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ENVIRONMENTAL IMPACT ASSESSMENT

FOR

THE CONSTRUCTION AND OPERATION OF A TEMPORARY BARGE UNLOADING FACILITY

at Rocky Point, Clarendon

BY JAMALCO

For

FLUOR

ON BEHALF OF JAMALCO

Jamalco

Halse Hall
Clarendon

Submitted to: NEPA

nepa

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EXECUTIVE SUMMARY

1 EXECUTIVE SUMMARY

1.1 INTRODUCTION

This Environmental Impact Assessment (EIA) was carried out on a "brownsite" location for a Proposed Temporary Barge Unloading Dock at Rocky Point in Clarendon by Jamalco. This upgrade of the Rocky Point Port is a component of the permitted efficiency upgrade of the Government of Jamaica-Alcoa owned Jamalco bauxite-alumina production facilities, approved in 2004 (Permit No. 2004-13017-EP00083).

Alcoa has been operating in Jamaica since 1963, firstly as a bauxite mining, drying and shipping operation with its port at Rocky Point, and later as an alumina producer, following construction and commissioning of a refinery at Halse Hall, Clarendon in 1970. The Company has established an environmental, social and economic baseline of over forty years of operations in Jamaica. The Company has, as a matter of policy and its internal values, consistently improved its technologies and methodologies for environmental, health and safety management.

This EIA was conducted against Terms of Reference (TOR) approved by the National Environment and Planning Agency (NEPA), the letter of approval is included as Appendix II.

1.2 LOCATION AND LAYOUT

1.3 POLICY, LEGISLATIONS, REGULATIONS & STANDARDS

The regulatory framework for the project included international and national policies, legislation, regulations and standards as well as Alcoa International policies and values. The project was designed and the EIA conducted to insure project compliance with the regulatory framework.

National Environmental Planning Agency (NEPA), the governing environmental agency, requires an environmental impact assessment (EIA) to be conducted for review along with the requisite development plans. The Environmental Control Division (ECD) of the Ministry of Health imposes guidelines for air, water and soil standards to be maintained after construction.

Legislations and Conventions relevant to the establishment of a Temporary Barge Unloading Dock at Rocky Point in Clarendon are:

- The Natural Resources Conservation Authority (NRCA) Act, 1991
- The Wildlife Protection Act (1945)
- The Beach Control Act (1956)
- The Public Health Act (1974)
- Jamaica National Heritage Trust Act (1985)
- Town & Country Planning Act (1987)
- RAMSAR

1.4 ENVIRONMENTAL & SOCIAL BASELINE

The environmental setting and baseline for the proposed temporary barge dock included studies, analyses and assessments on: geomorphology, geology, water resources, terrestrial and marine ecology, land use and aesthetics, socio-economics, community consultations, archaeological and historical heritage resources, air quality and weather, noise and vibration, natural hazard vulnerability and risk assessment, among others.

The EIA also addressed the following issues:

- Solid and hazardous waste management practice/landfill.
- Wastewater management
- Occupational health and safety
- Human health risk of proposed actions
- Analysis of Alternatives
- Impact identification
- Impact mitigation
- Strategic elements in relation to other developments planned for the region

Closure plans for construction phase and structural integrity testing.

1.5 POTENTIAL IMPACTS & MITIGATION

The major impacts to the environment were identified as dredging and modification of the coastline for the proposed development. The removal of limited vegetation and ecological habitats is unavoidable and is the main environmental trade-off from the project implementation. However, the replanting of mangroves in an approved location within the affected region will offset the immediate loss of mangrove. Issues related to dust management will be addressed in the monitoring plan for construction and should not be a major issue.

An environmental impact matrix is a simple tool for identifying the possible impacts, whether positive or negative, of human activities on the environment. Activities that may be carried out during the various phases of the temporary barge dock implementation are considered in the matrix with respect to the environmental factors each may impact. The impact mitigation matrix highlights those activities needed to remove or ameliorate any identified adverse impacts and to enhance the positive aspects of the development. The matrix for this project is included as Table 1-1: Potential Impacts & Proposed Mitigation Steps.

The construction of the dock will not significantly reduce the permeability to infiltration of water in the soil. The finished surface will consist of a 0.2 – 0.3 m thick layer of crushed aggregate and this will greatly assist with water infiltration. Additionally, runoff will be properly managed and channelled, where appropriate, to lessen the impact of sedimentation on the marine environment.

Potential impacts identified were in some cases negative and others beneficial. No new or unfamiliar major negative impacts or risks were identified. Negative impacts identified could all be successfully mitigated using various approaches and methodologies.

The potential environmental impacts identified for the pre-construction, construction and operating phases of the proposed project included:

1.5.1 NEGATIVE

- Potential fugitive airborne, particulate emissions at the temporary barge unloading dock and nearby port and transportation corridors.
- Potential for fuel and oil spillage from vessels and equipment.

- loss of biodiversity, at the dock
- potential impacts from improper collection and handling and disposal of wastes
- potential impacts from improper wastewater management
- noise and vibration during construction and operations
- aesthetics and transient change in land use

1.5.2 POSITIVE

- improved macro and micro economic performance nationally, through major investment, increased revenue and job creation
- the restoration of mangroves to mitigate biodiversity loss
- decreases the need for transportation of large equipment by road causing road damage and the need for utilities to be relocated in addition to the inconveniences and potential dangers involved

TABLE 1-1: POTENTIAL IMPACTS & PROPOSED MITIGATION STEPS

Potential Impact	Activity	Environmental Receptor(s)	Magnitude & Duration	Significance
Removal of Vegetation, Loss of Habitat	Pre-Construction [Site Clearance]	Land, Flora, Fauna, Endemic Species	Immediate/Medium & Long-term	Direct/Minor Negative / Reversible impact
Mitigation Measures: The removal of vegetation and ecological habitats is unavoidable and is the main environmental trade-off from project implementation. Mangrove replanting is proposed in proximity to the project area as indicated by the Mangrove Mitigation Guidelines outlined in Section 7.1.3. **Economic Value:** Included in cost of construction				
Removal of Marine Sediments and Associated Fauna & Flora	Construction [Dredging]	Benthic soils, Flora, Fauna	Immediate/Medium & Long-term	Direct/Minor Negative / Reversible impact
Mitigation Measures: The dredging activity is unavoidable and is the main trade-off to be made against the economic benefits to be derived from project implementation. Dredge material may be utilized in filling for proposed dock infrastructure. **Economic Value:** Included in cost of construction				
Sedimentation and Silting	Dredging	Entire Marine Environment	Medium & Long-term	Direct/Minor Negative / Reversible impact

Potential Impact	Activity	Environmental Receptor(s)	Magnitude & Duration	Significance
Mitigation Measures: The use of sedimentation skirts, silt screens, or similar to contain sediments in the project area. **Economic Value:** Included in cost of construction				
Fugitive Dust	Storage/Stockpiling or placement of dredge spoils (if placed on land)	Human, Flora and Fauna (Marine & Terrestrial)	Unknown	Minor Negative
Mitigation Measures: Appropriate scheduling of activities. Dust Suppression through sprinkling. Communication with Fishing Community and other resource users. Covered vehicles on public roads transporting spoil that may cause nuisance. The use of Flag men will be utilized, where necessary, to manage traffic flow in and out of the site				
Aesthetics	Construction [Changes to site appearance]	Humans	Minor & Approx. 1-3 months	Minor Negative /Indirect/Sporadic/ Unavoidable Impact
Mitigation Measures: Maintenance and Upkeep. Construction Monitoring. Communication with Community and other resource users.				
Noise/Vibration, Fugitive Dust, Air Pollution	Pre-Construction & Construction [Vehicular Traffic (Trucks/Heavy Equipment), Construction Activities]	Humans, Marine Environment	Medium & Occasional (4 months)	Minor Negative/ Indirect/Sporadic/ Avoidable Impact

Potential Impact	Activity	Environmental Receptor(s)	Magnitude & Duration	Significance
Mitigation Measures: Appropriate scheduling of activities. Construction Monitoring. Dust Suppression through sprinkling. Proper Servicing of Equipment. Quick Response. Communication with Community and other resource users. Flag men will be utilized, where necessary, to manage traffic flow in and out of the site				
Storm water, Erosion, Sedimentation, Silting, Run-Off to Sea	Pre-Construction / Construction/Operation [Site Clearance, Vegetation Removal, Excavation]	Marine/Coastal Zone	Medium & Occasional/Short Term	Minor Negative/Indirect/ Sporadic / Avoidable Impact
Mitigation Measures: Careful Phasing of Activities With Consideration of weather conditions. Construction Monitoring. Implementation of Control Devices (Drainage, Silt Fencing, etc.) **Economic Value:** Should not exceed JA$1.0 Million				
Sewage	Pre-Construction Construction & Operation [Temporary Sewage Handling during Construction]	Coastal Waters, Groundwater, Human	Minor & Short-term	Minor Negative, indirect, avoidable impact

Potential Impact	Activity	Environmental Receptor(s)	Magnitude & Duration	Significance
Mitigation Measures: The project site will utilise portable chemical toilets which will be managed and serviced by a licensed provider under contract to Jamalco. Portable toilets will be located away from the shoreline and/or secured to avoid accidental spillage during periods of heavy wind.				
Socio-Economic/Cultural/ Temporary Loss of Traditional Use and Access to Marine resources	Pre-Construction, Construction & Operation [Entire Development]	Human	Large & Short-term	Minor Negative/Direct Reversible Impact
Mitigation Measures: While the area is not a "commercial" fishing area it provides recreational fishing and nursery areas for juvenile fishes. The area will be able to recover from the impacts of dredging and recreational fishermen will be able to access the area by boat or land. Recognize utilization of area for fishing.				
Solid Waste Handling and Disposal	Pre-Construction, Construction & Operation [Vegetation Removal/Construction Activities/Packaging/Office Waste]	Coastal Waters, Land, Groundwater, Humans, Aesthetic	Minor & Occasional/Short-term	Avoidable / No Impact if properly managed

Potential Impact	Activity	Environmental Receptor(s)	Magnitude & Duration	Significance
Mitigation Measures: Minimize and reduce quantities of solid waste generated during site preparation and construction. Solid waste generated during construction will be managed according to Jamalco waste management procedures which includes: disposal at an approved landfill by approved haulers. Proper waste storage devices such as drums and skips will be located at the project site during all phases to collect refuse which will be handled by Jamalco and transported for disposal at the refinery landfill.				
Noise, Leaks, Exhaust from Construction Implements (heavy equipment	Pre & Post Construction, Operation	Soils, Groundwater, Coastal Waters, Air, Humans	Medium & Short-term	Minor negative, direct, sporadic, avoidable impact
Mitigation Measures: Equipment will be monitored and maintained on a regular basis. Any indication of leaks, discharge to the ground will be addressed immediately. Equipment maintenance on site will be minimal and monitored. Construction monitoring will include these potential impacts. Chemicals and fuels with a potential to leak, will be stored in secured, impermeable areas to reduce the likelihood of contamination (e.g. the use of existing storage areas at the Jamalco Rocky Point Port instead of on-site storage of chemicals and fuels).				
Mangrove & Coastline Aesthetics	Construction [Vegetation Removal/Construction Activities/Coastline Modification]	Soils, Groundwater, Coastal Waters and Marine Flora & Fauna therein,	Medium & Short-term	Minor negative, direct, sporadic, avoidable impact
Mitigation Measures: Silt screens will be used to contain sedimentation during dredging exercises. Sea grasses removed may be transplanted at a suitable location along the coast with permission from NEPA. Mangrove replanting and mitigation measures will be incorporated as outlined in section 7.1.3.				

1.6 MONITORING PLAN

The monitoring plan devised for the development will be implemented at the pre-construction, construction and operational phases of the project. Monitoring will involve the assessment of activities to ensure adherence to the recommendations made to reduce negative impacts. This should include monitoring for noise, dust, waste management, sewage handling, erosion and storm water management.

1.7 CONCLUSION

Over the forty year period which Jamalco has operated in Jamaica there has been marked improvement in Port activities as it relates to the environment, and environmental technology and management.

The potential impacts identified will be mitigated using proven technologies, most of which have been effectively applied in the past. No new or unfamiliar environmental impacts or risks have been identified with the implementation of the proposed barge dock facility.

The developers are willing to work with the regulatory agencies and community to ensure that the development is acceptable to all involved.

Because the potential impacts of the project can be mitigated and the beneficial impacts are substantial, we recommend that this project be permitted for implementation. Furthermore, all mangrove and associated flora not affected by this project in the immediate vicinity will be protected in their existing state.

PROJECT DESCRIPTION

2 PROJECT DESCRIPTION

2.1 INTRODUCTION

Established in 1963 as a bauxite mining and shipping operation, Alcoa Minerals of Jamaica, a subsidiary of Alcoa International, operates a shipping port at Rocky Point, Clarendon from which alumina is shipped to the United States of America for further processing, fuel and other raw materials are received for use at the refinery.

Alcoa and Jamalco have established a 40 year baseline of operation in bauxite mining, alumina production and shipping in Jamaica and in this regard have been responsible corporate citizens operating within local and international guidelines, policies, legislation, regulations as well as their own stringent internal environmental, health and safety policy, values, guidelines, and standards.

The Jamalco operations comprise the Clarendon Alumina Works refinery located in Halse Hall, Rocky Point Port Facilities, the Lands and Mining operations in Woodside and South Manchester respectively, and a traffic office in Kingston.

Shipping facilities are located at Rocky Point and commodity movement between the refinery and the port is via rail, which is operated by Jamalco. The overall operation currently employs approximately 600 persons and is managed by Alcoa Minerals of Jamaica for the joint venture.

The refinery is expected to be upgraded to produce 2.8 million tonnes of alumina annually. This upgrade will include the addition of new equipment that based on size and quantity will have to be brought to Jamaica from overseas by barges. The existing port facility has no means of accommodating barges and as such, Jamalco is seeking to establish a temporary barge facility to assist in the efficient movement of equipment from port to the plant in Halse Hall. The temporary barge dock will be a separate stand alone facility located adjacent to the existing port and will involve:

- the addition of a new rail spur from the existing Jamalco rail line,
- a temporary barge unloading dock with a 600mt ringer crane,
- construction of access roads,

- dredging of area for temporary dock, and
- modifications to mangrove plant community

In keeping with the NRCA Act of 1991, Jamalco is required to conduct an Environmental Impact Assessment (EIA) on the proposed operations. This includes linkages to and from the existing rail corridor. The EIA will be submitted to the National Environment and Planning Agency (NEPA), for review and permitting in order to facilitate implementation of the plans.

A detailed description of all elements of the project during the pre-construction, construction and operational phases has been prepared. The elements analyzed will include the infrastructure of the project including: drainage features; roads; waste generation and management; and utility requirements.

The purpose of this EIA is to assess the impacts, if any that may occur from the implementation of this project, inclusive of the proposed dredging works, modification to the mangrove plant community, construction activities and operation of the barge unloading facility at Rocky Point, Clarendon.

The key to this proposed temporary barge dock project is that it offers the least disruptive (to the surrounding population, road infrastructure and utilities) option that will allow for the safe transport of large equipment to the refinery for use in the efficiency upgrade project.

2.2 PROJECT LOCATION & DESCRIPTION

Rocky Point is located along Jamaica's south coast at Latitude 17°46'N and Longitude 77°16'W.

The Rocky Point Port is located approximately 14 km (8.7 mi) to the southeast of the alumina refinery on a peninsula separating Salt River Bay to the north and Peake Bay to the south. The port is reached via a secondary road and materials moved to and from the port is done by rail, operated by Jamalco.

The proposed barge unloading dock will be located at coordinates N 129,750 m and E 234,000 m and will be 76.2 m (250 ft) long by 30.5 m (100 ft) wide orientated along an east-west alignment. Shoreline stability will be maintained through the construction of a sheet pile wall backfilled with soil.

The finished elevation of the lay-down area south of the wharf face will be 1.5-1.8 m (5-6 ft) higher than the mean sea level. As a result, limited backfilling will be required over existing higher points of the site. The finished surface will consist of a 0.2-0.3 m (6-12 in) thick layer of crushed stone material.

No product stockpiling other than a general 300 psf live load is expected over the fill area south of the wharf line. A Manitowoc 888 Ringer Crane will be used to unload the barges directly onto rail cars. The center of the crane is expected to be a minimum 50 ft. away from the wharf surface. The total dead and live load to be transmitted to the soil is expected to be in the order of 3700 tons. A 500 ton load differential is anticipated between the front and the rear of the crane. These loads will be transferred via a series of 34 pads, each 1.94 m^2 (20.83 ft^2) placed along the perimeter of a 15.5 m (51 ft) diameter circular area. One or two layers of 0.3 m thick timber mats may be used to improve the soil bearing under the crane pads. The crane tolerance to differential settlement is 0.03 m (1 inch) over a 13.7 m (45 ft) distance.

It is intended to dredge the sediments and soils present before the wharf face to provide a minimum depth of 5.5 m (18 ft.) of water below the mean sea level for barge manoeuvrings. Depth to sediments and soils presently average 4-20 m below sea level and based on the anticipated area (estimate) to be cleared 34,559.93 m^2 will result in the possible removal of 138239.72 – 691,198.60 m^3 of spoil material. A new 243.84 m (800 ft) long single railway spur will service the proposed dock. The proposed spur line will extend from the existing rail line to a distance of 6 m (20 ft.) from the proposed dock face. A 250 ton dead and live load is expected from the railway cars. It is expected that most of the railway line footprint will require backfill to match the proposed finished grades.

PLATE 2-1: JAMALCO ROCKY POINT PORT

Other than the works associated with the construction of the dock features, the modification of the mangroves and dredging of the sediments, no other major aspects will be a part of the project. No fuel or chemical storage will be done in this area. It is not anticipated that any new tankage will be needed for storage of fuel oil.

Table 2-1 below outlines the proposed changes expected at the proposed site for the temporary barge.

TABLE 2-1: PROPOSED CHANGES TO PROPOSED SITE

Item	Change
Siting Temporary Barge Unloading Dock	Removal of mangrove and backfilling of area to required grade
Rail Spur addition	Modification of existing rail line, backfilling of area, removal of vegetation
Proposed Dredging	Removal of sediments from sea floor, use of dredge spoils for backfilling

2.2.1 MODIFICATIONS TO BEACH/FORESHORE/MANGROVE

The proposed temporary unloading barge dock will be utilized for offloading equipment necessary for the upgrade of Jamalco's operations for which a permit has already been granted. The proposed site for the barge dock is an uninhabited coastal area composed primarily of mangroves adjoining a secondary roadway that extends toward the main Rocky Point Port location.

The modifications to this area includes

- dredging a section of the foreshore to install a temporary barge unloading dock, and barge manoeuvring area
- a rail spur through the mangrove plant community

This project calls for modifications to the foreshore and the mangrove plant community and requires licenses under the Beach Control Act. All applicable licenses have been applied for and will be obtained prior to implementation.

Figure 2-2 below outlines the location of the temporary barge dock project and its associated impact zone.

FIGURE 2-1: GOOGLE EARTH IMAGE SHOWING LOCATION OF PROPOSED SITE AND EXISTING JAMALCO ROCKY POINT PORT

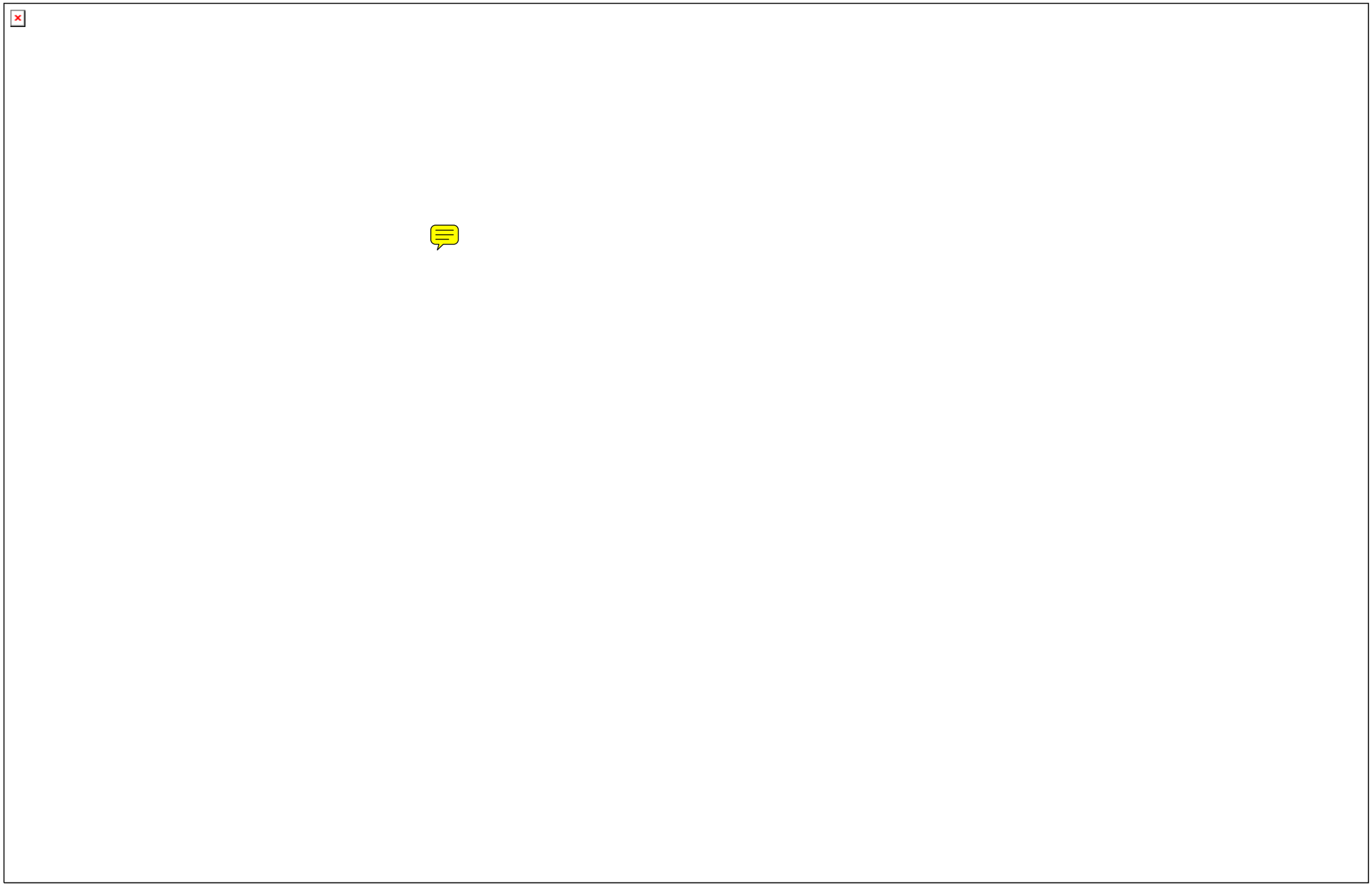

FIGURE 2-2: PROPOSED SITE OUTLINE FOR TEMPORARY BARGE UNLOADING DOCK

PLATE 2-2: PRESENT SITE USE

PLATE 2-3: BARGE DOCKED AT PROPOSED SITE FOR TEMPORARY UNLOADING DOCK

2.2.1.1 FORESHORE DREDGE AREA

The foreshore will be dredged to house a temporary barge unloading dock with a 600 mt ringer crane and to provide sufficient draft so that the loaded barges will not run aground on their entry to the dock. The origin coordinates for this area are 129,750 N and 234,000 E; coordinates are based on reference station Rocky Point Pier Coordinates 129,806.33 N, 234,870.15 E.

