures.
- All pipes and vessels should be lagged with appropriate insulating material and then covered with polished aluminum sheeting.
- All pressure vessels should be equipped with relief valves to limit pressures to safe levels.
- Quick Action Lock-off valves should be installed on alcohol feed and return lines.
- High pressure, high velocity fire fighting nozzles should be located external to the plant and around the unit.
- Portable fire fighting units should also be located around and throughout the facility.

The Boiler House

- Fire detection and fire suppression systems should be installed throughout the boiler house.
- High pressure, high velocity fire fighting nozzles should be located external to the plant and around the unit.
- Emergency fuel, feed-water and steam shut-off valves should be included in the engineering design.

Boiler Fuel and Water Tank Yard

- Installation of fire detection and fire suppression systems throughout this area.
- High pressure, high velocity foam/water hose nozzles will be located external to this area.
- Emergency fuel shut-off valves should be included in the engineering design.

Electrical Switchgear Room

- Fire detection and fire suppression systems should be installed throughout the Electrical Switchgear Room.

Import/Export Facilities

- High pressure, high velocity foam/water hose nozzles will be located in this area.
- Emergency fuel shut-off valves should be included in the engineering design.

- Protocols should be established between Jamaica Broilers Group Ltd. and Windalco regarding the use of the pier and training of staff from both companies.
- Jamaica Broilers Ltd. will make both the supplier and the purchaser aware that special response mechanisms, clean up and disposal methods must be documented on vessels.

Responsible Parties: Developer, Supplier, Purchaser, Contractor, Engineers, Management Personnel.

6.5.1 Public Health and Safety

Potential Impacts – Construction Phase

During the construction phase workers are at risk during construction activities and the from the use of heavy machinery and earth moving equipment.

Mitigation Measures

- All workers should receive proper briefing and/or training for the equipment to be used.
- All workers should be supplied, as appropriate for their tasks, with the relevant work gear including hard hats, safety boots, vests, ear muffs, goggles and gloves.

Potential Impacts –Operation Phase

Worker health and safety is a primary concern in this type of industrial facility. Workers will be exposed to hazardous materials and conditions.

Mitigation Measures

- It is recommended that a Fire Management Plan be prepared in conjunction with the Fire Brigade. This plan should be submitted to NEPA before the operational phase of the project.
- All mitigation measures for the prevention of technological hazards (Section 6.5.1) are applicable here to minimize injury to personnel.
- A written safety plan should be developed.

- Process safety analyses should be a continuous process and revalidated every two years
- Clear written operating procedures for safely conducting activities within the plant should be developed. This should include steps for each operating phase, operating limits, safety and health considerations and safety systems and their functions.
- Training of employees in the overview process and in the operating procedures
- Initial employee training before assignment.
- Documented three (3) year refresher training for all employees.
- Contractors onsite should be required to comply with the established safety standards of the facility.
- A mandatory safety review of the facility should be done to confirm that the construction and equipment of the process are in accordance with design specifications.
- Written procedures should be developed for the ongoing integrity of process equipment.
- Written procedures to manage changes to the facility should be established.
- All incidents and accidents should be investigated as soon as possible after occurring and no later than 48 hours after, for any incident which did or could have resulted in severe injury, death or spillage of fuel or ethanol.
- An investigation team should be assembled to investigate, analyze and report on the incident.
- A written incident report should be compiled and retained for a minimum period of five (5) years.
- An Emergency Action Plan that includes the procedures for handling leaks and spillages should be developed.
- Compliance Audits of the process safety should be conducted every two years.
- Immediate response to audit findings and recommendations is required.

Responsible Parties: Developer, Engineers, Management Personnel

7.0 Cumulative Impacts

The main cumulative impacts to be considered for this development are increased levels of fugitive dust during the construction phase, increased air emissions during the operations phase, increased effluent discharge and increased port activities.

Levels of fugitive dust are expected to increase during the site preparation phase and construction phase when there is vegetation clearance, earth movement and general construction work. These levels of fugitive dust will add to levels that exist on days when the pier is in operation for loading of bauxite.