Dredging will be done using locally available equipment usually utilised by Jamalco for maintenance dredging. This will include barge mounted cranes with large buckets for removal of spoil.

Alternatives for management of dredged materials are anticipated to include:

1) On land backfilling for proposed dock infrastructure and/or other projects in immediate area.
2) Discard the spoil at an approved dump site on land, such as a former quarry/borrow area or at a facility specifically authorised for land filling of dredge spoil
3) Discard the spoil at sea in an approved area(s), provided that dredged material is of suitable quality to be safely disposed in the marine environment.

Alternative 1 will be used in conjunction with crushed aggregate to finish area for dock.

Near-shore construction may include such heavy construction activities as infilling, sheet pile wall installation, rock fill installation, and intake/outfall canals and/or pipe installation. These activities will be managed in a way to minimise the risks to the marine environment. Important features include shoreline integrity, habitat, water quality, and aesthetic qualities. Protective measures will include measures for spill control, runoff management, erosion control, sediment control, and other means of protection.

2.2.1.2 MANGROVE PLANT COMMUNITY MODIFICATION

Adjoining this foreshore is an area of sand bars and mangrove trees. A new rail spur will extend to the temporary dock to facilitate movement of equipment via rail. Jamalco operates a cargo rail service for transporting alumina and raw materials to and from the Rocky Point port. This rail line runs adjacent to the proposed project location.

There exist a very small patch of mangroves to be affected by the rail spur. With clearance of 12 m (40 ft.) on either side of the rail spur, less than 2023.41 m^2 (0.5 acre) of mangroves and other flora will be affected.

2.2.2 DRAINAGE

The site is disturbed and has been backfilled with crushed limestone. The site currently has natural drainage that does not result in ponding or flooding in the area, it drains well and is relatively flat. The site itself has never undergone any of these events as further explained in the Hydrology and Natural Hazard section of this report.

The existing dock area is currently compressed stone/marl and naturally drains itself. The construction of a new dock will in no way destroy this natural process as the footprint will not be significantly greater than what presently exist, and the existing structure will be mostly shaped and reinforced to accommodate the crane and railway spur.

The new dock area will be comprised of compressed backfill and will allow for natural draining during rainfall event. The adjoining salina[1] will also assist with the drainage particularly during storm events through natural means. The presence of mangroves in close proximity will assist in the protection of the shoreline. Generally, soil in the area is made of sand or gravel and does not allow for the ponding of water. There is no natural flow pathways for storm water to reach the sea during periods of rainfall which will be maintained and/or improved upon.

No significant hardtop will be laid down in the form of asphalt or cement cover.

2.2.3 SOLID WASTE MANAGEMENT

Solid waste will be generated during the pre-construction, construction, and operation of the temporary barge unloading facility. During pre-construction solid waste will be generated from land clearance and soil movement. During construction activities, solid waste will be generated primarily from packaging and containers related to materials, supplies and equipment brought in for the construction phase of the project. Jamalco will place garbage skips at the temporary barge unloading facility to effectively manage

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[1] Salina: An area of upper intertidal lands characterized by extreme flatness and salt levels. When moist periods and greater tidal amplitudes return these favor mangrove re-occupation.

this anticipated increase, also the frequency of collection will be matched to the amount of waste being generated to avoid pile-up or spilling of contents. Collected solid waste will be transported by rail to the main plant where it will be disposed in the onsite landfill.

2.2.4 SEWAGE

Temporary portable chemical toilets will be used during the construction and operation of the temporary barge unloading facility. These toilets are widely used throughout Jamalco's operations and have always been properly located and maintained.

Existing protocol for the safe removal and disposal of sewage from these chemical toilets (practiced throughout Jamalco's system) will be extended to the barge dock. A private contracted firm will remove and dispose of the sewage and provide manifesting to Jamalco as to the point of final disposal.

2.2.5 WATER DEMAND

There will be no anticipated increase or demand for large volumes of water (potable or otherwise) at the barge dock. Any activities that may require volumes of water can be undertaken at the existing port facility. No water lines will be extended to this area.

2.2.6 ELECTRICITY DEMAND

A very small increase in electricity usage may be realised from lighting and a temporary office that will be located at the barge dock. This service can be easily obtained from the network supplied by power generated by Jamalco that feeds the port.

2.2.7 FUEL STORAGE

The present system of fuel demand and storage at the Port will be continued. The temporary unloading dock will have no fuel storage facility.

ANALYSIS OF ALTERNATIVES

3 ANALYSIS OF ALTERNATIVES

In considering the development options, the following alternatives were analysed. These are:

1) No Action
2) The Proposed Development
3) Use of Existing Port
4) Increase Berths of Existing Port
5) Use of Another Port

3.1 NO ACTION

With the "No Action" Alternative, Jamalco would have to find a different method of bringing in the large equipment and supplies it would need for the approved expansion to advance. In the past when Jamalco had the need to bring large equipment in it would result in major traffic disruption, displacement of utilities and significant inconvenience to the people of the area. The size and scale of the efficiency upgrade along with the size and weight of the structures and equipment that will be brought in makes a No Action Alternative unacceptable.

3.2 THE PROPOSED DEVELOPMENT

The proposed project seeks to develop a Temporary barge dock adjacent to the existing port facility along with dredging of the sea floor to allow for access of barges carrying structures, equipment and supplies for the expansion project.

The proposed project, despite having some environmental implications, presents the best practical, socio-cultural and economic option. The proposed project is temporary which allows for the area to return to semblance of normalcy after operations are concluded.

This option facilitates the uses of Jamalco's existing rail system to be used with additional offloading equipment installed at the barge dock. The use of the rail system for transport of heavy equipment will significantly reduce many negative impacts which have been experienced in the past. These negative impacts include severe traffic congestion, the need to modify roadways, the removal of utilities and the cutting down of trees to facilitate movement. This is the preferred alternative.

3.3 USE OF EXISTING PORT

The existing port in its present configuration is not set-up to receive and offload barges. To facilitate the receipt and offloading of expansion equipment, structures, and supplies, significant modifications would have to be made. This would prove to be costly and would be disruptive to the primary purpose of the port, the shipment of alumina and the receipt of fuel and other raw materials for the refinery from bulk ships. Additionally, there is no equipment or reasonable access to offloading equipment at the port suitable for the sizes and weights expected. This alternative would prove to be more costly and more disruptive than the proposed Temporary Dock.

Environmentally, it would pose similar challenges to the marine environment.

Not the preferred alternative.

3.4 INCREASE BERTHS AT EXISTING PORT

Increase number of berths at the existing port to accommodate barges. While this alternative could be done, the layout and orientation of the existing port (including the distance of the berths from shore) would make it difficult to locate a suitable crane in that area and would restrict rail access to the berth so that equipment removed from the barges would be difficult to move to the rail line. The required modification would be very expensive and would result in possible disruption in the core business of the port, the shipping of alumina and the receipt of fuel and chemicals for the refinery operation.

Not the preferred alternative.

3.5 USE OF ANOTHER PORT

This alternative would be economically, socially and to a lesser extent environmentally disadvantageous to Jamalco. The nearest port is Port Esquivel which houses Windalco's bauxite shipping operations. While this port may have limited wharf capabilities that could be used to off-load barges, the potential delays and congestion that would occur at the port would not be worth the effort for Windalco, a competitor of Jamalco. This option will not accommodate Jamalco's plans. Outside Clarendon, the other potential ports of entry would be Kingston Wharves to the east (Kingston) and Port Kaiser to the west (St. Elizabeth).

In the event that a deal could be brokered with another wharfage facility, Jamalco would have to transport the structures and equipment on specialized carriers (in most cases, due to size and weight) by road, through communities that would prove disruptive and result in significant cost to modify and upgrade the routes and to compensate for disruptions.

These options present a high economic cost to Jamalco and inherent dangers in transporting equipment via roadways from either of these ports to the Jamalco refinery in Halse Hall.

Possible routes from Kingston would include Spanish Town Road, the highway (provided structures can pass through toll booths) or through Old Harbour with its narrow winding roads and on to Halse Hall or Salt River which are just as challenging. The same goes for Port Esquivel. If Port Kaiser was used the coastal road through Alligator Pond to Milk River and onto Lionel Town would have to be widened and upgraded at significant cost to the project.

Not the preferred alternative.

EXISTING ENVIRONMENT

4 EXISTING ENVIRONMENT

The project site is a "brownsite" located in a coastal area at Rocky Point, Clarendon in close proximity to the existing permanent Port facility presently in use by Jamalco.

It is found within the Portland Bight protected Area (PBPA) which recently was designated as a Wetland of International Importance on 2nd February 2006 (RAMSAR designation). It is presently used as a dock facility. It is a flat and narrow strip of land with few mangroves bordering a salina. The mangroves in the area show damage from past storm events in the last two years (2004-2006), and human intrusion. All tree species exhibit growth affected by wind. Immediately opposite the proposed site is an extensive mangrove stand which also shows significant damage from the past storm events. The terrestrial, riparian and aquatic habitats within the PBPA are home to a wide range of native and migrant wildlife. Some of the native wildlife is endemic to Jamaica.

A transportation corridor (secondary road and railroad) runs parallel the coast in this area and provides access to the existing Jamalco Rocky Point Port. Electricity infrastructure is present along the transportation corridor.

4.1 PHYSICAL ENVIRONMENT

4.1.1 WEATHER & METEOROLOGY

Meteorological data for the area was sourced from the closest known collection point, which is the Jamalco Refinery located approximately 20 km to the north of the site at Halse Hall.

4.1.1.1 RAINFALL

The south coast of Jamaica is relatively dry with the majority of its rainfall coming in defined rainy seasons in the form of convectional rain. Convectional rain occurs when evaporation takes place causing the moist air to rise; this then cools and condenses as rainfall.

Rainfall data was acquired from the state of the art weather station at Jamalco Refinery at Halse, Hall, Clarendon. This weather station is the closest weather station to Rocky Point. Over the period 1983 – 2003 the rainfall totals for the southern Clarendon region

averaged 988.1 mm (38.9 inches) of rainfall with a monthly average of 83.1 mm (3.27 inches). The area experiences its wettest period during the months of May-June (90 – 163 mm) and August-November (89 – 154 mm).

It is not envisioned that the effects of rainfall will have any significant impact on the proposed project. The proposed mitigation plan that accompanies this report speaks to mitigation measures that will be followed to minimize negative impacts related to storm water flow and potential sedimentation of the marine environment.

The rainfall averages as measured at the Jamalco refinery weather station are outlined below in Table 4-1.

TABLE 4-1: Annual Rainfall - Inches. Jamalco Refinery

YEAR	MONTH												YEAR'S TOTAL	MONTHLY AVERAGE
	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.		
1983	0.44	6.68	0.40		2.54	6.48	0.06	6.36	1.42	5.29	2.01	0.16	31.84	2.89
1984	0.52	2.17	5.39	0.58	5.37	3.62	2.13	1.76	5.88	3.86	1.75	0.07	33.10	2.76
1985	0.14	-	-	-	-	-	-	2.45	1.86	8.62	7.74	1.12	21.93	1.83
1986	1.95	0.78	1.05	3.53	-	22.56	1.36	0.52	3.36	8.87	2.01	0.78	46.77	3.90
1987	1.86	0.28	0.16	6.90	6.48	1.31	1.70	3.04	1.46	17.38	5.52	3.10	49.19	4.10
1988	0.10	0.63	1.63	2.20	5.62	1.59	1.65	8.70	8.81	1.24	6.53	1.81	40.51	3.38
1989	2.99	1.60	3.01	0.74	4.64	1.40	0.21	1.61	7.15	0.98	1.22	0.36	25.91	2.16
1990	2.04	0.79	1.78	2.51	1.43	2.11	2.26	0.60	1.33	6.59	7.68	1.80	30.92	2.58
1991	0.39	0.26	1.58	1.46	7.52	0.37	1.66	1.67	2.36	2.24	3.37	0.37	23.25	1.94
1992	0.21	2.22	0.38	1.61	9.11	2.95	0.47	2.14	4.36	2.82	1.24	0.22	27.73	2.31
1993	3.60	3.54	4.62	7.89	27.45	0.75	1.82	0.75	4.76	0.68	3.59	7.27	66.72	5.56
1994	1.74	0.07	2.62	3.29	4.10	0.00	1.70	4.10	3.22	0.58	13.85	0.70	35.97	3.00
1995	2.75	0.80	2.31	5.09	6.19	3.05	1.13	13.08	8.32	17.70	0.87	1.83	63.12	5.26
1996	1.40	0.17	0.90	0.94	0.60	0.92	2.17	4.40	6.12	6.83	7.22	0.03	31.70	2.64
1997	1.03	0.89	1.26	1.36	0.85	7.88	0.33	0.64	5.70	6.47	3.14	2.15	31.70	2.64
1998	0.74	1.54	8.55	2.53	0.67	1.14	4.96	4.15	11.36	5.71	2.21	4.66	48.22	4.02
1999	0.87	3.10	6.93	0.93	2.43	3.67	2.96	1.75	13.63	11.73	8.87	1.99	58.86	4.91
2000	0.77	1.75	1.65	3.47	1.28	0.85	2.47	2.00	9.28	3.80	1.05	6.19	34.56	2.88
2001	1.75	0.35	0.49	1.48	6.14	0.09	1.73	0.55	2.31	5.30	8.55	5.78	34.52	2.88
2002	3.27	1.81	2.39	3.80	20.05	6.68	0.34	0.47	22.48	6.04	0.94	1.60	69.87	5.82
2003	1.31	0.91	1.97	3.00	14.72	3.46	1.08	12.64	2.28	3.30	1.46	1.11	47.24	3.94
2004	1.07	0.16	0.24	0.16	1.07								2.70	0.54

4.1.1.2 WINDS

Rocky Point experiences the traditional north easterly trade winds that affect the island. Hurricanes are a serious seasonal threat from June to November; since 1886, 21 hurricanes have made landfall in Jamaica, while over 100 have passed within 240 km (150 miles) of the island. Tsunamis are also a possible risk. The paragraphs below outline the current patterns that affect the area and were re-verified in February and March 2006 and found to be consistent with data presented in the Jamalco 2.8 Metric Tonne per year Efficiency Upgrade EIA done by Conrad Douglas and Associates Ltd. in 2004.

During the morning period, the prevailing winds are from the north. These winds are land driven and are reversed in the evenings. The plate below represents an aerial photograph of the area taken on an early morning in 1991. The area has remained consistent in size and topography as represented, and the conditions are quite similar as verified through ground truthing. The currents affecting the area are influenced by these winds.

Discharges of fresh water from the Salt River affect the proposed area from the mangroves to the north-west of the proposed project site. The discharges tend to be dark brown in colour, a reflection of the tannins that are leached from mangrove tree roots, particularly red mangrove within the Salt River.

Plate 4-1 below suggests that water movement indicators were being influenced by the prevailing wind at the time. Contributing to the direction of movement would be the effect that the seafloor has on currents, through a process called wave refraction (The process by which a wave approaching the shore changes direction due to slowing of those parts of the wave that enter shallow water first).

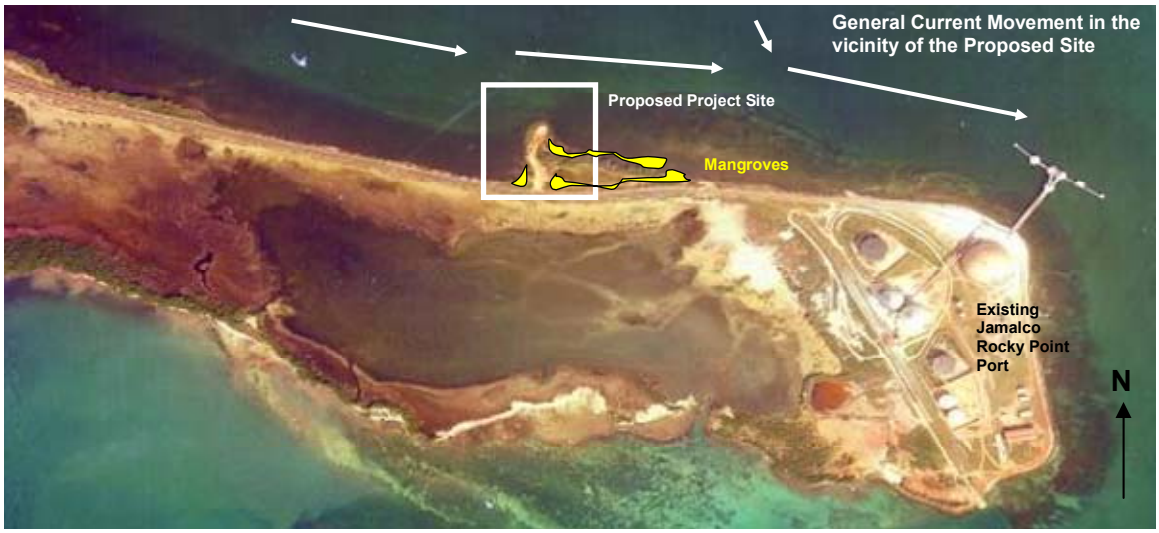

PLATE 4-1 GENERAL CURRENT MOVEMENT IN THE VICINITY OF THE PROPOSED SITE

4.1.2 TOPOGRAPHY

The topography of the area is characterised by the coastal strip. It is fairly flat rising 2-3 m to the road elevation. The area slopes gradually away from the highland areas that surround it; elevations at the project site and surrounding flat areas (including mangrove stands) never exceed 10 meters.

4.1.2.1 BASIN BATHYMETRY

The sea basin in the vicinity of Rocky Point extends to a depth of approximately 8.2 m (27 ft) on a gently sloping contour. This section is based in part on a Report compiled by Golder Associates on behalf of Jamalco[2]. Bathymetric survey data is illustrated in Figure 4-1 below. The marine geophysical survey was carried out on a 46 ft. long tug boat. The following equipment was used:

- Garmin GPSMAP188
- Datasonics SPR-1200 Seismic Profiling (Bubble Pulser) System
- Datasonic SBP-5000 3.2 kHz Sub-Bottom Profiling System
- Krone-Hite Filter – a two-channel programmable analog filter

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[2] Report on Marine Geophysical investigation, Jamalco, Rocky Point, Jamaica, Barge Unloading Facility. Golder Associates Ltd. December 2005

- EPC1086 – a dual channel graphic recorder

All depths were referenced to mean se level, noting tidal variations onsite of +/- 6 inches or less. No correction was made for tidal variations that occurred during the survey.

Depths ranged from 1.2 – 8.2 m (4 – 27 ft) below mean sea level. The bathymetric surface was observed to be shallow and flat to the south near shore, sloping downwards to the north in the central part of the proposed dredge area and deeper and relatively flat to the north and northwest. There is an elongated localised depression along the slope between deep and shallow water at 2408550E, 2067650N.

Examination of the boreholes taken for the site indicated an upper 35 to 45 ft of sediments consisting mainly of loose sand and soft silty clay to clayey silt material. These sediments are underlain by a thick, relatively undifferentiated layer of stiff silty clay to clayey silt, to the maximum depth of the boreholes (about 80 ft below top of sediments). The results of the borehole tests are outlined in Section 4.1.3.1.

FIGURE 4-1: BATHYMETRY OF PROPOSED SITE LOCATION, ROCKY POINT

4.1.3 GEOLOGY

The general area is fairly flat with maximum height above sea level of approximately 2 metres.

The geology of the area is largely unconsolidated sands and silt. The geological formation of the area could be the result of the accretion of sand in the area from wave action, and the eventual colonization by mangroves and other wetland plant species. The area, as is typical with similar such areas, is characterized as Marshland on the geology map for southern Clarendon and is typically not assigned much detail in terms of geology on the Geological Sheets developed for the island. The growth of the mangrove provides added stability to the geological formation, and prevents the removal of sand from the area.

The area is located some 2.6-3.0 km from the nearest major fault line, and is located in a region of the island where earthquakes only have a 10% probability of exceeding 8 MMI within fifty years of any such previous occurrence.

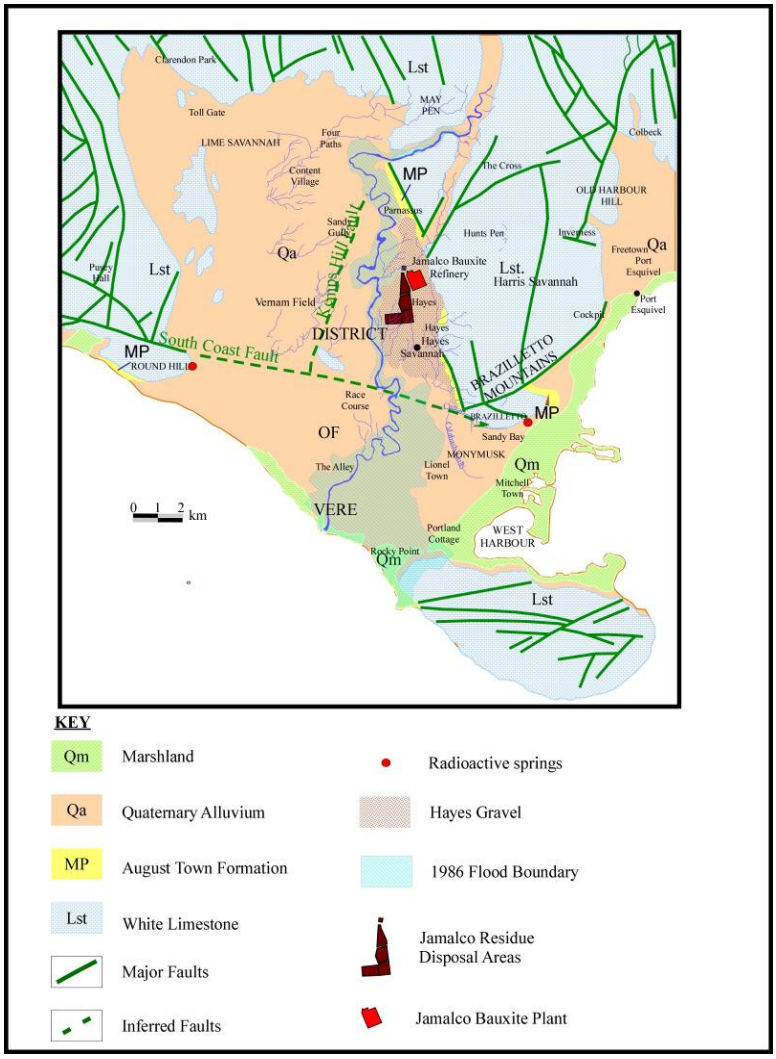


PLATE 4-2: GEOLOGY MAP OF SOUTHERN CLARENDON

4.1.3.1 SUBSURFACE PROFILE

The geology of the proposed project area was assessed by a series of boreholes drilled during this period. A total of 10 boreholes were drilled, 5 on-land and 5 offshore[3]. Table 4-2 below outlines the borehole locations and drilling depths.

[3] Report on Consolidated Geotechnical Investigation and Geophysical Survey, Jamalco, Rocky Point, Jamaica, Barge Unloading Facility. Golder Associates Ltd. January 2006.

TABLE 4-2: BOREHOLE IDENTIFICATION, LOCATION AND DEPTH

Boreholes	Location	Depth of Water (m)	Soil Penetration depth (m)
B-1	On-land	-	30.6
B-2	On-land	-	32.1
B-3	Offshore	2.9	24.5
B-4	Offshore	2.3	24.4
B-5	Offshore	2.8	6.8
B-6	Offshore	5.4	7.4
B-7	Offshore	2.1	6.6
B-8	On-land	-	18.5
B-9	On-land	-	14.6
B-10	On-land	-	17.1

* Soil penetration depths for offshore locations are the depths below the marine floor and not the water surface.

4.1.3.1.1 DOCK

The geological investigation for the physical location of the proposed dock area included on-land boreholes B-1 and B-2 and offshore boreholes B-3 and B-4. The general soil stratigraphy was consistent with only slight variations in soil type content and lithological unit thickness. The only notable difference in soil stratigraphy was the presence of approximately 22 ft. of fill material on land at boreholes B-1 and B-2, 2.3 ft. in borehole B-3, and 5.0 ft. in borehole B-4.

The fill material comprises primarily loose sandy gravel and compact gravely sand with some silt and clay with occasional boulders. The stratigraphy of the natural soils beneath the fill consists of a layer of approximately 8.2-10.4 m of very loose to compact, grey sand with variable proportions on interbedded, very soft silt and/or clayey silt. Below this, a layer of cohesive soils can be found. This represents about 12.8-15.8 m of very stiff, brownish to greenish clayey silty sand between the three boreholes becoming silty clay, with varying proportions of silt and clay.

4.1.3.1.2 THE PROPOSED DREDGING AREA

The proposed dredge area was investigated by means of boreholes B-5 to B-7. All three boreholes were drilled from a barge, in water depths of 2.8 – 5.4 m. The general soil stratigraphy was similar.

The initial layers were of very loose to compact, grey, fine to coarse sand. This layer varied in thickness from 2.7 m at B-6 to 4.9 m at B-7. A 2.1 m thick layer of very soft sandy silt was encountered beneath the fine to coarse sand in B-6. The fine to coarse sand in B-5 and B-7, and the very soft sandy silt in B-6 are underlain by approximately 1.5 m of very loose to loose, grey silty sand. In B-6, this layer appeared to be clayey. The fine particle size allows for quick re-suspension of particles, and hence leads to the low visibility and poor water quality experienced at the site.

Figure 4-2 outlines the position of the respective boreholes done at the proposed site.

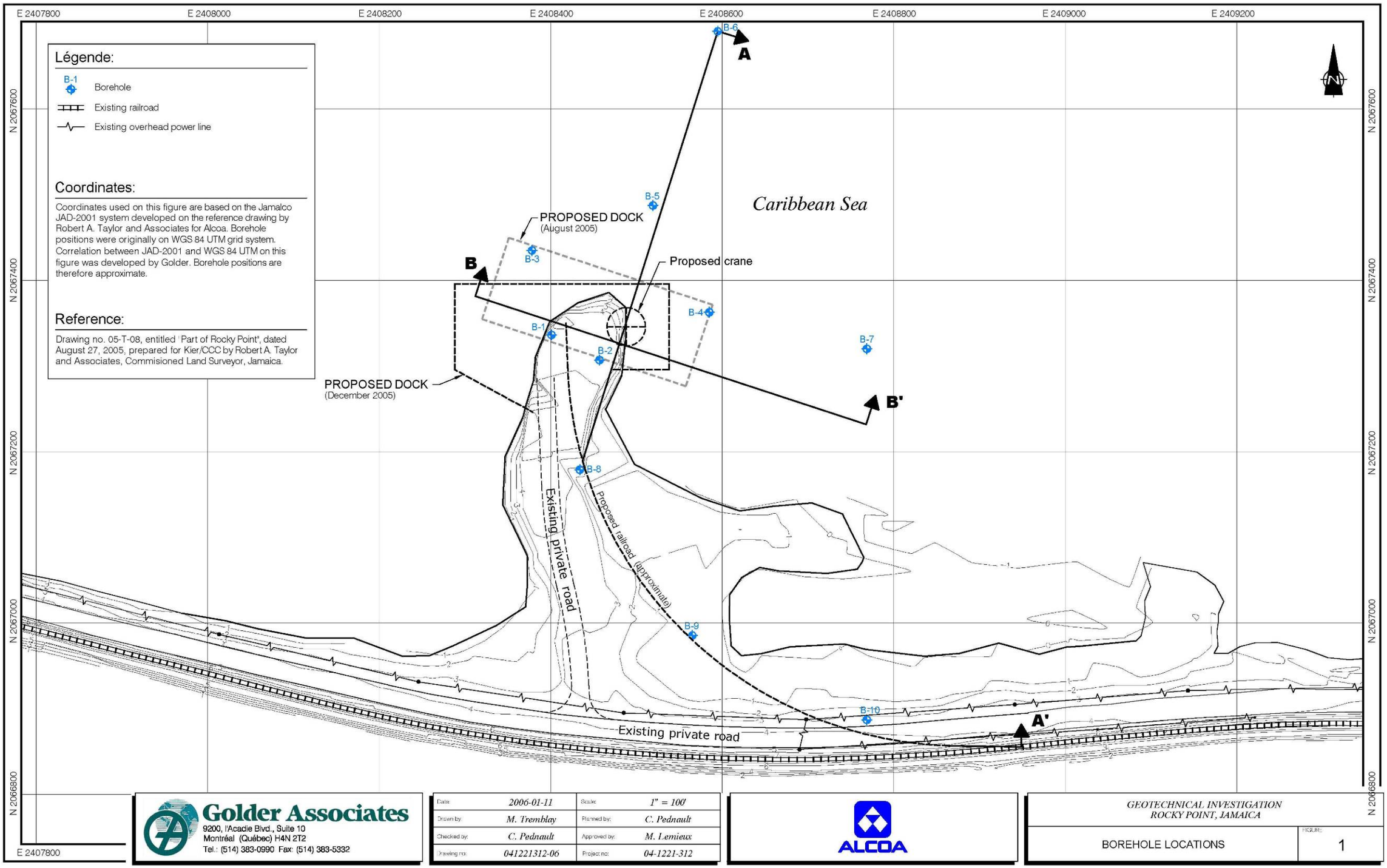


FIGURE 4-2: LOCATION OF BOREHOLES

4.1.3.1.3 THE RAILWAY

The geology of the area for the proposed railway spur was investigated by means of boreholes B-8 to B-10. Fill was encountered in all three boreholes with thickness ranging from 0.8 – 2.8 m. This fill consisted of loose to compact, beige sand with some silt, gravel and boulders in variable proportions.

The natural soil stratigraphy beneath the fill and surficial organic soils generally consisted of a very loose, grey, silt to fine to medium sand with layers of silty sand ranging between 8.2-8.7 m in thickness. Soils encountered beneath this geological unit are alternating layers of compact, brown, fine to coarse sand and soft to stiff, brown silty clay. These horizons alternate in variable thicknesses within each borehole.

4.1.4 HYDROLOGY

Groundwater levels were measured in all of the open boreholes drilled on land, after completion of drilling operations. The water levels in the boreholes were closely related to the mean sea level. Influence of tidal variations on the water table level measured in the on-land boreholes was not considered significant.

The maximum difference between the low and high tide at the time of fieldwork was 0.3 m.

TABLE 4-3: GROUNDWATER CONDITION MEASURED AT BOREHOLES DRILLED ON LAND

Borehole	Depth below ground surface (m)
B-1	1.4
B-2	1.3
B-8	1.1
B-9	0.1
B-10	1.3

4.1.5 MARINE WATER QUALITY ASSESSMENT

The following parameters were evaluated within a 100 m radius (of marine waters) of the proposed project area at Rocky Point, Clarendon:

- Total and Faecal coliform
- Total suspended solids

- Phosphates
- Nitrates
- Oil and Grease

Table 4-4 below outlines the findings of this assessment. The certificates of analysis can be seen in the Appendix. The results as given by Poly-Diagnostics Centre Ltd for phosphates, oil and grease, total and faecal coliform, and total suspended solids all fall within acceptable NEPA standards as seen below. The value for nitrates was slightly elevated.

It should be noted that when compare with NEPA's trade effluent standards and the National Ambient Water Quality Standard for Freshwater, these values are all within limits and are exceedingly low. NEPA has no standard for marine water bodies along any of Jamaica's coast.

TABLE 4-4: ANALYSIS OF KEY PARAMETERS OF THE MARINE WATERS IN THE IMMEDIATE VICINITY OF THE PROPOSED PROJECT SITE AT ROCKY POINT, CLARENDON

PARAMETERS	METHOD	RESULTS	NEPA STANDARD
Phosphate as PO_4 / (mg/L)	Colorimetric (Spectrophotometric) Method # Hach 8048 Page 537 2nd Edition	0.029	0.001 - 0.055
Phosphate as PO_4-P / (mg/L)		0.009	
Nitrate as NO_3 / (mg/L)	Colorimetric (Spectrophotometric) Method # Hach 8039 Page 400 2nd Edition	2.480	0.001 – 0.081
Nitrate-Nitrogen NO_3-N / (mg/L)		0.560	
Total Suspended Solids / (mg/L)	Gravimetric Method # Hach 8158 Page 605 2nd Edition	20.000	All times <150 mg/l Monthly average 50 mg/l
Oil & Grease as HEM / (mg/L)	Gravimetric n-Hexane Extractable Method # Hach 10056 Page 877 3rd Edition	2.290	10
Total Coliform / (MPN/100 mL)	Multiple-tube Fermentation Technique	2.000	$4.8 \times 10^1 – 2.56 \times 10^2$
Faecal Coliform / (MPN/100 mL)		2.000	$<2.0 – 1.3 \times 10^1$

4.1.6 NOISE ASSESSMENT

There are no residential communities within 3km of the area. The only current development in the area is the existing Jamalco Rocky Point Port. No construction or operation noise is expected to exceed national noise standards or impact negatively on the closest residents to the area.

The noise level in the coastal area was on average 52.29 audible decibel (dB), measured with a Norsonic 118 sound pressure level meter over a period of 23 hours. Table 4-5 below shows the average, maximum and minimum audible decibel levels for the project site and surroundings. Maximum noise levels would have been generated by the rail services to the Port and marine traffic in the area which is intermittent.

TABLE 4-5: AVERAGE SOUND PRESSURE LEVELS FOR THE PROPOSED JAMALCO TEMPORARY UNLOADING BARGE AT ROCKY POINT, CLARENDON

	Average (dB)	Maximum (dB)	Minimum (dB)
LAeq	52.29	72.8	42.1

LAeq refers to the “equivalent” average sound pressure level measured using the A-weighting which is most sensitive to speech intelligibility frequencies of the human ear. The A-weighting curve is used in sound level meters for measuring environmental and industrial noise as it relates to the potential hearing damage (normal hearing range of 31.5Hz to 8kz) and other noise health effects at moderate to high intensity levels. As such it has widespread use in audio equipment measurement.

The complete audiometric report is included as Appendix III.

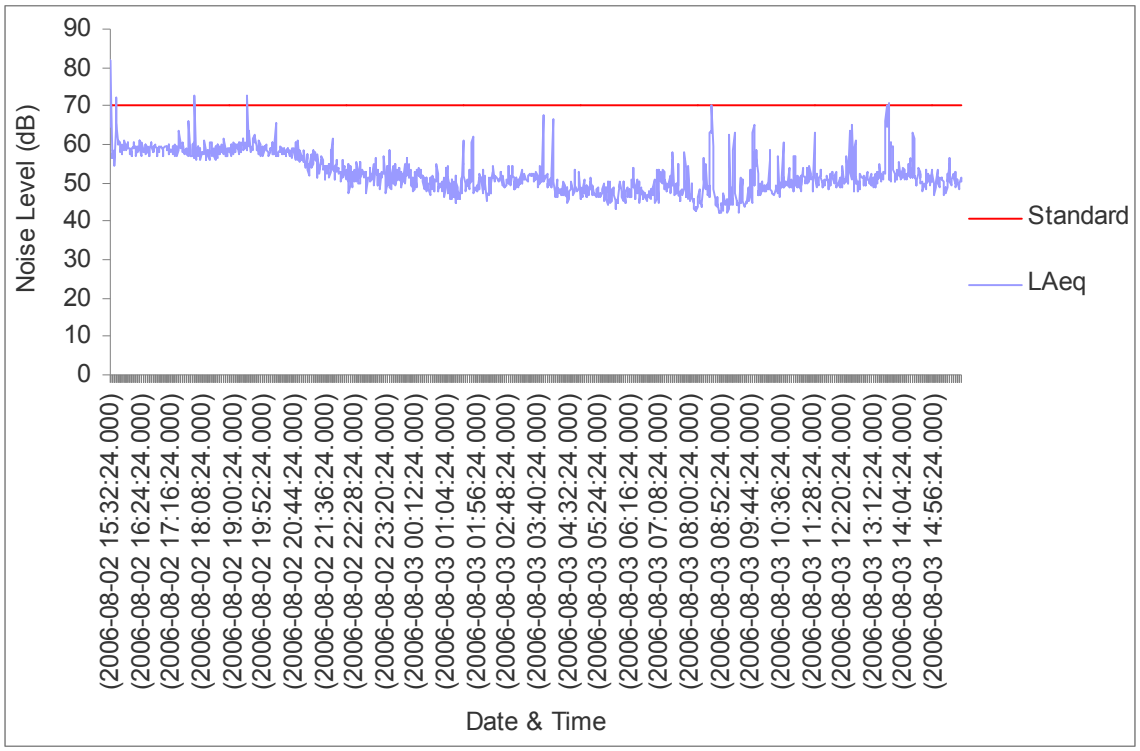


FIGURE 4-3: NOISE LEVEL BASELINE TREND

4.1.7 AIR QUALITY

Ambient air quality assessment was conducted on October 08-09, 2006. The prevailing winds at the proposed site are from the northeast. This wind direction would effectively reduce the potential for nuisance by taking any potential wind blown nuisance away from the general direction of neighbouring communities. It is not anticipated that the works proposed for the construction of the barge dock and railroad spur would result in the formation of fugitive dust or emissions of a quantity and composition that would cause a negative impact on the closest residents to the area or the surrounding environment.

Analysis of Concentration of Total Suspended Particulate Matter (TSP)

Start Date & Time	**2006/10/08**
End Date & Time	**2006/10/09**
Filter Element #:	**P5029325**

Mass Concentration (MC) is given by

$$MC = (W_f - W_i)/ V$$

Where W_f = final mass of filter element

W_i = initial mass of filter element
V = corrected sample volume

Now

W_f = 0.1514 g = 151400 µg
W_i = 0.1511 g = 151100 µg
$W_f - W_i$ = 300 µg

Corrected Volume = 4254.4 L = 4.2544 m^3

MC = 300 µg ÷ 4.2544 m^3 = **70.5152 µg/ m^3**

Regulatory Standard for TSP is:
24 hr (average) = 150 µg/ m^3
Annual Average = 60 µg/ m^3

4.1.8 NATURAL HAZARD VULNERABILITY

4.1.8.1 HURRICANE ACTIVITY

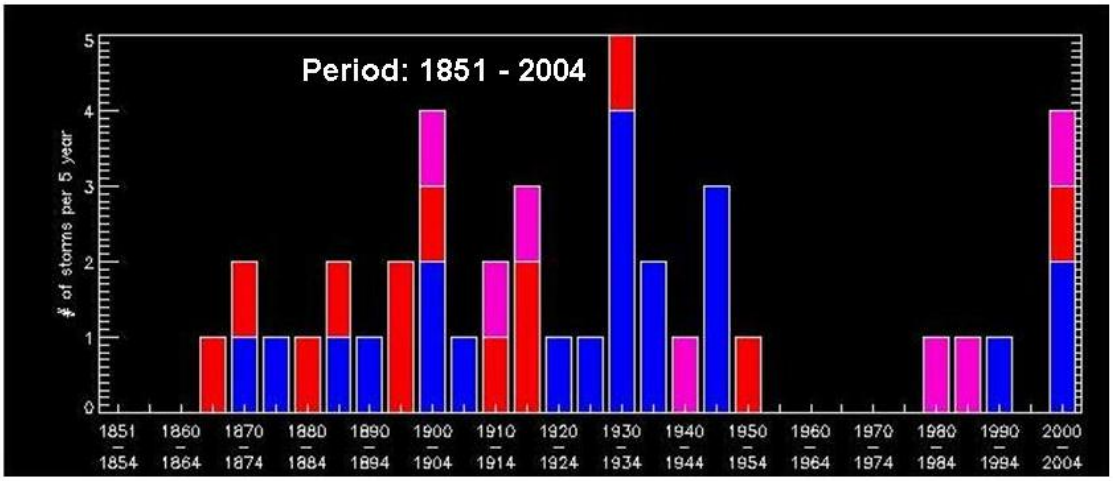
Analyses of tropical systems passing within 60nm (= 60mi.) of the island per five year period is outlined below, using latitude/longitude coordinates of 17.93N, 76.78W as point location. All recorded tropical storm and hurricane activity over a period of 100 years are considered to estimate any trends related to the hurricane activity and the return period of such activities to the island[4]. This can be done confidently as Jamaica is a small island and is likely to be affected wholly regardless of the point of approach of a tropical depression or storm system.

For the past two years there have been three (3) hurricanes that have affected the island across a one year period. All three may be considered big hurricanes (Category 3 and above). Two passed to the south (Emily & Ivan) and one to the north (Dennis) of the island. They were hurricanes Ivan – Cat 5 (September 2004), Emily – Cat 3 (July 2005) and Dennis - Cat 4 (July 2005). Only one, Hurricane Ivan is considered in the 100 year analysis below.

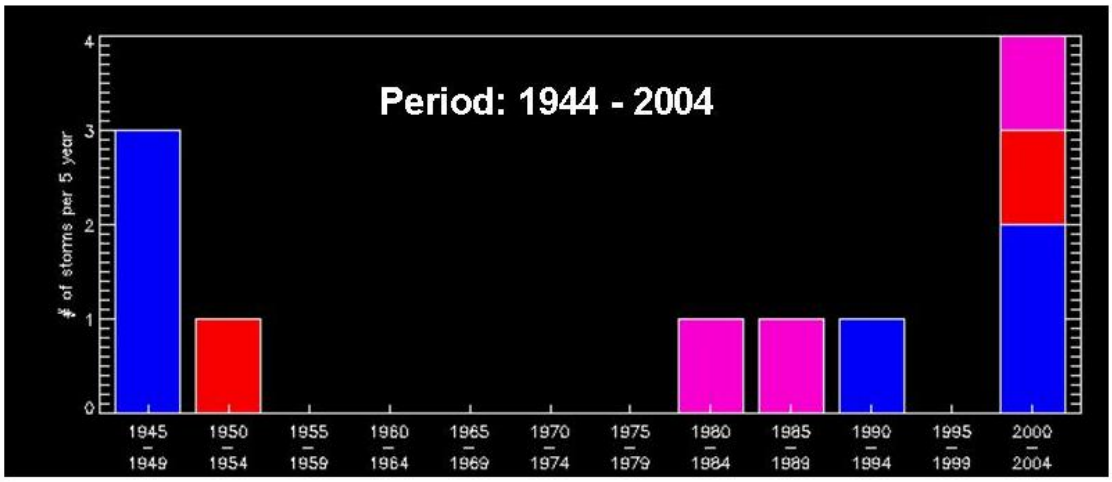
[4] ***Caribbean Hurricane Network***.
http://stormcarib.com/climatology/MKJP_5year.htm Accessed July 25, 2005

The Jamalco Rocky Point Port was taken out of operation as a result of damage sustained during the onset of Hurricane Ivan, a powerful category 5 hurricane that passed to the south of the island. The structural damage to the dock was primarily in pipelines and pre-cast sections. This Port has been in operation for over 30 years and its ability to handle hurricane events of this magnitude is exemplary. The temporary unloading barge dock will be constructed to meet or exceed the requirements for withstanding at a minimum, a category 5 hurricane.

In the graphs below the number of tropical systems passing by is plotted for each 5 year period since 1851 and since 1945. This can show if there are more storms lately or which 5-year period in the last 150+ years was most active. Those tropical systems reaching hurricane strength are in red, and the 'big ones' (severe hurricanes, or category 3 and up) in purple. A summary is shown below the graph (Period 1944 – 2004) showing which 5-year period was most active, with the number of storms during that period between brackets.



Category 3-5 hurricanes: purple;
Category 1-2: red;
Tropical storms: blue



Category 3-5 hurricanes: purple;
Category 1-2: red;
Tropical storms: blue

Most active 5 year period since 1944:
Most storms: 2000-2004 (4)
Most hurricanes: 2000-2004 (2)
Most severe hurricanes: 1980-1984, 1985-1989, 2000-2004 (1)

Figure 4-4 below outlines the varied return periods for wind at Rocky Point, Clarendon. A 10 year return period has winds at 28 ms^{-1} compared with a 100 year return period of 52 ms^{-1}.

Using the TAOS model, Caribbean Disaster Mitigation Project (CDMP) has produced maximum likely estimates for surge and wave height throughout the Caribbean basin for 10-, 25-, 50- and 100-year return periods. Estimates were made for each cell in a 30 arcsecond (approx 1km x 1 km) grid, covering the entire Caribbean. These maps are a result of new techniques for modeling storms and estimating the probabilities of storms, developed in part under the patronage of CDMP.

The projection of the illustrations is Plate Carrée, a square grid of latitude and longitude. Resolution is 30 arc-seconds. North-South distances are true to scale. East-West distances are stretched 4.6% at 17 degrees North, and stretched 5.8% at 19 degrees North. All model results were calculated using great-circle distances based on the WGS84 datum.

- **WINDS** represent sustained 1-minute winds at 10 m above the surface, and include both surface friction and topographic effects at a resolution of 30 arc-seconds. Friction factors derive from a Level I land-cover classification, with water, forest and open land predominating.