These impacts are expected to be short term, for the construction phase only, and with the absence of residential communities in close proximity- should not present a major impact. However, workers on site (both for the Ethanol Plant and Windalco staff) should be equipped with dust masks as appropriate.

During the operations phase, air emissions from the broiler will be added to existing emissions from the Windalco operations. As a coastal site with open windy conditions these emissions are expected to be dissipated and not remain over the site. This will be a long term cumulative impact but it is not expected to be major.

Effluent discharge from the plant will include treated domestic and process waste. Although expected to be within NEPA guidelines, the location of the plant will add to the volumes of liquid effluent being discharged from this area. However, no negative impacts are expected from this. Additionally, the ethanol operations will see an increase in port activity which will realize increased income for Port Esquivel and increased loading and off loading requirements.

7.1 Positive Impacts

Several positive impacts are expected from the development of Ethanol Plant, as proposed. These positive impacts are given below:

7.1.1 Generation of Employment in the Operation and Construction Phases

During the construction phase employment will be generated for skilled and unskilled labourers as well as some professionals. Employment opportunities should continue for the duration of the construction period. Employment for trained personnel during the operation phase will not be expected to exceed twenty (20) persons.

7.1.2 Economic Benefits

The project is expected to produce 60 million US gallons of fuel ethanol annually, which will push local production of ethanol to 140 million US gallons. The local market for the introduction of ethanol into motor gasoline is estimated to be about 15 million US gallons per annum, and the developers intend to export 100% of output in the short term. Flexibility in export contracts will allow export to the domestic market.

The environmental benefits attributable to ethanol via the project, will, in short term, mainly accrue to the end user export markets. Except to the extent (not determinable) that Jamaica will participate in a wider global benefit. In relative economic terms however the Project is not insignificant. It is expected to generate J$4.4 billion in revenues per annum and some portion of this amount which is retained locally, will contribute to sustainable development and poverty reduction.

8.0 Consideration of Alternatives

8.1 Alternative Technologies

Jamaica Broilers Group Ltd. has consulted with other firms, but feel that the selected company, DEDINI is the best suited for the project. The Molecular Sieve technology selectively reabsorbs water and eliminates the use of the carcinogenic chemical benzene. This represents the most modern, efficient and clean technology.

8.2 Alternative Sites

The Salt River area was considered as an alternative site. However, it would be more expensive for this project due to its location to available piers and land type.

8.3 Wastewater Treatment Plant

Several options have been considered and are discussed within the EIA report. The selected option will meet NEPA trade effluent standards.

8.4 The No Action Alternative

If the site were to be left as is, Jamaica Broilers Group Ltd. and the island would not realize the additional revenue and foreign exchange earnings. The site would likely remain undeveloped until another industrial concern realized its potential for development.

9.0 Outline Monitoring Programme

If a permit is granted for the proposed development, and before site preparation and construction activities begin, a Monitoring Programme should be prepared for submission to NEPA, for their approval. The aim of the Monitoring Plan is to ensure the following:

- ✓ compliance with relevant legislation
- ✓ implementation of the mitigation measures provided
- ✓ conformance with any General or Specific Conditions as outlined in the permit
- ✓ long-term minimization of negative environmental impacts.

The Monitoring Plan should include the following components:

- Inspection protocol
- Parameters to be monitored, which should include
  - Ambient air quality
  - Water quality
  - Perimeter noise
  - Coastal water quality
- Construction monitoring
  - Worker health and safety
  - Disposal of solid waste
  - Handling and disposal of hazardous material
  - Disposal of liquid waste
- Materials handling and storage
- Covering of haulage vehicles
- Transportation of construction materials
- Deployment of flaggers and signposting
- Storage of fines and earth materials

The duration of the monitoring programme should be for the entire construction period, with monthly reporting.

The Monitoring Programme cannot be prepared in detail before the permit is received from NEPA as Terms and Conditions of the permit must be taken into consideration, and included in the monitoring programme as appropriate.

Monitoring of operations during the Operation Phase is recommended.

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