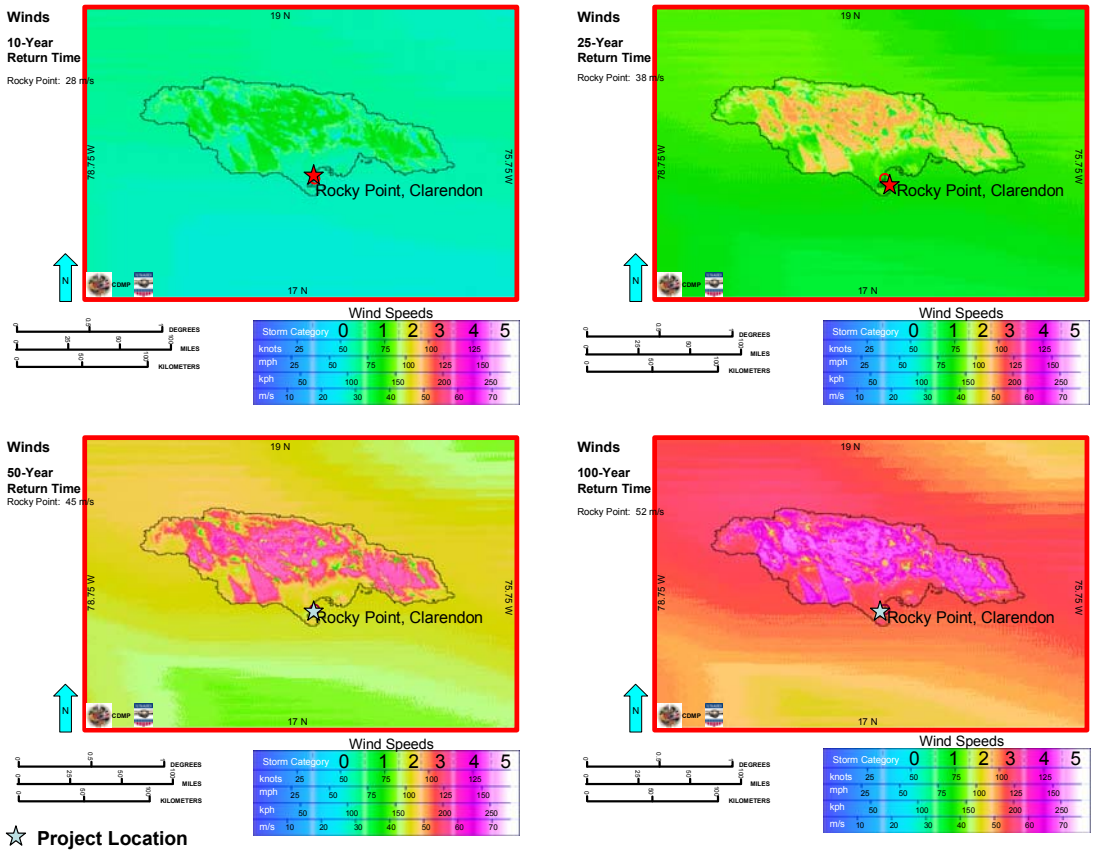


FIGURE 4-4: 10, 25, 50 AND 100 YEAR RETURN PERIOD FOR WIND AT ROCKY POINT, CLARENDON[5]

- For a 10 year return period, the project site can anticipate winds on the order of 100.8 kph (62.6 mph).
- For a 25 year return period, the project site can anticipate winds on the order of 136.8 kph (85.0 mph).
- For a 50 year return period, the project site can anticipate winds on the order of 180.0 kph (111.8 mph).
- For a 100 year return period, the project site can anticipate winds on the order of 187.2 kph (116.3 mph).

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[5] [5] Data adapted from www.oas.org/CDMP/document/reglstrm/**jamaica**.ppt, Accessed March 24, 2006

4.1.8.2 SEISMICITY

4.1.8.2.1 REGIONAL

Jamaica lies in the seismically active northern plate boundary zone of the Caribbean Plate (Draper et al., 1994 and Plate 4-3). High magnitude earthquakes originating from as far away as the south coast of Cuba may be felt in Jamaica. For example the Cabo Cruz earthquake of magnitude 6.9 which occurred in May 1992 was felt with intensity 4 in Kingston, Jamaica. The 1993 earthquake of magnitude 5.4 which originated in Jamaica was felt in Cuba with intensities of 3-4. No damage was reported in either case from the distant country (pers. comm. M. Grandison).

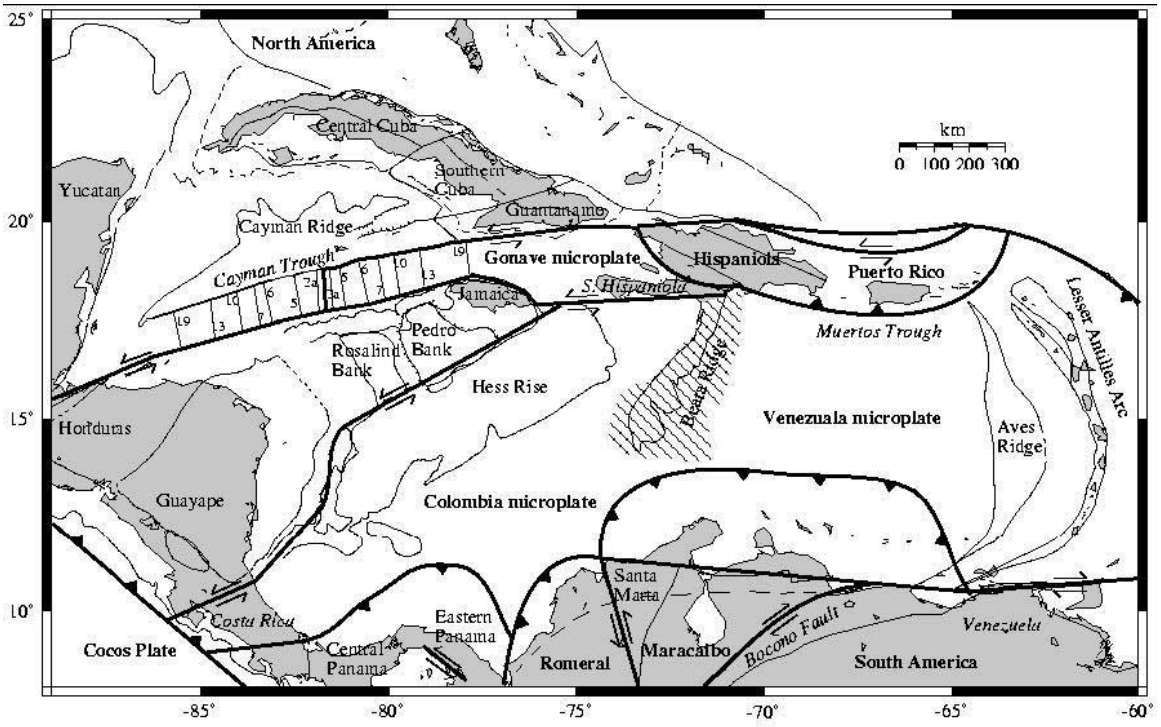

PLATE 4-3: TECTONIC PLATES IN THE CARIBBEAN REGION[6]

4.1.8.2.2 NATIONAL AND LOCAL

Plate 4-4 shows the epicentres of over one-hundred (100) earthquakes which have occurred in or near Jamaica between 1998 and 2001. With over 100 such occurrences, there was no significant damage to any approved infrastructure within the island to

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[6] Draper, G, T.A. Jackson, and S.K. Donovan, 1994. Geological Provinces of the Caribbean Region. Caribbean Geology, an Introduction. UWIPA, Kingston, pp. 3-12.

warrant consideration for the adjustment or revision of any building or construction codes for the island.

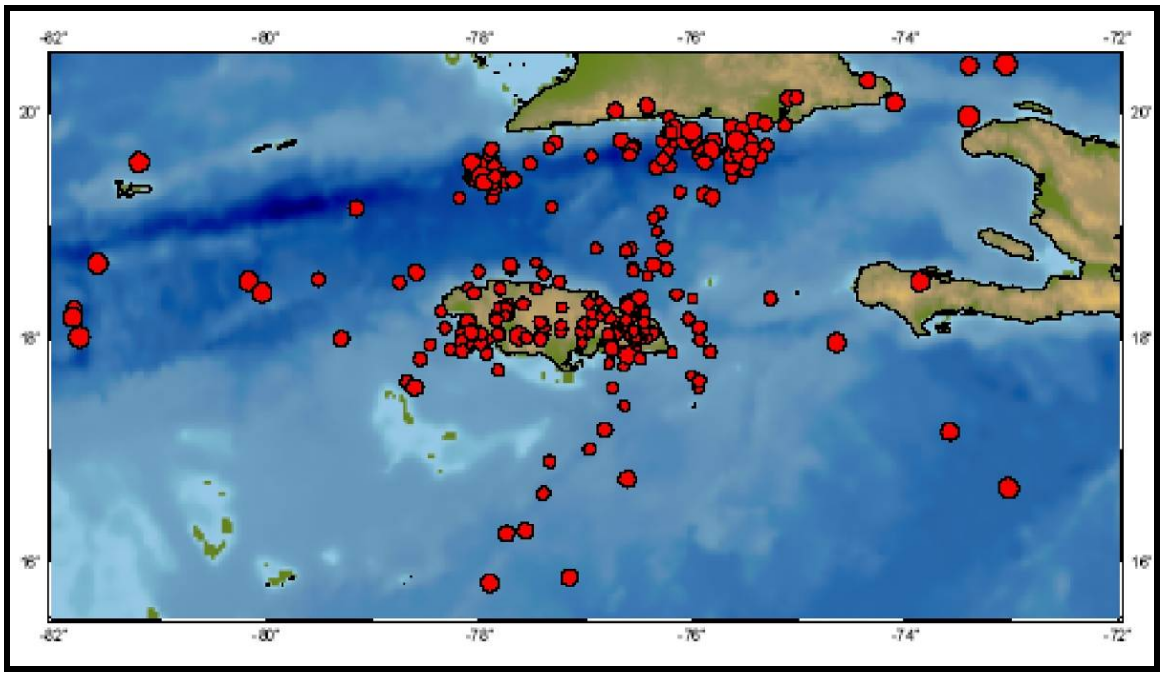

PLATE 4-4: EPICENTERS OF EARTHQUAKES OCCURRING BETWEEN 1998 AND 2001 IN THE VICINITY OF JAMAICA[7]

Figures 3-6 and 3-7 below outline the Horizontal Ground Acceleration with 10% probability of exceedance in any 50-year period, and the expected maximum Mercalli Intensity with 10% probability of exceedance in any 50-year period. Rocky Point, Clarendon is situated in the area of Jamaica which experiences an exceedance of 14 cm per second in any 50-year period for Horizontal Ground Acceleration or expected Maximum Mercalli Intensity (MMI) 7.

[7] Source: Earthquake Unit

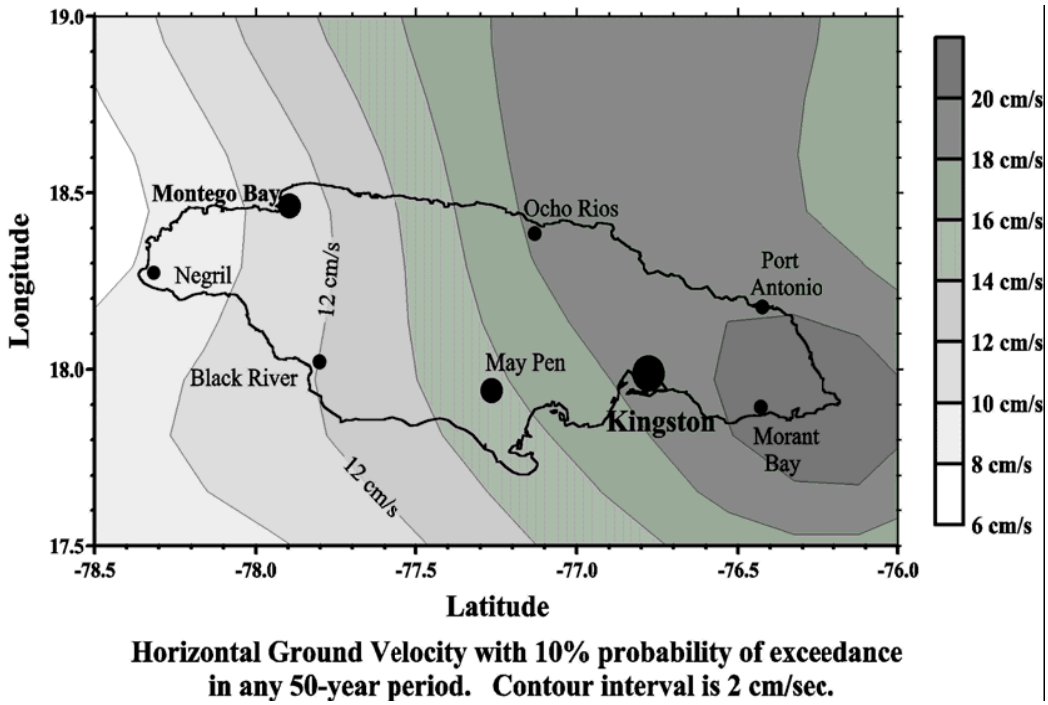

PLATE 4-5: HORIZONTAL GROUND ACCELERATION IN JAMAICA[8]

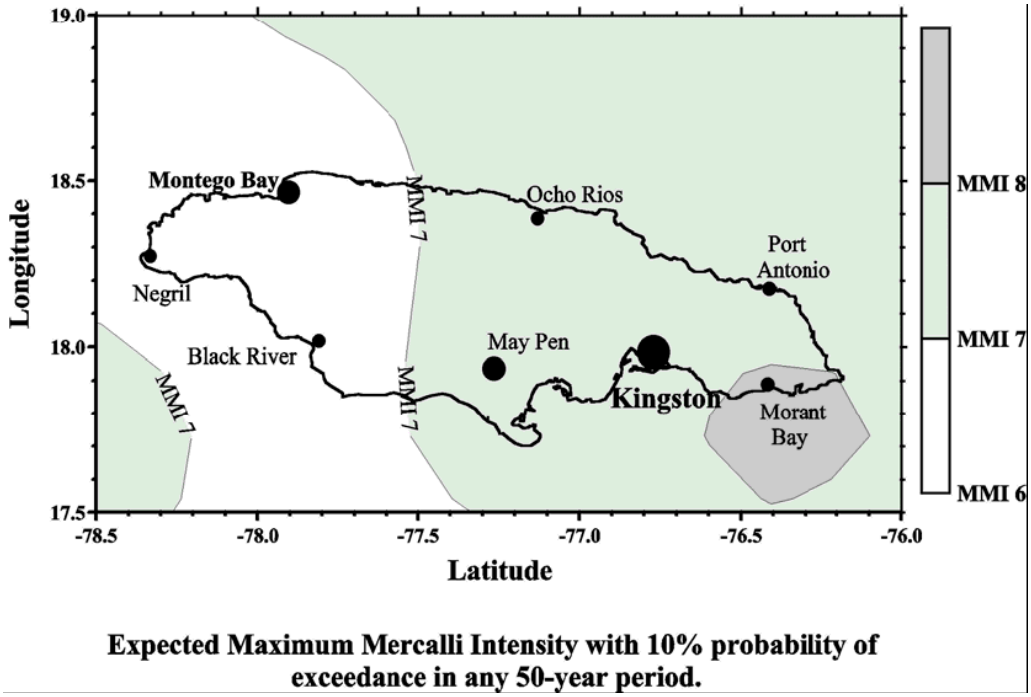

PLATE 4-6: MAXIMUM MERCALLI INTENSITY IN JAMAICA[7]

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[8] OAS **Sub-regional Seismic Hazard Maps for Jamaica,** http://www.oas.org/CDMP/document/seismap/ Accessed Friday, June 23, 2006

Damaging earthquakes to have affected Jamaica in recent times are, most notably, those of 1907 and 1957. The 1907 earthquake appears to have caused some damage in the Vere Plains. Intensities of MM (VII) were reported in Alley with incidence of damage to chimneys and buildings (Tomblin & Robson, 1977). The 1957 earthquake had intensities of MM (IV) to MM(V) in the Lower Vere Plains (Robinson *et al.*, 1959). In each 50-year period, starting with 1991 and counting backward for four 50-year cycles, at least one damaging earthquake, of MM (VI) or higher, has occurred in the area. Shepherd (1971) reported that Lower Vere had a frequency of 5-9 damaging earthquakes per century on average.

However, the Jamalco Rocky Point Port area is built in part largely on reclaimed marshland and the Vere Plain is largely built up of alluvial clays, sand and gravel, and in the presence of ground water, this material will be susceptible to liquefaction in an earthquake of high enough intensity. Thus, the height of the water table will be an important factor in determining the area's earthquake risk.[9]

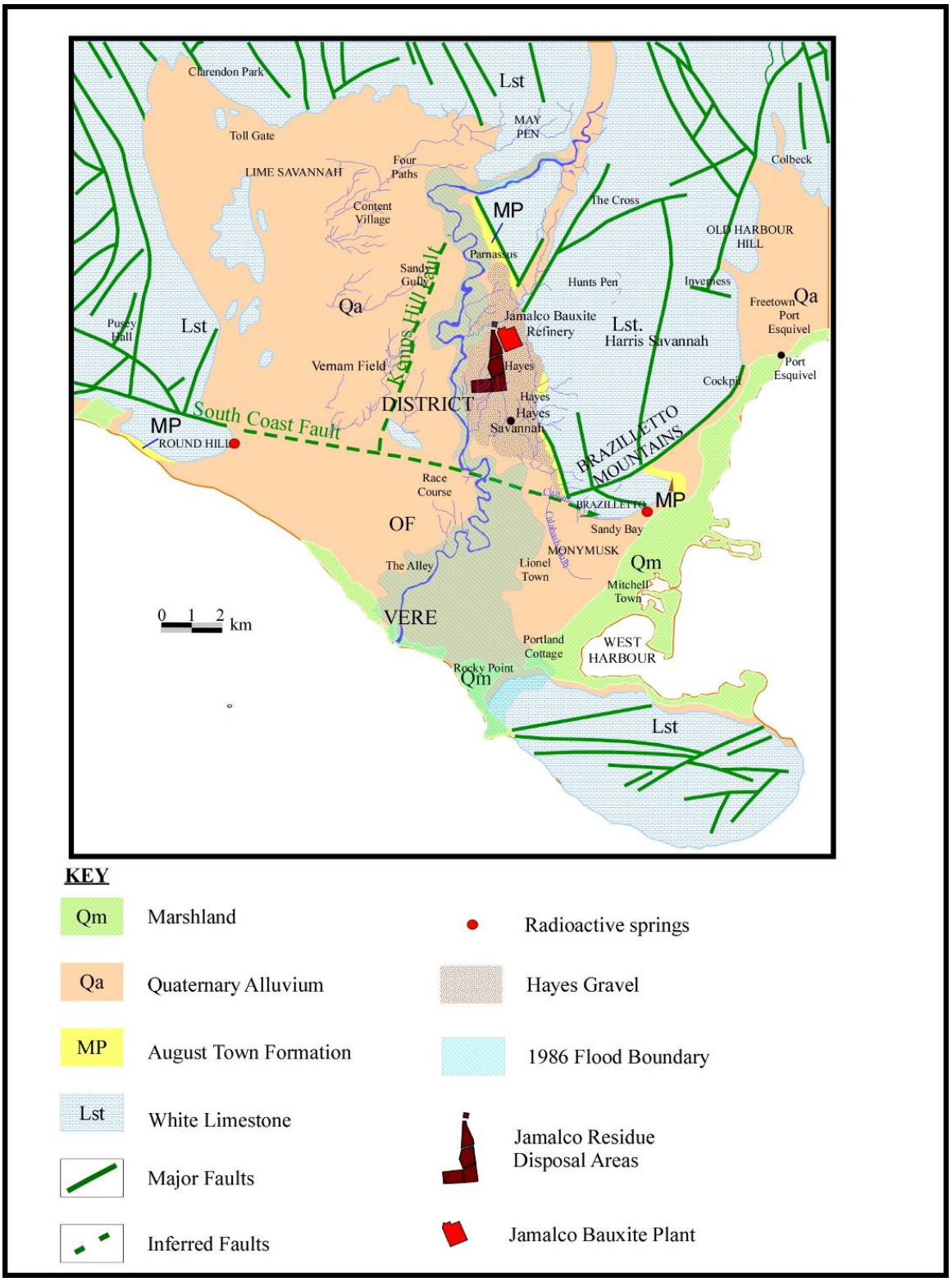
4.1.8.3 FLOODING VULNERABILITY AND STORM WATER MANAGEMENT

4.1.8.3.1 FLOODING

Specific records of flooding in the Rio Minho floodplain, the closest to Rocky Point, date back to 1886, reported in the Tri-Weekly Gleaner, June 19, 1886, when heavy rains in June of that year led to what was believed to be the worst flooding on record for that river. The river was 40 ft (12.2 m) deep at the May Pen Bridge, some 4 ft higher than the previous record, and did immense damage to roads and property. Affected localities included Halse Hall and Parnassus and Caswell Hill. This river does not pass close to or drain the Rocky Point area and as such a 100 year return event should have little or no impact. Plate 4-7 shows the extent of the 1986 flood event. The proposed site location is outside the boundaries of the 1986 flood event.

[9] Information courtesy of Earthquake Unit

PLATE 4-7: Geology Map of Southern Clarendon[10]



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[10] Adapted from Jamalco 2.8M Metric Tonne per year Efficiency Upgrade EIA, by Conrad Douglas & Associates Ltd. July 2004

The noted and most appreciable flooding event in the southern section of Clarendon is limited to a widespread section some 2km long and 0.5km wide, extending along the Hayes gravel sections of the Vere district between the Rocky Point marshland areas and the Portland cottage marshland areas to the northwest and west of the proposed project area. No significant flooding has been recorded in the section of marshlands further Northeast near the Salt River area and is unlikely to be a significant feature of the proposed project site located in that same area. The project area is located at the tip of the coastal marshlands and is not a receiving body for any run-offs from the Rio Minho. It is also bordered by a system of sandbars and mangroves on the east and west, by the Caribbean Sea to the north, and by about 0.25km of marshlands inland to the south. This makes flooding a limited possibility during extreme storm surges and an unlikely occurrence from run-offs created by inland flooding.

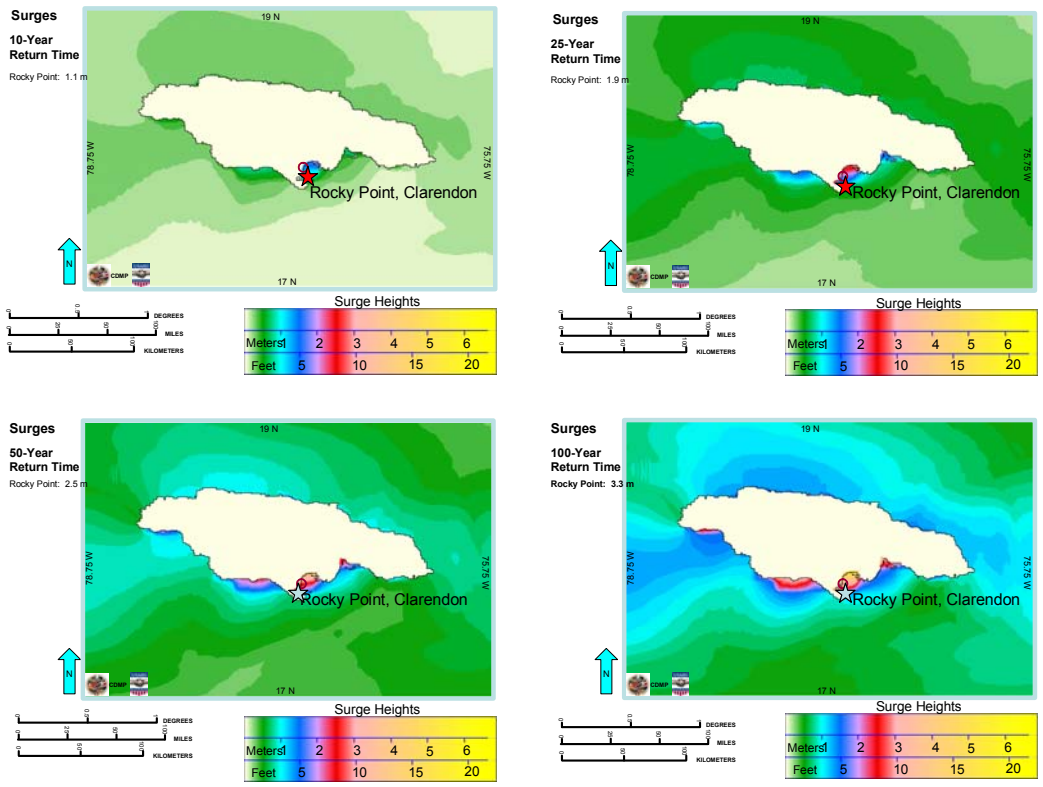
Figure 4-5 below shows storm surge potential for Rocky Point with 10, 25, 50 and 100 year return periods projected. A 10 year period is expected to bring average wave heights of 1.1 m compared with a 100 year return period of 3.3 m. Figure 4-6 below shows potential waves for Rocky Point with 10, 25, 50 and 100 year return periods projected. A 10 year period is expected to bring average wave heights of 3.6 m compared with a 100 year return period of 6.6 m.

Using the TAOS model, Caribbean Disaster Mitigation Project (CDMP) has produced maximum likely estimates for surge and wave height throughout the Caribbean basin for 10-, 25-, 50- and 100-year return periods. Estimates were made for each cell in a 30 arcsecond (approx 1km x 1 km) grid, covering the entire Caribbean. These maps are a result of new techniques for modeling storms and estimating the probabilities of storms, developed in part under the patronage of CDMP.

The projection of the illustrations is Plate Carrée, a square grid of latitude and longitude. Resolution is 30 arc-seconds. North-South distances are true to scale. East-West distances are stretched 4.6% at 17 degrees North, and stretched 5.8% at 19 degrees North. All model results were calculated using great-circle distances based on the WGS84 datum.

- **SURGES** include astronomical tide and setups from pressure, wind and wave, but not wave runup. Surges over land are shown as elevation above sea level, not water depth.
- **WAVES** are the heights of wave crests above the storm surge level in open water. Shoreline effects do not appear at this resolution.

Waves and surges for Point of Interest, Rocky Point, are reported from the nearest cell offshore. Storm surges and waves in excess of 3.0 can impact on the proposed project. However, the designs and construction methodology have taken this factor into consideration.



☆ **Project Location**

FIGURE 4-5: 10, 25, 50 AND 100 YEAR RETURN PERIOD FOR SURGE AT ROCKY POINT[11]

[11] Data adapted from www.oas.org/CDMP/document/reglstrm/**jamaica**.ppt, Accessed Friday, June 23, 2006

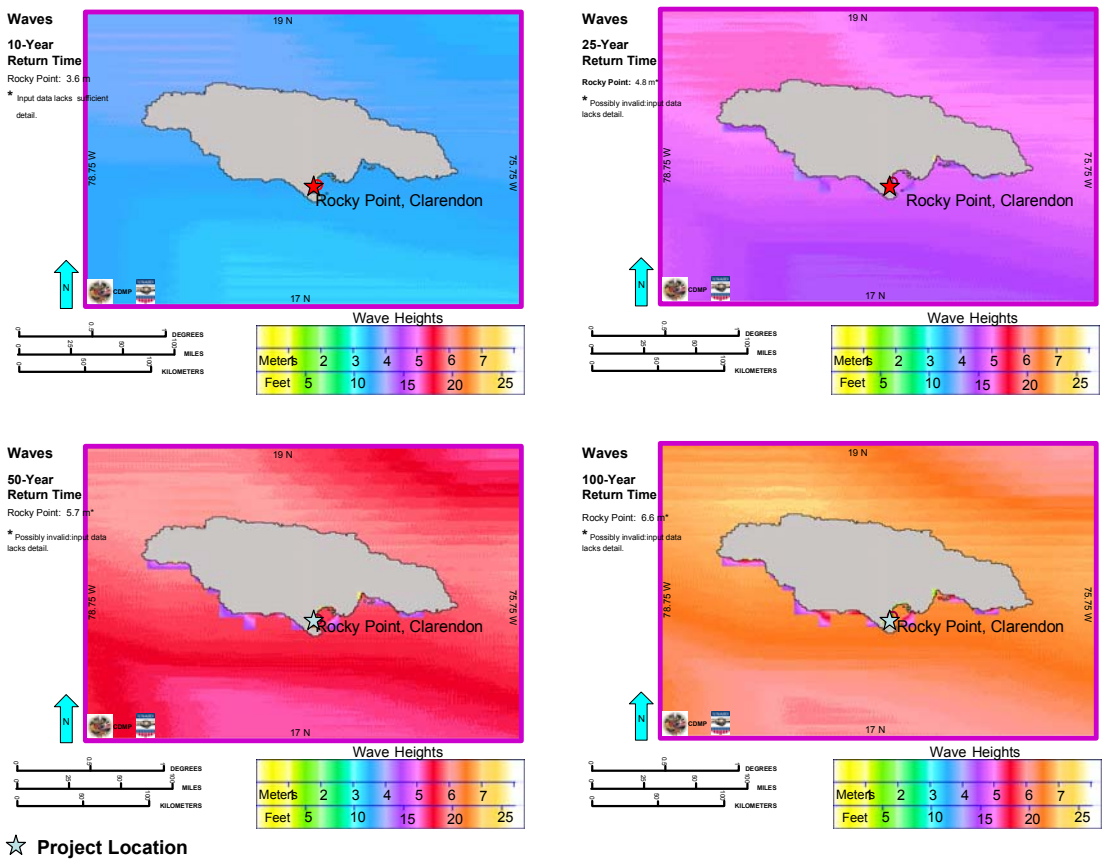


FIGURE 4-6: 10, 25, 50 AND 100 YEAR RETURN PERIOD FOR WAVES AT ROCKY POINT, CLARENDON[12]

4.1.8.3.2 LANDSLIDES

The landslide susceptibility map of southern Clarendon (Plate 4-8) indicates low susceptibility levels in the general area where the temporary barge docking facility will be located. This can be attributed to the flat lying nature of the topography, the presence of fairly easily drained alluvial soils, the relatively dry climate, and the presence of wetland flora such as mangrove.

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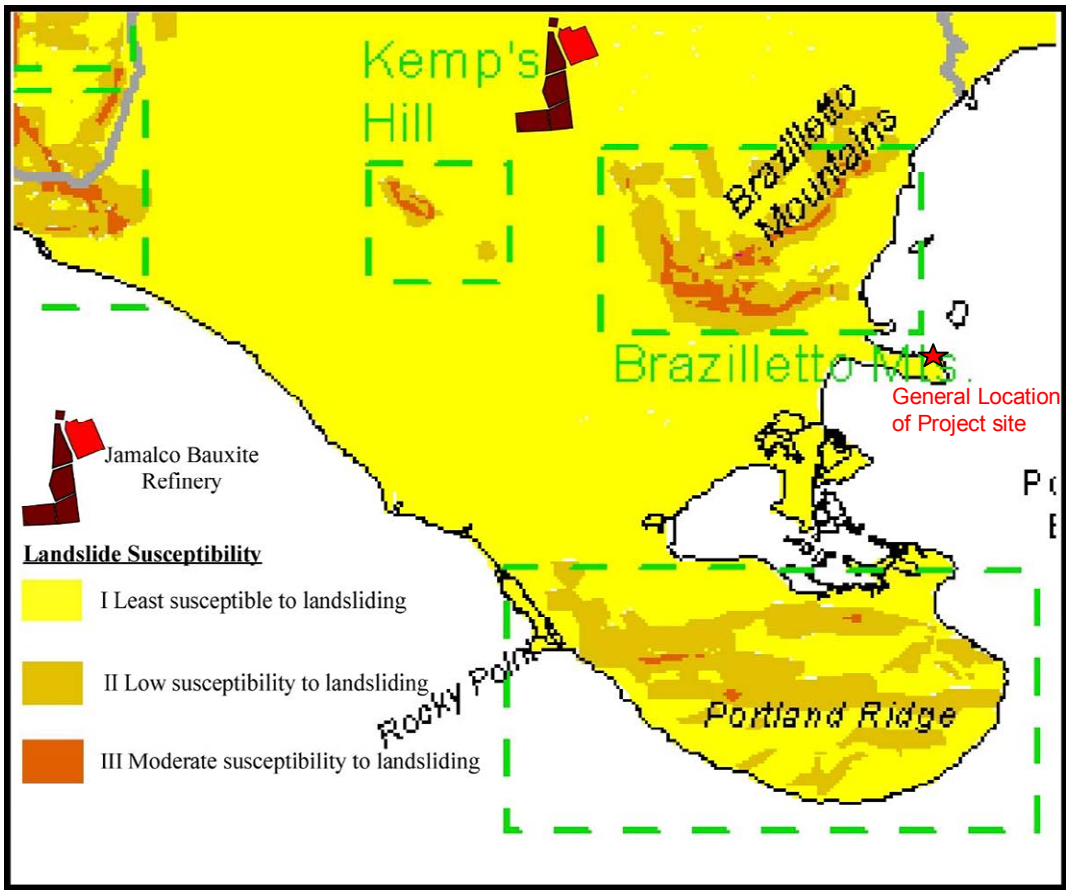
[12] Data adapted from www.oas.org/CDMP/document/reglstrm/**jamaica**.ppt, Accessed June 23, 2006

PLATE 4-8: Landslide susceptibility Map of Southern Clarendon[13]



4.1.9 SOLID WASTE MANAGEMENT

Solid waste generated during the pre-construction, construction and occupational phases of the project will be properly managed to maintain the aesthetic and cleanliness of the site. This will include the placement, monitoring and maintenance of garbage skips and other approved receptacles so that all solid waste generated at the site can be deposited there. Solid waste receptacles will be managed in much the same manner as those at the Port. Collected refuse will be properly packaged, secured and transported to the refinery by rail for disposal at the approved solid waste landfill located there.

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[13] South Coast Development Project

4.2 BIOLOGICAL ENVIRONMENT

This section covers:

- The forestry and wetlands, estuaries and coastal zones, flora and fauna and endangered or endemic species that may be impacted by this project.
- It presents the species diversity and ecological relationships among them, identifies special or protected areas and the potential impacts on these and,
- Records the extent and potential impact of the temporary barge unloading dock.

4.2.1 METHODOLOGY

The ecological assessment was conducted primarily through qualitative methods supported by literature research and ground-truthing. The literature review was based on a series of relatively current studies which employed the use of quantitative methods for several areas in the sphere of influence of the project sites. Methods employed included the following:

- Aerial photography and land use classification mapping to identify plant species distribution and classification.
- Ground-truthing to confirm land use classification and vegetation type and distribution
- Plant collection and plant identification, where necessary, through the aid of a recognized taxonomist and herbarium
- Literature research of information related to the geographical influence of the proposed project to generate species inventories.
- Animal identification through field guides, photography, vocalization, tracks, fecal deposits, burrows among others.

4.2.2 COASTAL VEGETATION

The primary vegetation in proximity to the Rocky Point Port is coastal type, which indicates that vegetation in this area is subject to water stress due to salinity of the surrounding areas, as well as increased levels of transpiration due to high winds. Accordingly, the plants that have colonized the study area demonstrate classic adaptations to survive this harsh environment.

PLATE 4-9: VIEW OF COASTAL APPROACH TO ALUMINA PORT LOOKING TO THE NORTH WITH VIEW OF BRAZILLETTO MOUNTAINS IN BACKGROUND

PLATE 4-10: EXISTING SITE CONDITIONS

PLATE 4-11: VIEW OF VEGETATION ALONG RAILWAY CORRIDOR DIRECTLY ACROSS FROM PROPOSED PROJECT SITE

In general the following adaptations were noted;

- Small, thick and/or shiny leaves to reduce transpiration loss.
- Succulent parts for increased water storage.
- Presence of salt glands for excreting excess salts e.g. mangroves.
- Presence of spines, prickles and hairs to reduce herbivory[14].
- Modified root systems to avoid oxygen deprivation e.g. pnuematophores[15] of Black Mangrove.

Stratification in this community was not complex and primarily consisted of a tree layer. Generally, plants were thin-boled with open and thin-depth canopies, although mature stands of Red Mangroves *(Rhizophora mangle*) showed diameter at breast height (dbh) of 0.30 m (12 inches) and above.

Ground cover was for the most part absent, except in open areas where species such as Seaside Purslane (*Sesuvium portulacastrum*), Ipomea and Jamaican Samphire (*Batis maritima*) dominated.

Mangroves 3 m in height were among the species recorded and accounted for the majority of the vegetation cover of the area. Button Mangrove (*Conocarpus erectus*), Red Mangrove *(Rhizophora mangle*) and Black Mangrove (*Avicennia germinans*) were among the dominant species along with White Mangrove (*Laguncularia racemosa*), *Seaside* Mahoe (*Thespecia populnea*), and Acacia (*Acacia tortuosa*).

A significant bare area exists between the shoreline bordered by mangroves and the road also bordered by mangroves and other coastal plant species. This area appears to be a typical open salina. Plant coverage in this area was limited and suggests a backwash zone at very high tide. Stumps of dead mangrove were observed. The area is approximately 180 m long by 60 m wide. Mangrove stands on either side were less than 3 m wide (8 – 10 ft.).

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[14] Herbivory-consumption of plant/plant parts by animals

[15] Pnuematophores- roots with straight, erect, blunt branches

PLATE 4-12: RED MANGROVE PROP ROOT AND BLACK MANGROVE PNEAMATOPHORES

PLATE 4-13: RED MANGROVE AND SEASIDE MAHOE

Water levels and/or proximity to the sea dictated mangrove distribution; Button mangrove is restricted to areas with consolidated soils where water logging is not a common feature, Black mangrove are found in areas with waterlogged soils but behind the Red mangrove which fringe the water line. As such pneumatophores (breathing roots) of black mangrove could be seen in the water logged soil beneath the black mangrove trees. The red mangroves fringe the coastline and are able to withstand wave energies more than other species, utilizing their prop roots to offer support and breathing roots. Human influence was noted through the maintenance of road and rail verges and a single incidence of possible human habitation possibly a squatter or vagrant. No recent cutting of mangroves was noted during site inspection; however, it is known to occur (particularly large specimens of Red Mangrove).

PLATE 4-14: SINGLE INCIDENCE OF POSSIBLE HUMAN HABITATION NEAR ENTRANCE TO JAMALCO ROCKY POINT PORT

PLATE 4-15: COASTAL SPECIES ENCOUNTERED WITHIN 100 M OF PROPOSED PROJECT LOCATION AND THE SALINA ADJACENT THE PROPOSED PROJECT AREA

Summary

Of the species identified all were noted as common and naturally occurring in their distribution. None of the observed species were listed as endemic[16] or rare species.

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[16] Endemic- found only in one area or location

TABLE 4-6: LIST OF PLANT SPECIES ENCOUNTERED AT THE PROJECT SITE AND WITHIN 100 M OF THE PROPOSED PROJECT LOCATION

SCIENTIFIC NAME	COMMON NAME	HABIT	STATUS
Sesuvium portulacastrum	Seaside purslane	Perennial, with succulent stem and leaves	Common, widespread distribution
Calotropis procera	Dumb Cotton	Shrub or small tree 3-5 m high	Locally commom
Avicennia germinans	Black mangrove	Shrub or tree 3-10 m high	Common in saline and brackish communities
Batis maritima	Jamaican samphire	Low growing succulent	Common in coastal areas and on cays
Capparis ferruginea	Mustard shrub	Shrub or tree ranging from 1-8m	Common in coastal areas and on cays
Conocarpus erectus	Button mangrove	Shrub or small tree 3-5 m high	Common and widespread
Laguncularia racemosa	White mangrove	Shrub or tree 3-10 m high	Common in saline and brackish communities
Rhizophora mangle	Red Mangrove	Shrub or tree 3-10 m high	Common in saline and brackish communities
Sporobulus virginicus	none	Grass	Abundant and gregarious, sometimes forming continuous swards
Rhynchelytrum repens	Natal grass	Grass	Locally common
Thespecia populnea	Seaside Mahoe	Shrub or tree with spreading branches average 3-6 m in height but may attain heights of up to 20 m	Common in littoral situations , widespread throughout the tropics
Acacia tortuosa	Wild Poponax	Shrub or tree with spreading branches average 3-5 m in height	Locally very common

4.2.3 COASTAL FAUNA

The proposed site had few fauna aside from birds, partly due to the current and past uses of the site, the size, and fragmentation due to existing transport corridor.

4.2.3.1 COASTAL AVIFAUNA

4.2.3.1.1 METHOD

In the survey, two point counts along with a 1.5 km transect were used to generate the avifauna species list in the area. The species list generated was inclusive of residents, migrants and endemic birds.

4.2.3.1.2 RESULTS

Only one local endemic bird, that is not dependent on forest habitats, was observed during the survey. Most of the birds seen in the survey are typical of a coastal wetland habitat.

The proposed expansion of the dock will have an impact on the small mud flat that was seen in the area. The mud flat which was observed during the survey was dry at that time; this could be as a result of low tides or as a result of the area experiencing a dry season. Mudflats provide a source of food for sea birds, by providing a home for small marine invertebrates that the seabirds forage on. However, these mud flats are prevalent in the area. Few birds were observed in the dry mudflat, although the other mudflats (wet mudflats) which do not have an impact on the development had a larger number of sea birds. Birds such as Wilson's Plover, Kildeer, Little Blue Heron, Cattle Egret and the Great egret were observed foraging in the mudflats (note: none of the sea birds observed are endemic). The removal of the mudflat will not have a significant impact on the birds in the vicinity because there are a lot of other mudflats in the surrounding area that the birds can utilized at any given time.

The area also has a few mangrove trees (red mangrove); the saffron finch and the grass quit were seen in these trees. The removal of the trees will not have a significant impact on the avifauna for the surrounding area, since the development will only occur in a small area and does not require the removal of all the mangroves. A number of mangrove seedlings were also seen in the designated area. The seedlings should be replanted in another area; this action would benefit the overall fauna in the long term.

TABLE 4-7: BIRD SPECIES (RESIDENT & ENDEMICS) IDENTIFIED AT THE PROPOSED SITE

Common Name	Scientific name	Local name	Status
American Kestrel	*Falco sparverius*	Lizard Hawk /Killy-killy	R1

Common Name	Scientific name	Local name	Status
Bananaquit	*Coereba flaveola*	beeny, bird sugar bird	R1
Cattle Egret	*Bubulcus ibis*	Ticks bird, Gaulin	R1*
Great egret	*Casmerodius albus*	Crane	R1*
Greater Antillean Grackle	*Quiscalus niger*	Cling cling	R1
Kildeer	*Charadrius vociferus*	Tell tale	R1*
Laughing Gull	*Larus atricilla*	Sea Gull	R1*
Little Blue Heron	*Ardea herodias*	Blue Gaulin	R1*
Loggerhead kingbird	*Tyrannus caudifasciatus*	Loggerhead	R1
Magnificent Frigatebird	*Fregata magnificens*	Man-o- war Bird	R1*
Merlin	*Falco columbarius*	Pigeon hawk	R1
Northern Mockingbird	*Mimus polygottos*	Nightingale	R1
Sad Flycatcher	***Myiarchus barbirostris***	**Little Tom Fool**	**E1**
Saffron Finch	*Sicalis flaveola*	Canary	R1
Snowy Egret	*Egretta thula*	White Gaulin	R1*
Tricoloured Heron	*Egretta tricolor*	Gaulin	R1*
Turkey Vulture	*Cathartes aura*	John Crow	R1
White-crowned Pigeon	*Columba leucocephala*	Bald Pate	R1
Wilson's Plover	*Charadrius wilsonia*	Thick-billed Plover	R1*
Yellow-Crowned Night Heron	*Nycticorax violaceus*	Crab- Catcher	R1*
Yellow-faced Grassquit	*Tiaris olivacea*	Squit	R1

Note: Endemic species in bold.
Coastal birds with *
Most of the coastal birds observed, were seen in the mudflats and only one endemic bird was observed during the survey.

TABLE 4-8: TABLE SHOWING THE ADDITIONAL BIRDS (EXCLUDING THE BIRDS FROM TABLE 1) OBSERVED DURING A SURVEY OF THE SURROUNDING AREAS INCLUDING THE AREA FOR THE PROPOSED DEVELOPMENT IN JUNE 2004

Common Name	Scientific name	Local name	Status
Mangrove Cuckoo	*Coccyzus minor*	Rainbird	R1
Smooth-billied Ani	*Crotophaga ani*	Tick bird	R1
Mourning Dove	*Zenaida auritia*	Long-tail Pea Dove	R1
Brown Pelican	*Pelecanus occidentalis*	Old Joe	R1*

4.2.3.2 OTHER FAUNA

Only two species of reptiles were observed at the site, both are lizards and endemics, *Anolis grahami* and *Anolis lineatopus*. Both have wide distribution in Jamaica. Jamaica's largest reptile, the crocodile (*Crocodylus.acutus*) has also been reported in the Portland Bight area but was not observed at or near the proposed site. Only two species of butterflies were observed during site inspection, a common skipper, *Pyrgus sp.* and the West Indian Buckeye*, Precis evarete zonalis.* Other fauna observed were dragonflies, grasshoppers, snails, ants and flies. However, literature reviews indicated the likely occurrence of certain species of reptiles and amphibians generally within Portland Bight. This is outlined below in section 4.2.4

4.2.4 PROTECTED AREA ENVIRONMENT – PORTLAND BIGHT

The port is located within the Portland Bight area which is a designated protected area under the NRCA Act of 1991 and under the management of the non-governmental organization, Caribbean Coastal Area Management. Please see Plate 4-16 below.

It is not envisioned that this project will result in significant and irreversible negative impacts of the protected area. This will be discussed in detail in the Impact Identification and Mitigation sections of this report.

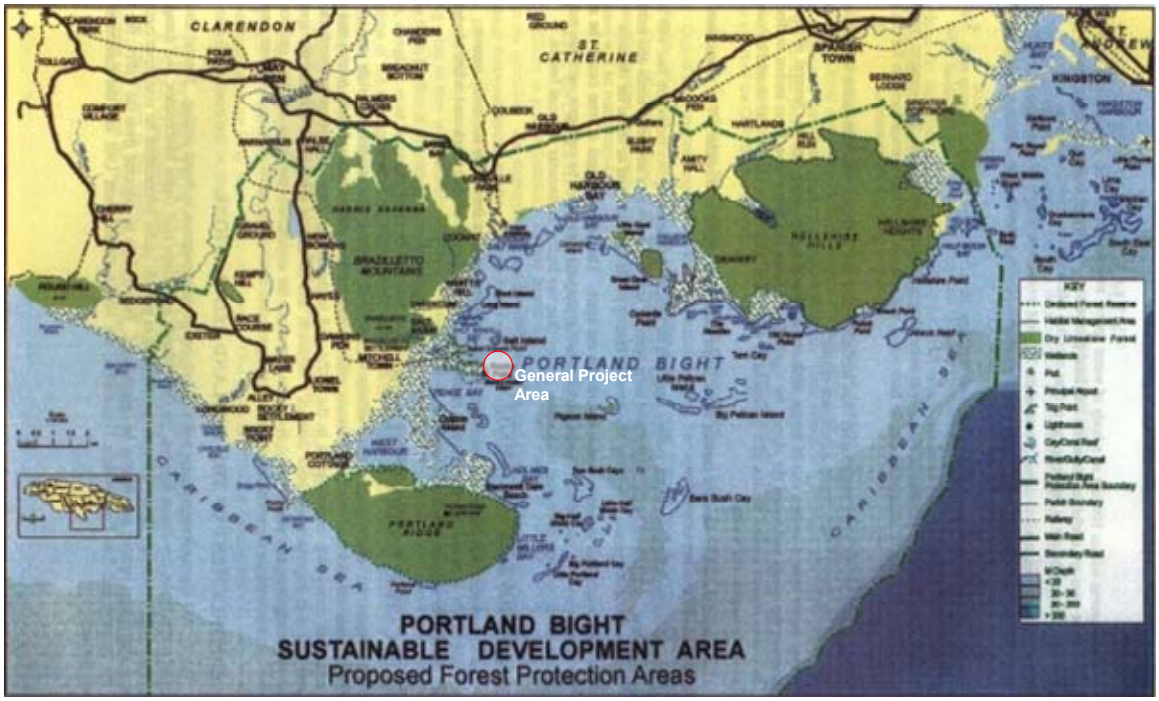


PLATE 4-16: PORTLAND BIGHT PROTECTED AREA (SOURCE: WWW.CCAM.ORG)

4.2.4.1 FAUNAL STUDIES

The area has been extensively studied and the literature research is shown in the following sections (Section 4.2.4.1.1 – 4.2.4.2.2) and is taken from a previous EIA, EIA for 2.8 Million Metric Tonne Per year Efficiency Upgrade at Jamalco by Conrad Douglas & Associates Ltd. (2004).

4.2.4.1.1 GENERAL AVIFAUNAL DESCRIPTION

Analysis of avifauna species was conducted in relation to the coastal habitat type. At least 18 bird species were observed in that report, of which 15 were identified. Of this number, 73.33% (11) were residents, 13.33% (2) were migratory and 6.66% (1) introduced. It is likely, however, that one of the unidentified birds was migratory.

According to the Gosse Bird Club of Jamaica, all the birds identified are given a status of one (1), indicating 'Common in suitable habitat'. The number of sightings also indicated that many of the identified birds were common in the area. There were no endemic, rare or endangered species noted in the area. However, a number of species, particular grass quits and warblers were seen collecting nesting material.

Literature sources confirmed that major nesting periods are between January and May.

4.2.4.1.2 THORN SCRUB

The vegetation types identified in the study area have the potential to support a number of bird species, providing habitats particularly for columbids, and passerines. The vegetation types have also been known to support a large number of migrant warblers in the winter season.

Generally, bird counts conducted over the study period did not confirm a large number of bird species and only one migrant was identified in the total of fifteen (15) species identified.

4.2.4.1.3 ESTUARIES AND RIVERS

Of the species identified the following feeding categories were represented in the railway route.

- Frugivores (fruit and seed eaters) - 19.1% (4)
- Omnivores (a combination of the above two feeding groups) - 19.1% (4)

- Carnivores (meat eaters) - 4.8 % (1)
- Shore feeder/Wader (feeds on mollusks, annelids etc.) - 4.8% (1)

38.1% of the total number of birds identified was observed along the proposed railway area, which consisted of dry scrub. Of the 38.1% total, 14.3% of the birds were in altered habitats due to the effects of rivers or streams.

The figures strongly suggest that the habitats provide mainly for fruiting, seeding structures and insects, these food types being maximized by the omnivores. The second largest group was the frugivores.

TABLE 4-9: AVIFAUNA OF COASTAL AND THORN SCRUB

FAMILY NAMES	SCIENTIFIC NAMES	COMMON NAMES	STATUS/ RANK	FEEDING HABIT
Apodidae	*Tachornis phoeicobia*	Antillean Palm Swift	R1	Insectivore
Apodidae	*Streptoprocne zonaris*	White-Collard swift	R1	Insectivore
Ardeidae	*Bubulcus ibis*	Cattle Egret	R1	Omnivore
Cathartidae	*Cathartes aura*	Turkey Buzzard	R1	Scavenger
Charadriidae	*Charadrius vociferous*	Killdeer	R1	Omnivore
Columbidae	*Columbina passerine*	Ground Dove	R1	Frugivore
Columbidae	*Zenaida aurita*	Mourning Dove	R1	Frugivore
Cucilidae	*Crotophaga ani*	Smooth-billed Ani	R1	Omnivore
Emberizinae	*Tiaras olivacea*	Yellow-faced Grass quit	R1	Frugivore
Falconidae	*Falco sparverius*	American Kestrel	R1	Carnivore
Mimidae	*Mimus polyglottos*	Northern Mockingbird	R1	Omnivore
Scolopacidae	*Actitis macularia*	Spotted sandpiper	W1	Omnivore
Sturnidae	*Sturnus vulgaris*	European Starling	I1	Frugivore
Trochilidae	*Mellisuga minima*	Vervain	R1	Nectarivore
Tyrannidae	*Tyrannous dominicensis*	Gray Kingbird	S1	Insectivore

Families -13
Species - 15
Endemics -none

4.2.4.2 OTHER TERRESTRIAL FAUNA

The proposed site had few fauna, partly due to the current and past uses of the site, the size, and fragmentation due to existing transport corridor.

Only two species of reptiles were observed at the site, both are lizards and endemics, *Anolis grahami* and *Anolis lineatopus*. Both have wide distribution in Jamaica. Our largest reptile *Crocodylus.acutus* has also been reported in the Portland Bight area but was not observed at or near the proposed site. Only two species of butterflies were

observed during site inspection, a common skipper, *Pyrgus sp.* and the West Indian Buckeye*, Precis evarete zonalis.* Other fauna observed were dragonflies, grasshoppers, snails, ants and flies. However, literature reviews indicated the likely occurrence of certain species of reptiles and amphibians generally within Portland Bight.

4.2.4.2.1 AMPHIBIANS AND REPTILES

Insects are fairly well represented in the Portland Bight area, with butterflies and bees being the most obvious of the group. At least 5 different species of Lepidoptera (butterflies etc,) are known to exist in the area. More importantly is the ecological functions of these insects where they act as pollinators. Other insect's species included ants, beetles, stinkbugs, wasps and honeybees.

At least four species of the snake *Arrhyton sp* are known to exist in the Portland Bight area, three of which are endemic. The snakes feed on other reptiles and amphibians such as *Anolis spp, Eleutherodactylus* adults and eggs as well as *Sphaerodactylus spp* (Gecko). Of the *Sphaerodactylus spp* one, not endemic, has a range extending to the study area.

In addition, at least six *Anolis spp* are suspected to occupy the area. Of these six species at least five are endemics with one species thought to be extinct.

Portland Bight is thought to have at least 15 species of amphibians, thus the potential exist for occurrences in the study area, and of these fifteen species twelve are endemic. Furthermore, nine of those species are *Eleutherodactylus spp* (frogs).

4.2.4.2.2 MOTHS AND BUTTERFLIES

Portland Bight is thought to have a distribution of seven families of butterflies, accounting for approximately 41 species, of which nine are endemic species or sub-species.

4.2.5 CONCLUSIONS & RECOMMENDATIONS

4.2.5.1 CONCLUSIONS

The proposed project area is narrow in its geographical scope and will not impact greatly or irreversibly on the ecology of the area. The temporary barge unloading dock will be contained within a limited, previously disturbed area currently influenced by industrial shipping/marine activities. The railway and transport system is already in place and the extension of a spur to the proposed barge dock will only result in limited but reversible

impacts to the existing vegetative cover. Floral and faunal species noted in the study area are relatively common, resilient and in terms of fauna, mobile enough to relocate in proximity to the proposed site should they be disturbed.

4.2.5.2 RECOMMENDATIONS

The areas of primary concern are:

1. Vegetation that will have to be removed to facilitate the temporary barge unloading dock.

2. The dredging of the area to accommodate the barges.

The following steps are recommended as actions to be taken:

- Land clearance will be kept to a minimum to reduce unnecessary habitat loss.

- Mangrove mitigation procedures as outlined the Section 7.1.3 will be followed and monitored throughout its implementation phase.

- Care will be exercised to minimize anthropologic influences on nearby areas of significant biological value.

- Where identified and possible, important plant species will be removed for replanting in proximity to the project area in a similar setting as it was found.

- Indigenous species will be utilized in any rehabilitation or landscaping programme to promote re-establishment of similar vegetation types particularly mangrove species, in keeping with Jamalco's policies.

4.2.6 MARINE ENVIRONMENT

To provide information on the baseline conditions and characteristics of the marine environment, a marine assessment of the environment in proximity to the location of the temporary barge unloading dock and existing Rocky Point Port was conducted along with the review and comparative analysis of previous studies in the area over recent years.

4.2.6.1 REGIONAL SETTING

The JAMALCO Marine Terminal at Rocky Point was established over 40 years ago on a Mangrove inhabited peninsula at Colon Bay in the northeastern side of Portland Bight in the Parish of Clarendon. The Marine Terminal facilitates the export of Alumina from the JAMALCO Halse Hall refinery and the import of raw materials and goods (e.g. fuel, caustic soda) required for the operation. The port accommodates vessels at the terminal by way of a T-shaped piled pier and mooring dolphins (See Plate 4-17).

PLATE 4-17: T-SHAPED PILE PER AT JAMALCO ROCKY POINT PORT

The facility is one of two Marine terminals in the Bight, WINDALCO's Port Esquivel facility being the other. The terminal also shares marine accesses with two power

generation facilities, namely the Jamaica Public Service Company Ltd's Old Harbour Bay Power Station and the Jamaica Energy Partners Power Barge. Finally, a number of communities ring the Portland Bight area, including Mitchell Town, Portland Cottage, Salt River, Tarentum, Longville, Kelly's Pen and Old Harbour Bay.

The JAMALCO Terminal falls within the Portland Bight Protected Area, which extends from the Hellshire Hills area to the east, to the Rio Minho River estuary in the west. The Natural Resources Conservation Authority (NRCA) declared the protected area on April 22, 1999. The NRCA ultimately delegated responsibility for the protected area to two management entities. The Caribbean Coastal Area Management Foundation which oversees the management of the areas extending from Old Harbour Bay, west and south to the Portland Cottage area and including the cays and marine environment contained within and the Urban Development Corporation who oversee the management of the Hellshire Hills area and the Goat Island region[17] (See Plate 4-18).

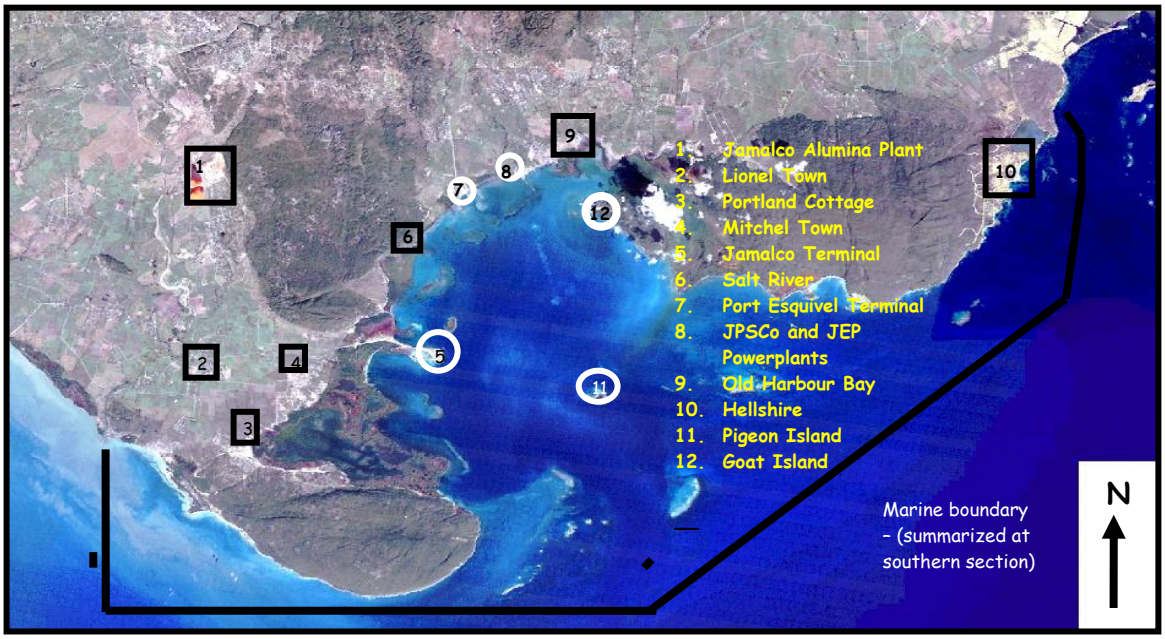


PLATE 4-18: Environment Contained Within the Portland Bight Protected Area – Landsat TM Image

The declaration was initiated, owing in part to the presence of rich coastal and marine resources within the area. Some of the largest Mangrove wetlands and fresh water

CONRAD DOUGLAS AND ASSOCIATES LIMITED
[17] Source: Manchester Parish Council

marshes in the island exist within and adjoin the borders of the Portland Bight[18]. Also integrally associated with wetlands are Seagrass Beds and Coral Reefs, which support a diverse array of fish, crustaceans and other forms of marine organisms[19].

Several studies have been initiated in the past, which have shed light on the extent and value of natural resources within the Portland Bight Protected area. The most extensive to date has been an environmental baseline study, which was commissioned by the Jamaica Public Service Company Ltd in 1997-98 for a Coal/Oil fired power plant, which was proposed for the Salt River area[18].

Extensive land-use, climatic, terrestrial, marine and socio-economic research was conducted to support the preparation of the baseline study. Plate 4-19 represents a spatial representation of the marine resources within the study area, and as projected over the Protected Area using aerial interpretation techniques.

[18] National Strategy and Action Plan on Biological Diversity in Jamaica - 2003

[19] Environmental Baseline Study to JPSCo for Coal/Oil Fired Power Plant 1998, Conrad Douglas & Assoc. Ltd.

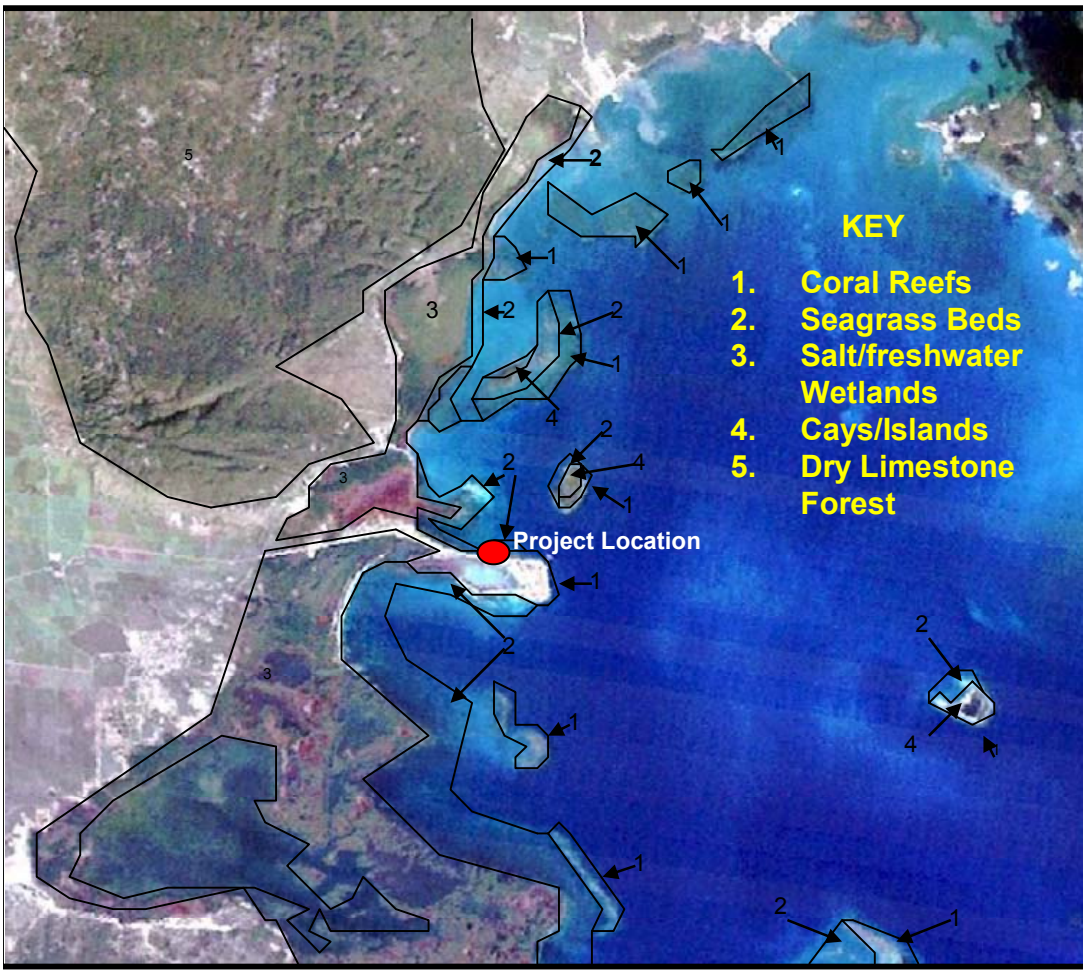


PLATE 4-19: Coastal and Marine Resources within Portland Bight Area.

4.2.6.2 STUDY AREA DEMARCATION:

The area defined for the oceanographic and benthic assessment was selected with proximity and accessibility to the existing dock and rail facilities being the primary consideration. However, the selection bore relevance to another consideration, which was that the area in proximity to the existing structures of the marine terminal appeared to be representative of the general benthic conditions existing along the Peninsula at which the temporary barge unloading dock is to be situated, and the existing terminal. Previously existing information for the area was used to make generalizations about the study site, which were then be verified in the field.

4.2.6.3 MARINE ASSESSMENT

A marine assessment was conducted of the marine environment at Rocky Point, Clarendon at the proposed dock site north-west of the existing Jamalco Rocky Point

Port. The marine assessment utilized dives of the area, video, and still photography to document the condition of the structures and marine life in the study area. The list of marine flora and fauna follows the end of this section. The plates are in Appendix VI.

Video and photographic records

A Sony HandyCam DVD R/RW Disc Camcorder in an Ikelite Digital underwater housing was used to capture real time data for both video and photographic records.

Quadrat sampling

One (1) metre square quadrats were laid along the shoreline east and west of the dock, at 50 m intervals for a distance of 300 m. Species composition and density were recorded.

Transect Line Sampling

Three transects were laid perpendicular to the shoreline, 100 m apart extending 200 m away from dock face. Two transect were also laid parallel to the shoreline, extending 200 m away east and west from dock face. All five transect lines were used to delineate the coastal zone in the vicinity of the dock where dredging is expected to be carried out. Transects were completed by a series of snorkel, dives and video photography.

Along the 200 m transects, habitat type and benthic and low motility species were recorded within 1 metre of the lines. All highly motile organisms observed (fish and fast moving invertebrates) whether in the immediate vicinity or not were recorded.

Within shallow waters and where seagrass beds were found, a 1 x 1 m quadrat was used to assess the density of the seagrasses. Lengths of seagrass blades, randomly selected, were measured and an average taken.

TABLE 4-10: GPS LOCATIONS AND DISTANCES OF TRANSECTS

TRANSECT NUMBER		GPS COORDINATES		DISTANCE
No.	Start/End	Longitude	Latitude	(in metres, approx.)
1	Start	N17° 49.227	W77° 09.004	200
	End	N17° 49.276	W77° 09.100	
2	Start	N17° 49.259	W77° 09.077	320
	End	N17° 49.428	W77° 09.021	
3	Start	N17° 49.208	W77° 08.997	430
	End	N17° 49.434	W77° 08.998	
4	Start	N17° 49.249	W77° 08.878	254
	End	N17° 49.373	W77° 08.844	
5	Start	N17° 49.227	W77° 08.987	308
	End	N17° 49.173	W77° 08.824	

FIGURE 4-7: TRANSECT MAP FOR MARINE SURVEY

The observations of the typical progression from shore to deep water included: sandy shore, to algae (usually *Acetabularia sp. and Caulerpa* sp.), to patches of healthy sea grass beds.

The sediment throughout the area was fairly consistent. Transects 2, 3 and 4 had a light grey colour sediment with an anoxic substratum. Sediments are easily stirred up. Depths exceeding 5 m are turbid, leading to poor visibility within 1 to 2 m. Transect 1 and 5 also had similar substratum but was mixed with rubble in the shallower areas. Transect 1 also had incidence of substrate that was reddish grey. Transect 5 showed seagrass encrusted with reddish coloured silt, similar to seafloor in approximately 3 m of water. The sea floor throughout was typically of a muddy unconsolidated sea floor with a maximum depth of 35 feet within the study area. Significant mixing of benthic sediments has occurred in the area. No significant mounding was observed in the area probably due to effects of currents and counter-currents that are active in the area.

The shoreline was typically rocky in the vicinity of the dock, no more than 10 m in either direction, presumably from the weathering action of the boulders and other rock material used to build the dock. Crumbling of the sections of the damaged pier (Hurricane Ivan) that are located here may also be responsible for much of the small pebbled area observed. This area was found to be teeming with molluscs. These are typical of other rocky shores in Jamaica and are not endemic to the area. Species density and composition changed in this area with changes in size and composition of the rocky shoreline. Species inhabiting this area affix themselves to the hard substrate material and scrape food from off the rocks. They are well adapted to the area in terms of feeding, anchoring and protection from predators. The dominant species are herbivores such as *Nerita sp*. and *Littorina sp.* Degree of tolerance to wave action serves to spatially septate species and reduces competition for food. Chitons and other well anchored species were found at the dock face. A complete list is presented at the end of this section. The density of species such as *Nerita* sp. and *Littorina* sp. were 40 and 18 respectively in a 1 x 1 m quadrat area, whereas chitons were 3-4 individuals per square metre. Crabs such as the hermit crab were highly motile and were very few. Only 8 individuals were observed. The plant life along the rocky shore comprised several species of green and red algae.

The sandy shoreline was nearly devoid of any fauna with the exception of crabs such as the Patriot crab (*Cardisoma sp.*) and the Ghost crab (*Ocypode quadrata*). Patches of seagrass and algae could be seen in the shallows and washed up on the shore just below the existing mangroves. Prop roots of the red mangroves were encrusted with red algae in some places.

The seagrass beds were fairly extensive on either side of the dock. Two species were observed; *Thalassia testudinum* (Turtle grass) *and Syringodium filiforme* (Manatee grass). Turtle grass was observed to be growing at a depth of 1.5 m to approximately 4 m, blade length measured were 32 cm maximum length and 24 cm average length. *Syringodium* was found in densities of 5-10% cover per square metre compared with a 40-100% cover for turtle grass. Manatee grass was also observed further away from the dock area and in less turbid waters than turtle grass. The turbidity of the water decreases the ability of light to penetrate the water column and as such seagrass were not found in deeper water. The associated benthic macroalgae, green and red algae, are found interspersed in the seagrass beds. *Caulerpa sp*. and *Acetabularia sp.* are the most common. Only one instance of coral was observed within seagrass beds at a depth of 4 m just outside the sample area, east of the dock. This area is known to have sea turtles grazing such as the Hawksbill turtle, however, none were observed during the assessment exercise. Bare coralline sand patches, dead coral and coralline rubble and algae accounted for less than 5 % of the benthic substrate, predominantly to the east of the dock face.

Not surprisingly, no significant coral reef structure was observed in the area.

Not many macro-organisms were observed in the study area. The presence of polychaete worms is however suggested by the few holes observed throughout the area. Sea stars, sea horse and starfishes were the only macro-organisms observed.

Overall, at least 4 different species of fish were observed**.** Table 4-11 and Table 4-12 below outline the marine flora and fauna identified at Rocky Point, Clarendon.

TABLE 4-11: OBSERVED MARINE FLORA AT ROCKY POINT, CLARENDON

Species	Common Name	% Cover
Algae		
Amphiroa sp.	Red algae	<1
Gracilaria	Red algae	<2
Acetabularia sp.	Green algae	<10
Caulerpa racemosa.	Green algae	<5
Caulerpa sertularia	Green algae	<10
Halimeda sp.	Green algae	<1
Penicillus sp.	Green algae	<2

Species	Common Name	% Cover
Udotea sp.	Green algae	<1
Dictyota linearis	Brown algae	<1
Sea Grasses		
Syringodium filiforme	Manatee Grass	<2-10
Thalassia testudinum	Turtle Grass	<40-100

TABLE 4-12: OBSERVED MARINE FAUNA AT ROCKY POINT, CLARENDON

Species	Common Name	DAFOR
Fishes		
Holocentrus ascensionis	Long Jaw	R
	Shad	O
Haemulon sp.	Grunt	R
Stegastes sp.	Damselfish	O
Fishes known from the general area (source: local fishermen)		
Acanthurus chirurgus	Doctor fish	R
Chaetodon sp.	Butterflyfish	R
Holocentrus sp.	Angelfish	R
Ocyurus chrysurus	Yellow tail Snapper	R
Pomacanthus sp.	Angel fish	R
Holacanthus sp.	Angel fish	R
Centropomus sp.	Snook	O
Scarus sp.	Striped Parrot fish	R
Diodon sp.	Puffer	R
Bothus lunatus	Peacock Flounder	R
Invertebrates		
Echinaster sp.	Red sea star	O
Trypneustes ventricosus	White Sea Urchin	F
Lytechinus variegatus	Green sea urchin	F
Gonodactylus sp.	Mantis shrimp	O
Nerita tessellata.	Nerite, Periwinkle	F
Nerita versicolor.	Nerite, Periwinkle	F
Littorina zigzag	Zigzag	F
Tectarius muricatus	Knobby Periwinkle	R
Chiton tuberculatus	Chiton	O
Cardisoma sp.	Great Land Crab	R
Ocypode quadrata	Ghost crab	O
Vertebrates (source: local fishermen)		
unknown	Marine Turtles	-

SOCIAL ENVIRONMENT

5 SOCIAL ENVIRONMENT

5.1 SURVEY POPULATION

The surveyed areas were chosen based on the Enumeration Districts as outlined by the Statistical Institute of Jamaica, which were in closest proximity to the site at Rocky Point Port, Clarendon.

The survey population was calculated based on a 5% sample of the Total Housing Units (THU) in the area. Each respondent was from a different household, such that, each respondent would represent one Housing Unit.

The Enumeration Districts surveyed, along with their corresponding Total Housing Unit (THU) values are found in the table below. These statistics were obtained from the ***Population Census 2001***, at the Statistical Institute of Jamaica.

TABLE 5-1: ENUMERATION DISTRICTS SURVEYED

ENUMERATION DISTRICT CODE	THU	5% SAMPLE VALUE	SURVEYS ISSUED
SE 71	101	5	5
SE 72	85	4	5
SE 73	142	7	7
SE 74	121	6	5
SE 93	177	9	8
SE 94	64	3	4
TOTAL	690	34	34

Please see the map following, showing the location of the Enumeration Districts in which socio-economic surveys were issued concerning the development.

Also, please refer to Appendix III for a copy of the Survey Instrument.

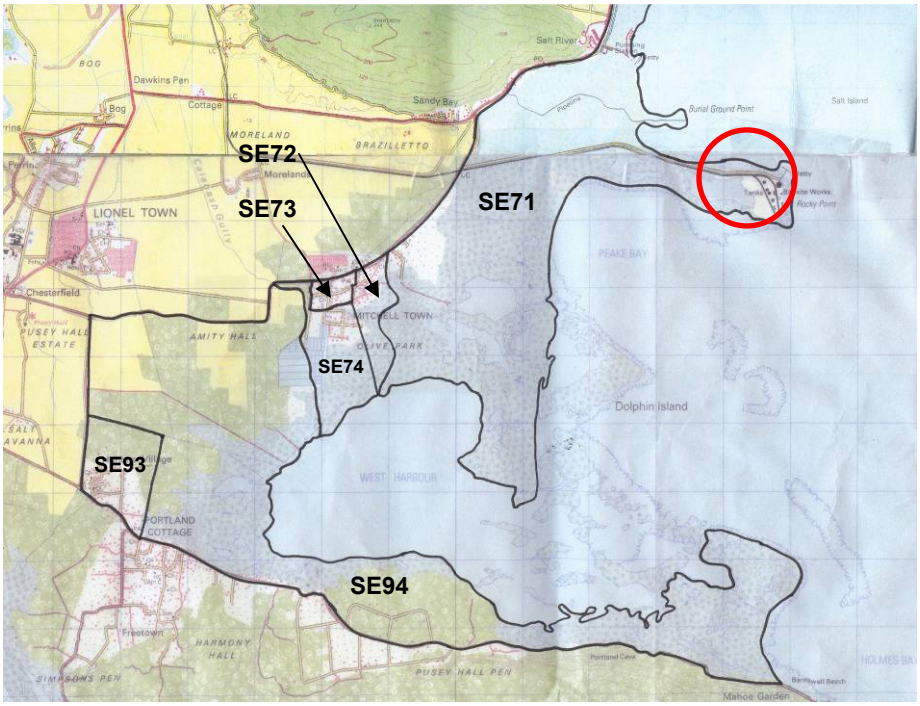


FIGURE 5-1: MAP SHOWING THE LOCATION OF EDS SURVEYED

Key

Site Location

ED Boundary

Table 5-2: Male Population by Age groups and Enumeration District

MALE POPULATION BY FIVE-YEAR AGE GROUPS, BY ENUMERATION DISTRICTS (CLARENDON)

ENUMERATION DISTRICT (ED)	TOTAL	0-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80-84	85 & over
SE 71	188	16	24	20	14	22	18	8	18	8	6	4	6	10	7	2	4	1	0
SE 72	154	15	24	19	8	13	12	10	11	10	6	5	2	7	7	4	0	1	0
SE 73	239	25	32	28	14	17	22	18	13	10	11	7	13	10	5	11	1	4	0
SE 74	186	24	28	22	8	12	18	17	7	11	13	7	7	6	5	1	1	0	0
SE 93	396	43	48	53	51	30	31	20	23	24	11	18	10	8	12	5	6	2	1
SE 94	136	21	20	12	10	13	13	8	10	6	7	5	0	4	5	1	1	0	0

TABLE 5-3: FEMALE POPULATION BY AGE GROUPS AND ENUMERATION DISTRICTS

FEMALE POPULATION BY FIVE-YEAR AGE GROUPS, BY ENUMERATION DISTRICTS (CLARENDON)

ENUMERATION DISTRICT (ED)	TOTAL	0-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80-84	85 & over
SE 71	179	15	20	29	17	17	14	8	10	10	7	10	5	5	6	2	2	2	0
SE 72	143	13	19	16	8	19	10	10	11	5	8	6	4	4	5	2	2	0	1
SE 73	233	27	35	28	19	17	23	8	18	13	6	6	7	6	6	8	6	0	0
SE 74	187	15	23	26	22	12	19	13	19	11	2	1	4	7	5	5	1	0	2
SE 93	408	54	55	57	31	34	22	29	25	24	13	17	11	11	10	5	5	5	2
SE 94	123	18	22	16	8	13	12	7	5	2	6	5	4	0	1	0	1	2	0

5.1.1 PERSONAL CHARACTERISTICS

A total of 34 community members were surveyed. Of that figure, 16 were male and 18 were female. The majority fell in the 40-49 age-group and had been living in the community for more than 20 years. Data collected about the residents' personal characteristics are in the following three tables.

1. Gender

	SE 71	SE 72	SE 73	SE 74	SE 93	SE 94	Total
Male	3	1	4	2	3	3	16
Female	2	4	3	3	5	1	18
							34

2. Age Range

	SE 71	SE 72	SE 73	SE 74	SE 93	SE 94	Total
Under 20	1	0	0	0	0	0	1
20 – 39	1	1	2	2	4	0	10
40 – 49	1	2	2	1	1	4	11
50 – 59	2	1	0	1	2	0	6
60 – over	0	1	3	1	1	0	6
Not Stated/No Response	0	0	0	0	0	0	0
							34

3. How many years have you been living in the community?

	SE 71	SE 72	SE 73	SE 74	SE 93	SE 94	Total
0-5 years	0	0	0	0	0	0	0
6-10 years	1	0	1	0	0	0	2
11 -20 years	1	0	1	0	2	0	4
more than 20 years	3	4	5	5	6	4	27
not stated/ no response	0	1	0	0	0	0	1
							34

5.1.2 OPINIONS ON THE COMMUNITY

31 residents expressed that the absence of crime and violence was their favourite thing about their communities. This represents 91% of the survey population. The next two favourite characteristics of the community were its quietness and the friendliness of the people, in that order.

The least favourite attributes of the community were unemployment, poor roads and lack of utilities. As will be seen from the rest of the survey results, the unemployment of people of the surveyed communities is of significant concern to the residents.

With regard to lack of utilities, several respondents commented that they did not have access to piped water, even though there were several water pipes in the community.

38% of the respondents gave other attributes that they did not like about their communities. Of these 13, 6 respondents stated that community development was needed. 3 cited the absence of a training centre, 2 cited dust damage and 1 person each cited the need for housing development and the lack of jobs provided by JAMALCO.

4. What do you like most about the community?

	SE 71	SE 72	SE 73	SE 74	SE 93	SE 94	Total
Friendly people	3	4	3	5	4	3	22
Clean environment	0	0	1	1	0	0	2
Availability of beaches/ bathing areas/ fishing grounds	1	1	2	0	8	3	15
Quiet	3	5	4	5	4	2	23
No crime & violence	5	5	6	5	7	3	31
Other, (specify)	0	1	2	0	0	0	3
Not Stated/No Response	0	0	0	0	0	0	0

5. What don't you like about the community?

	SE 71	SE 72	SE 73	SE 74	SE 93	SE 94	Total
Poor roads	2	4	7	5	8	4	30
Lack of Utilities	5	4	4	3	8	4	28
Crime & violence	0	0	1	0	0	0	1
Unemployment	5	5	7	5	7	4	33
Dirty environment	0	0	0	0	0	0	0
Other, (specify)	2	1	3	2	2	3	13
Not Stated/No Response	0	0	0	0	0	0	0

5.1.3 AWARENESS ON EXISTING OPERATIONS

76% of the respondents were aware of the expansion and upgrade plans of JAMALCO. A similar percentage claimed to have experienced negative impacts from the operations

at JAMALCO's Rocky Point Port. 24 of those 27 persons cited dust as the major nuisance. Some had even commented that the dust had damaged personal property as well as plants.

6 respondents said that the Port facility had caused damage to fishing grounds.

Of note is the fact that the same number of persons who said that they experienced negative impacts also said that the Port facility had positive impacts on the community.

All 27 said that job opportunities were a major positive. 9 respondents noted the educational and social benefits of the Port, in the community.

6. Are you aware that JAMALCO has been given a permit to expand their bauxite refinery operations?

	SE 71	SE 72	SE 73	SE 74	SE 93	SE 94	Total
Yes	4	3	5	5	6	3	26
No	1	2	2	0	2	1	8
Not Stated/No Response	0	0	0	0	0	0	0
							34

7. Are you experiencing any negative impacts from the operations at the JAMALCO Rocky Point Port facility?

	SE 71	SE 72	SE 73	SE 74	SE 93	SE 94	Total
Yes	3	4	6	4	6	4	27
No	2	1	1	1	2	0	7
Not Stated/ No Response	0	0	0	0	0	0	0
							34

8. If <u>YES :</u> What is this negative impact?

	SE 71	SE 72	SE 73	SE 74	SE 93	SE 94	Total
Odour	0	0	0	1	0	0	1
Oil Pollution	0	0	1	0	0	1	2
Dust, soot or gaseous emission	3	4	6	3	4	4	24
Noise	0	0	0	1	0	0	1
Damage to fishing grounds	1	0	1	1	1	2	6
Not Stated/No Response	0	1	0	0	0	0	1
Other, (specify)	1	0	0	0	1	0	2

9. Would you say that the existing port facility has had a positive impact on this community?

	SE 71	SE 72	SE 73	SE 74	SE 93	SE 94	Total
Yes	5	4	6	5	4	2	27
No	0	1	1	0	3	2	7
No answer	0	0	0	0	0	0	0
							34

10. What positive impacts do you think the port facility has had on the community?

	SE 71	SE 72	SE 73	SE 74	SE 93	SE 94	Total
Improved community relations	1	0	2	1	1	0	5
Job opportunities	5	4	7	5	4	2	27
Educational and social benefits	2	1	3	1	2	0	9
Amenities – roads, lights, water supply	0	0	4	0	1	1	6
Environmental conditions	0	0	1	0	0	0	1
None of the above	0	0	0	0	2	2	4
Other (specify)	0	0	0	0	0	0	0
Not Stated/No Response	0	0	0	0	0	0	0

5.1.4 KNOWLEDGE AND VIEWS ON UPGRADE PLANS

50% of the respondents did not know that a temporary Barge unloading facility was proposed for construction; however, the majority of respondents thought that this proposed construction would impact the economic value to the community and job opportunities positively.

15 of the 34 residents surveyed said that they thought that the proposed temporary facility would not affect them personally. The majority of respondents (34%) did not know how it would affect their income, while 53% thought that it would positively affect job opportunities. In contrast, 44% thought that their health would be negatively affected. This could be attributed to their views that the Port upgrade would cause more air pollution and noise, as well as cause more dust to be circulated in the communities. These views were second and third, respectively, to the view that the Port upgrade would bring more jobs to the area. The primary reasons for these views were that more

jobs would be available and that these effects were considered common to all bauxite operations.

11. Are you aware that Jamalco has proposed construction of a temporary barge unloading facility in order to facilitate their expansion?

	SE 71	SE 72	SE 73	SE 74	SE 93	SE 94	Total
Yes	3	2	5	3	2	2	17
No	2	3	2	2	6	2	17
							34

12. What effect do you think the proposed construction of JAMALCO's temporary barge unloading facility in or near your area will have on the following:

i) Income/ Economic value of the community

	SE 71	SE 72	SE 73	SE 74	SE 93	SE 94	Total
Positive	5	3	4	4	2	2	20
Negative	0	1	0	0	0	0	1
No Change	0	1	0	1	1	0	3
Don't Know	0	0	3	0	5	2	10
Not Stated/No Response	0	0	0	0	0	0	0
							34

ii) Job Opportunities

Positive	5	4	4	5	5	2	25
Negative	0	1	0	0	1	0	2
No Change	0	0	0	0	0	0	0
Don't Know	0	0	3	0	2	1	6
Not Stated/No Response	0	0	0	0	0	1	1
							34

iii) Pollution

Positive	1	2	1	0	1	0	5
Negative	2	1	3	0	4	1	11
No Change	2	0	1	2	1	0	6
Don't Know	0	2	2	3	1	3	11
Not Stated/No Response	0	0	0	0	1	0	1
							34

13. Do you think the proposed construction will affect you personally?

	SE 71	SE 72	SE 73	SE 74	SE 93	SE 94	Total
1. Yes	1	2	0	0	3	1	7
2. No	2	0	5	2	4	2	15
3. Don't Know/Not Sure	2	3	1	3	1	1	11
4. Not Stated/No Response	0	0	1	0	0	0	1
							34

14. How?

i) Income

	SE 71	SE 72	SE 73	SE 74	SE 93	SE 94	Total
Positive	0	0	0	0	3	0	3
Negative	1	3	0	0	1	1	6
No Change	0	0	0	0	0	1	1
Don't Know	1	2	3	3	3	1	13
Not Stated/No Response	3	0	4	2	1	1	11
							34

ii) Job Opportunities

Positive	3	2	4	3	4	2	18
Negative	0	0	0	0	0	1	1
No Change	1	0	1	1	1	0	4
Don't Know	1	3	1	1	3	1	10
Not Stated/No Response	0	0	1	0	0	0	1
							34

iii) Health

Positive	0	1	0	0	0	0	1
Negative	2	2	3	1	5	2	15
No Change	3	1	1	1	1	1	8
Don't Know	0	1	3	3	2	1	10
Not Stated/No Response	0	0	0	0	0	0	0
							34

15. What do you think are the main impacts that the upgrade at the Port and its environs would have on the local community?

	SE 71	SE 72	SE 73	SE 74	SE 93	SE 94	Total
More jobs	5	4	7	5	5	3	29
Loss of income	0	0	0	0	0	1	1
More dust circulating in the area	2	3	4	2	4	2	17
Less air pollution and noise	0	0	0	0	0	0	0
More air pollution and noise	2	3	6	2	6	4	23
Contamination of fishing grounds	2	3	2	1	0	2	10
Better community relations	2	1	0	1	1	0	5
Improved environmental protection and other amenities	0	1	2	0	1	0	4
More crime in the community	0	0	0	0	1	0	1
Increased population	1	3	3	1	4	3	15
Don't know/Not Sure	0	0	0	0	0	0	0
Other (specify)	0	0	0	0	0	0	0
Not Stated/No Response	0	0	0	0	0	0	0

16. Why do you think so?

	SE 71	SE 72	SE 73	SE 74	SE 93	SE 94	Total
The present activities at the Port have caused this already. So it can only get worse.	1	1	2	1	1	2	8
The upgrade will add new equipment that will be cleaner to operate	0	0	1	1	2	0	4
More jobs will be available	5	4	5	4	5	4	27
This is something common to all bauxite operations	2	4	3	0	4	2	15
The upgrade will cause more people to pass through the community. So it gives more opportunity for crime	0	0	4	0	1	0	5
This is something that someone told me	0	0	0	0	0	0	0
Don't Know/Not Sure	0	0	0	0	0	0	0
Other (specify)	0	0	0	0	0	0	0
Not Stated/No Response	0	0	0	0	0	0	0

17. What do you think are the main impacts that the upgrade at the Port and its environs would have on the local coastal area?

	SE 71	SE 72	SE 73	SE 74	SE 93	SE 94	Total
More pollution	2	4	6	2	3	3	20
Less pollution	0	0	0	0	0	0	0
Loss of biodiversity	2	1	2	1	1	2	9
No impact	3	1	0	1	0	1	6
No response	0	0	0	1	0	0	1
I don't know	0	0	1	1	4	0	6

18. Have you or any member of your household ever worked for a bauxite company or in the bauxite industry?

	SE 71	SE 72	SE 73	SE 74	SE 93	SE 94	Total
Yes	4	5	6	5	4	3	27
No	1	0	1	0	4	1	7
Don't Know/Unsure	0	0	0	0	0	0	0
Not Stated/No Response	0	0	0	0	0	0	0
							34

19. Are you aware of any programs or activities initiated by bauxite companies in your community?

	SE 71	SE 72	SE 73	SE 74	SE 93	SE 94	Total
Yes	4	3	5	5	3	4	24
No	1	2	1	0	2	0	6
Don't Know/Unsure	0	0	1	0	3	0	4
Not Stated/No Response	0	0	0	0	0	0	0
							34

5.1.5 SITE USE

Several areas in the community are utilized by the residents, both for recreation and in order to make a living, mostly by commercial fishing. Only 16 of the residents who responded to using the sea for any purpose, whether recreational or otherwise, stated how many days per week they use the sea. On average, the 16 respondents use the sea 3 days per week.

20. Do you rely on the area (mangroves and sea) for your livelihood?

	SE 71	SE 72	SE 73	SE 74	SE 93	SE 94	Total
Yes	1	4	3	3	5	4	20
No	4	1	4	2	3	0	14
							34

21. How do you rely on the area (mangroves and sea) for your livelihood?

	SE 71	SE 72	SE 73	SE 74	SE 93	SE 94	Total
Commercial fishing	1	1	2	3	5	4	16
Sport fishing	0	2	1	2	3	1	9
Firewood	0	0	0	0	0	1	1
Diving / snorkeling	0	0	0	0	2	0	2
Pleasure boating	0	0	0	0	2	0	2
Eco-Tours (mangrove and coral reefs)	0	2	0	0	3	0	5
Other	0	0	0	0	0	0	0

22. Do you use the sea for recreational purposes?

	SE 71	SE 72	SE 73	SE 74	SE 93	SE 94	Total
Yes	3	3	3	4	7	2	22
No	2	2	4	1	1	2	12
							34

23. How many days per week do you use the sea (for any purpose, recreational or otherwise)?

#	SE 71	SE 72	SE 73	SE 74	SE 93	SE 94	Total
1	1	0	0	0	2	0	3
2	0	1	0	2	0	1	4
3	1	2	1	1	0	0	5
4	0	0	0	0	0	0	0
5	1	0	0	0	1	0	2
6	0	0	0	0	0	1	1
7	0	0	0	0	1	0	1
							16

24. When do you use the sea?

	SE 71	SE 72	SE 73	SE 74	SE 93	SE 94	Total
Weekends only (Fri, Sat, Sun)	1	1	3	1	2	1	9
Sun-Sat (all week)	2	2	1	2	4	1	12
Mon – Fri	0	0	0	1	0	2	3
							24

The areas specified, and the number of residents who used them, are found in the table below:

AREA	TOTAL RESPONDENTS
Half Moon Cay	1
Pig Bay	1
Pigeon Island	1
Rocky Point	2
Barnswell Beach	3
Portland Beach	3
Portland Cottage	3
Jackson Bay	4
Portland Cay	4
Salt River	6
Welcome Beach	10

5.1.6 EMPLOYMENT

It is clear from the responses that employment is one of the main concerns of the residents in the communities surveyed.

Not only is it the number one nominated dislike about the community, it is also what is most anticipated following the proposed works by JAMALCO. There were several comments made, that it was not expected that a large number of jobs would be provided. They remained hopeful, however, that there would be a positive impact on the community's economic state as well as a positive impact on the joblessness of the community's youth.

POLICY, LEGISLATION, STANDARDS AND REGULATORY FRAMEWORK

6 POLICY, LEGISLATION, STANDARDS AND REGULATORY FRAMEWORK

The policies, legislation, regulations and environmental standards of the Government of Jamaica (GOJ), which pertain to this development have been researched and analyzed, to ensure that the project complies with all policy, legal and regulatory requirements. The areas examined included environmental quality, Protected Areas Policy, beach control, National Heritage Trust, health and safety, protection of sensitive areas, protection of endangered species, site selection and land use control at the regional, national and local levels, which relate to or should be considered within the framework of the project.

6.1 POLICY

6.1.1 AGENDA 21

In June 1992, Jamaica participated in the United Nations Conference for Environment and Development (UNCED). One of the main outputs of the conference was a plan of global action, titled Agenda 21, which is a "comprehensive blueprint for the global actions to affect the transition to sustainable development" (Maurice Strong). To which, Jamaica is a signatory. Twenty seven (27) environmental principles were outlined in the Agenda 21 document. Those relevant to this project, which Jamaica is obligated to follow are outlined below:

Principle 1 – Human beings are at the centre of concerns for sustainable development. They are entitled to a healthy and productive life in harmony with nature.

Principle 3 – The right to development must be fulfilled to equitably meet developmental and environmental needs of present and future generations.

Principle 10 – Environmental issues are best handled with the participation of all concerned citizens, at the relevant level, each individual shall have appropriate access to information concerning the environment that is held by public authorities, including information on hazardous materials and activities in their communities, and the opportunity to participate in the decision making process.

Principle 11 – States shall enact effective environmental legislation, environmental standards, management objectives and priorities should reflect the environmental and developmental context to which they apply.

Principle 15 – In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.

6.1.2 RAMSAR SIGNIFICANCE

The Convention on Wetlands came into force for Jamaica on 7 February 1998. Jamaica presently has 3 sites designated as Wetlands of International Importance, with a surface area of 37,765 hectares (includes Portland Bight Wetland and Cays). The Portland Bight Wetlands and Cays was given Ramsar designation on 2nd February, 2006. Below is a synopsis of the Portland Bight Wetlands and Cays and their importance as outlined by the Ramsar Convention Secretariat, as taken from their website[20].

Portland Bight Wetlands and Cays. *02/02/06*; St. Catherine, Clarendon; 24,542 ha; 17º49'N 077º04'W. Protected Area. Located on the south coast of the island, just west of Kingston, Portland Bight (or bay) includes some 8,000 ha of coastal mangroves, among the largest contiguous mangrove stands remaining in Jamaica, as well as a salt marsh, several rivers, offshore cays, coral reefs, seagrass beds, and open water. The site constitutes a critical feeding and breeding location as well as a general habitat for internationally threatened species such as the cave frog (*Eleutherodactylus cavernicola*), the Jamaican boa (*Epicrates subflavus*), the endemic hutia or coney (*Geocapromys brownii*), and the West Indian manatee (*Trichechus manatus manatus*). An endemic cactus (*Opuntia jamaicensis*) is also considered endangered under CITES. More than 3,000 fisher families make their livelihoods in the Bight, harvesting mostly finfish but also lobster, shrimp, oysters, and conch, and there are important sugar plantations in the surrounding area. Threats are feared from over-hunting and -fishing, pollution from sugar wastes, mangrove destruction for aquaculture, and invasive species. Ramsar site No. 1597.

CONRAD DOUGLAS AND ASSOCIATES LIMITED

[20] Ramsar Convention on Wetlands http://www.ramsar.org/profile/profiles_jamaica.htm Posted 26 January 2000, updated 10 February 2006

6.1.3 PROTECTED AREAS POLICY

The proposed project falls within the Portland Bight Protected Area (PBPA). It is managed by the Caribbean Coastal Area Management (CCAM) Foundation in conjunction with the Natural Resources Conservation Authority. The Ministerial Order creating the Portland Bight Protected Area under Section 5 of the Natural Resources Conservation Act was signed on Earth Day (April 22) 1999.

The PBPA is approximately 1,876 sq. km (724 sq. mile) of integrated terrestrial and marine protected area. The 520 sq. km (200 sq. mile) terrestrial area is 4.7% of Jamaica's land mass, and the 1,356 sq. km (524 sq. mile) of marine space is 47.6% of her shallow shelf. The PBPA contains 210 sq. km (81 sq. mile) of dry limestone forest, 82 sq. km (32 sq. mile) of wetlands, and an as yet undetermined area of seagrass beds and coral reefs. It is habitat for birds, iguanas, crocodiles, manatees, marine turtles, fish and human beings.

6.2 RELEVANT LEGISLATION

Legislations relevant to the proposed activities in Clarendon are outlined below.

6.2.1 THE NATURAL RESOURCES CONSERVATION AUTHORITY (NRCA) ACT, 1991

The NRCA Act (1991) is the overriding legislation governing environmental management in Jamaica. It requires that all new projects, (or expansion of existing projects), which fall within prescribed categories be subject to an environmental impact assessment (EIA).

The regulations require that eight (8) copies of the EIA Report be submitted to the Authority for review. There is a preliminary review period of ten (10) days to determine whether additional information is needed. After the initial review the process can take up to ninety (90) days for approval. If on review and evaluation of the EIA the required criteria are met, a permit is granted. In the event that the EIA is not approved, there is provision for an appeal to be made to the Minister.

Specifically, the relevant section(s) under the Act which address the proposed project are:

Section 10: Empowers the Authority to request EIAs for the construction of any enterprise of a prescribed category.

Section 12: Addresses the potential for contamination of ground water by trade effluent and sewage.

Section 15: Addresses the implementation of stop orders and fines associated with the pollution of water resources.

Section 16: Authorizes the government to intervene in order to prevent the contamination of ground water.

Section 17: Addresses the authority of the government to request in writing, any information pertaining to the:

1. performance of the facility
2. quantity and condition of the effluent discharged
3. the area affected by the discharge of effluent

In keeping with the requirements of this Act, the following submittals have been in support of this project:

- Permit Application (pursuant to Section 9)
- Project Information Form (PIF) pursuant to Section 10 (1)(a)
- Completed EIA document (8 copies to NEPA and one electronic copy)

6.2.2 WILDLIFE PROTECTION ACT, 1945

This act involves the declaration of game sanctuaries and reserves, game wardens, control of fishing in rivers, protection of specified rare or endemic species. The Act also provides for the protection of animals and makes it an offence to harm or kill a species which is protected. It stipulates that, having in one's possession "whole or any part of a protected animal living or dead is illegal.

This Act has to be considered for the proposed project, ecological assessments will determine if rare or endangered species will be impacted.

6.2.3 THE BEACH CONTROL ACT (1956)

The Beach Control Act provides for the regulation of activities within twenty-five (25) metres of the shoreline. It includes control of the construction of sheds and huts on beaches, and prohibits the use of public beaches for fishing activities. The Act is administered by NEPA, and also makes provisions for the creation of Marine Protected Areas. The sections of the Act relevant to the project are:

Section 7:

1. Notwithstanding anything to the contrary in this Act, the Minister may, upon the recommendation of the Authority, make an order declaring:
   a) any part of the foreshore and the floor of the sea defined in the Order together with the water lying on such part of the floor of the sea to be a protected area for the purpose of this Act; and
   b) such activities as may be specified in the Order to be prohibited activities in the area defined in the Order, being any or all of the following activities:
      i) fishing by any means specified in the Order;
      ii) the use of boats other than boats propelled by wind or oars where such boats are used for purposes other than for the doing of anything which may be lawfully done under the Harbours Act, the Marine Board Act, the Wrecks and Salvage Law, the Pilotage Act or the Exclusive Economic Zone Act;
      iii) the disposal of rubbish or any other waste material;
      iv) water-skiing;
      v) the dredging or disturbance in any way of the floor of the sea

Section 9:

1. Subject to the provision of Section 8 (this does not apply to docks wharves pier etc. constructed prior to June 1, 1956), no person shall erect, construct or maintain any dock, wharf, pier or jetty on the foreshore or the floor of the sea, or any structure, apparatus or equipment pertaining to any dock, wharf, pier or jetty and encroaching on the foreshore or the floor of the sea, except under the Authority of a license granted by the Minister on behalf of the Crown.

6.2.4 THE PUBLIC HEALTH ACT (1974)

This Act falls under the ambit of the Ministry of Health (MOH) and governs all matters concerning the handling of food material. In addition, provisions are also made under this Act for the activities of the Environmental Control Division (ECD), a division of the MOH. The ECD has no direct legislative jurisdiction, but works through the Public Heath Act to monitor and control pollution from point sources. Action against any breaches of this Act would be administered by the Central Health Committee. The functions of the department include:

- The monitoring of waste water quality, including regular water quality analysis, using water standards published by NEPA;
- Monitoring of occupational health as it relates to industrial hygiene of potentially hazardous working environments;
- Monitoring of air pollutants through its laboratory facilities.

6.2.5 THE CLEAN AIR ACT (1964)

This Act falls under the ambit of the Ministry of Health (MOH) and governs all matters concerning the control of emissions of gases such as smoke, fumes, other gases or dust into the air. The sections of the Act relevant to the project are:

Section 5:

An inspector on production of his authority if so required may enter any affected premises at any time while work is being carried on there, or while there is any discharge of smoke or fumes or gases or dust into the air from any part of such premises and may inspect and examine such premises or any part thereof and may make such enquiries, and make such tests and take such samples of any substance, smoke, fumes, gas or dust as he considers necessary or proper for the performance of his duties.

Section 6:

Subject to the provisions of this Act the owner of every affected premises shall use the best practicable means for-

a) preventing the escape of any noxious or offensive gas; and
b) preventing the discharge of any such gas into the air; and
c) rendering such gas, where discharged, harmless or inoffensive, and an inspector may enquire whether in any affected premises the best practicable means have been adopted for carrying out the provisions of this subsection and shall submit a report thereon to the Central Health Committee.

6.2.6 JAMAICA NATIONAL HERITAGE TRUST ACT (1985)

The Jamaica National Heritage Trust, formerly the Jamaica National trust, administers the Act. This Act provides for the protection of important areas, including the numerous monuments, forts, statues, and buildings of historic and architectural importance in Jamaica.

This Act will prove applicable if any structures of archaeological and/or architectural importance are located on the site, affected by the site activities or unearthed during site activities. Since this project is in an area that may contain items of archaeological importance, an Archaeological Retrieval Plan is included as part of this document.

6.2.7 TOWN & COUNTRY PLANNING ACT (1987)

This Act governs the development and land use (excluding agriculture) in specified areas, through Development Orders, local planning authorities, development planning processes and Tree Preservation Orders. Under this Act the Town Planning Department is the agency responsible for the review of any plans involving development. The Act allows for specific conditions to be stipulated and imposed on any approved plans. The planning decision is based upon several factors, including;

- Location of the development;
- Land use and zoning;
- Effect of the proposal on amenities, traffic, etc.

6.2.8 PORT AUTHORITY ACT, 1974

This Act authorises the Port Authority to declare harbours, and establish or alter boundaries of harbours. The Marine Board is established by this Act and makes rules for the regulation and control of harbour and ship channels. The following activities are prohibited under this Act:

- the discharge of rubbish,
- earth,
- stone,
- ballast,
- mud,
- oil and mixtures with oil or its residues,
- the removal of stones and gravel from reefs, shoals, or cays

The Marine Divisions of the Port Authority regulates the construction of structures on or over the water, or dredging activities. It empowers the Authority to regulate the use of all

port facilities in the port including berths and stations, and accompany and removal of vessels.

6.2.9 THE HARBOUR ACT

The Marine Board makes the rules for the regulation and control of any harbour in the Island and of the channels and approaches leading thereto and of persons, boats and vessels using such harbour or approaches, and for all purposes connected with any such matters. According to the Act, the duty of the Harbour Master includes all matters relating to maintaining and protecting the harbour and shipping channels.

6.2.10 THE FACTORIES ACT

Section 25 states:

1) The provisions of sections 12, 18, 19, 20, 21 and 22 shall apply to every dock, wharf or quay (including any warehouse belonging to the owner of any such dock, wharf or quay and any line or siding, not forming part of a rail way, used in connection with and for the purposes of any such dock, wharf or quay) and every other warehouse (not forming part of a factory) in or for the purposes of which mechanical power is used.
2) The provisions of such sections as aforesaid in their application to any of the places referred to in subsection (1) shall have effect as if-
    a. *such* place were a factory; and
    b. the person having the actual use or occupation of such place or of any premises therein or forming part thereof were the occupier of a factory, and with such adaptations and modifications as may be necessary.
3) The provisions of such sections as aforesaid shall apply to the process of loading, unloading or fuelling of any ship in any dock or harbour and to all machinery or plant used in such process as if the process were carried on in a factory, and the machinery or plant were machinery or plant in a factory and the person who carries on such pro*cess* were the occupier of a factory.
4) In subsection (3) “plant” includes any gangway or ladder used by any Person employed to load or unload or fuel a ship.

Section 12 addresses the “safety, health and welfare of persons employed in any factory or in connection with machinery”

Section 18 addresses Inspection and Medical Examination.

Section 19 addresses the Penalty for obstructing the Inspector.

Section 20 addresses the Power of Inspector to conduct proceedings.

Section 21 addresses notification of accidents and industrial diseases.

Section 22 addresses the penalty for contravention of the provision of the Factories Act

6.3 DEVELOPMENT GUIDELINES

All development applications are submitted for approval to the Town Country Planning Authority, through the local Parish Council and then forwarded to the relevant authorities including NEPA and the Environmental Control Division (ECD) of the Ministry of Health. NEPA, the governing environmental agency, may require an environmental impact assessment (EIA) to be considered along with the development plan for the Authority's approval. The ECD imposes guidelines for air, water and soil standards to be maintained after construction.

IMPACT IDENTIFICATION

7 IMPACT IDENTIFICATION

This temporary barge project has the potential to create a variety of impacts as it is implemented. These potential impacts can be either positive or negative depending on the receptors involved and other parameters such as magnitude and duration. Since this report is geared primarily towards identification of environmental impacts those will be presented in greater detail later in this report, other impacts will be presented in less detail as indicated below:

7.1.1 SOCIO-ECONOMIC IMPACTS

Employment – This project will provide a limited amount of new employment opportunities during construction and operation of the temporary barge dock. Additionally, Jamalco will utilise its existing contractors and engineers who may seek to employ residents of the surrounding communities due to their proximity to the project site, and their knowledge of the area and operations there.

Foreign Exchange Earnings/Benefit to Economy – The proposed development represents a small segment of the approved and permitted plant efficiency upgrade. An investment of at least US$690,000,000 in keeping with recently permitted improvements to current operations by Jamalco in Jamaica. The Island should see increased revenues from Income and General Consumption Taxes resulting from future use of the barge dock. This is a significant positive, both direct and indirect, long-term impact on the economy of the communities and the country.

IF TEMPORARY DOCK IS NOT PERMITTED - Then Jamalco would have to rely on road transportation from an alternate port facility. This would result in wide-scale disruption of lifestyles, livelihood and conveniences for many people in many communities leading to the refinery. Road widening, removal or relocation of utilities and traffic congestion would have to take place at many points along the way. This may lead to elevated project costs, inconvenience to residents, and may lead to conflict between Jamalco, its contractors and these communities.

7.1.2 ENVIRONMENTAL IMPACTS

The following tables provide a clear indication of potential environmental impacts associated with this project, and provide information on potential receptors, duration, magnitude, and mitigation measures. Since these are potential impacts, there is no certainty that they will materialize, however, the developers will be prepared to deal with any adverse impacts should they arise during any phase of this project.

7.1.2.1 PRE-CONSTRUCTION, CONSTRUCTION & OPERATION PHASES

TABLE 7-1: POTENTIAL IMPACTS & PROPOSED MITIGATION STEPS

Potential Impact	Activity	Environmental Receptor(s)	Magnitude & Duration	Significance
Removal of Vegetation, Loss of Habitat	Pre-Construction [Site Clearance]	Land, Flora, Fauna, Endemic Species	Immediate/Medium & Long-term	Direct/Minor Negative / Reversible impact
Mitigation Measures: The removal of vegetation and ecological habitats is unavoidable and is the main environmental trade-off from project implementation. Mangrove replanting is proposed in proximity to the project area as indicated by the Mangrove Mitigation Guidelines outlined in Section 7.1.3. **Economic Value:** Included in cost of construction				
Removal of Marine Sediments and Associated Fauna & Flora	Construction [Dredging]	Benthic soils, Flora, Fauna	Immediate/Medium & Long-term	Direct/Minor Negative / Reversible impact
Mitigation Measures: The dredging activity is unavoidable and is the main trade-off to be made against the economic benefits to be derived from project implementation. Dredge material may be utilized in filling for proposed dock infrastructure. **Economic Value:** Included in cost of construction				
Sedimentation and Silting	Dredging	Entire Marine Environment	Medium & Long-term	Direct/Minor Negative / Reversible impact

Potential Impact	Activity	Environmental Receptor(s)	Magnitude & Duration	Significance
Mitigation Measures: The use of sedimentation skirts, silt screens, or similar to contain sediments in the project area. **Economic Value:** Included in cost of construction				
Fugitive Dust	Storage/Stockpiling or placement of dredge spoils (if placed on land)	Human, Flora and Fauna (Marine & Terrestrial)	Unknown	Minor Negative
Mitigation Measures: Appropriate scheduling of activities. Dust Suppression through sprinkling. Communication with Fishing Community and other resource users. Covered vehicles on public roads transporting spoil that may cause nuisance. The use of Flag men will be utilized, where necessary, to manage traffic flow in and out of the site				
Aesthetics	Construction [Changes to site appearance]	Humans	Minor & Approx. 1-3 months	Minor Negative /Indirect/Sporadic/ Unavoidable Impact
Mitigation Measures: Maintenance and Upkeep. Construction Monitoring. Communication with Community and other resource users.				
Noise/Vibration, Fugitive Dust, Air Pollution	Pre-Construction & Construction [Vehicular Traffic (Trucks/Heavy Equipment), Construction Activities]	Humans, Marine Environment	Medium & Occasional (4 months)	Minor Negative/ Indirect/Sporadic/ Avoidable Impact

Potential Impact	Activity	Environmental Receptor(s)	Magnitude & Duration	Significance
Mitigation Measures: Appropriate scheduling of activities. Construction Monitoring. Dust Suppression through sprinkling. Proper Servicing of Equipment. Quick Response. Communication with Community and other resource users. Flag men will be utilized, where necessary, to manage traffic flow in and out of the site				
Storm water, Erosion, Sedimentation, Silting, Run-Off to Sea	Pre-Construction / Construction/Operation [Site Clearance, Vegetation Removal, Excavation]	Marine/Coastal Zone	Medium & Occasional/Short Term	Minor Negative/Indirect/ Sporadic / Avoidable Impact
Mitigation Measures: Careful Phasing of Activities With Consideration of weather conditions. Construction Monitoring. Implementation of Control Devices (Drainage, Silt Fencing, etc.) **Economic Value:** Should not exceed JA$1.0 Million				
Sewage	Pre-Construction Construction & Operation [Temporary Sewage Handling during Construction]	Coastal Waters, Groundwater, Human	Minor & Short-term	Minor Negative, indirect, avoidable impact

Potential Impact	Activity	Environmental Receptor(s)	Magnitude & Duration	Significance
Mitigation Measures: The project site will utilise portable chemical toilets which will be managed and serviced by a licensed provider under contract to Jamalco. Portable toilets will be located away from the shoreline and/or secured to avoid accidental spillage during periods of heavy wind.				
Socio-Economic/Cultural/ Temporary Loss of Traditional Use and Access to Marine resources	Pre-Construction, Construction & Operation [Entire Development]	Human	Large & Short-term	Minor Negative/Direct Reversible Impact
Mitigation Measures: While the area is not a "commercial" fishing area it provides recreational fishing and nursery areas for juvenile fishes. The area will be able to recover from the impacts of dredging and recreational fishermen will be able to access the area by boat or land. Recognize utilization of area for fishing.				
Solid Waste Handling and Disposal	Pre-Construction, Construction & Operation [Vegetation Removal/Construction Activities/Packaging/Office Waste]	Coastal Waters, Land, Groundwater, Humans, Aesthetic	Minor & Occasional/Short-term	Avoidable / No Impact if properly managed

Potential Impact	Activity	Environmental Receptor(s)	Magnitude & Duration	Significance
Mitigation Measures: Minimize and reduce quantities of solid waste generated during site preparation and construction. Solid waste generated during construction will be managed according to Jamalco waste management procedures which includes: disposal at an approved landfill by approved haulers. Proper waste storage devices such as drums and skips will be located at the project site during all phases to collect refuse which will be handled by Jamalco and transported for disposal at the refinery landfill.				
Noise, Leaks, Exhaust from Construction Implements (heavy equipment	Pre & Post Construction, Operation	Soils, Groundwater, Coastal Waters, Air, Humans	Medium & Short-term	Minor negative, direct, sporadic, avoidable impact
Mitigation Measures: Equipment will be monitored and maintained on a regular basis. Any indication of leaks, discharge to the ground will be addressed immediately. Equipment maintenance on site will be minimal and monitored. Construction monitoring will include these potential impacts. Chemicals and fuels with a potential to leak, will be stored in secured, impermeable areas to reduce the likelihood of contamination (e.g. the use of existing storage areas at the Jamalco Rocky Point Port instead of on-site storage of chemicals and fuels).				
Mangrove & Coastline Aesthetics	Construction [Vegetation Removal/Construction Activities/Coastline Modification]	Soils, Groundwater, Coastal Waters and Marine Flora & Fauna therein,	Medium & Short-term	Minor negative, direct, sporadic, avoidable impact
Mitigation Measures: Silt screens will be used to contain sedimentation during dredging exercises. Sea grasses removed may be transplanted at a suitable location along the coast with permission from NEPA. Mangrove replanting and mitigation measures will be incorporated as outlined in section 7.1.3.				

7.1.3 AFFECTED COASTAL MANGROVES

- Loss of mangroves and other marine habitats
- The mangrove communities that will be disturbed are not unique to the site being very established and widely distributed along the foreshore in the general vicinity among other areas along Jamaica's coastline.

The loss of mangrove habitat proposed to facilitate this project, represents less than five (5) percent of the existing mangrove habitat. This loss of wetland is unlikely to have a significant ecological impact on the mangrove system distributed throughout the surrounding area.

While Jamalco is committed to implementing the best available environmental practices in this project, there is the potential for other indirect impacts unless appropriate mitigation measures are implemented, particularly during any near-shore works. Such mitigation measures mainly relate to controlling the potential for impacts to water quality. As with all other projects occurring at the land-water interface, the control of erosion, sedimentation and other water quality impacts is a key issue. Given the existing level of disturbance in the vicinity of the proposed project area and the fact that any activities associated with the dredging works would incorporate implementation of appropriate environmental management and impact mitigation measures, the potential impacts are unlikely to be substantial or significant with regard to the marine and aquatic communities.

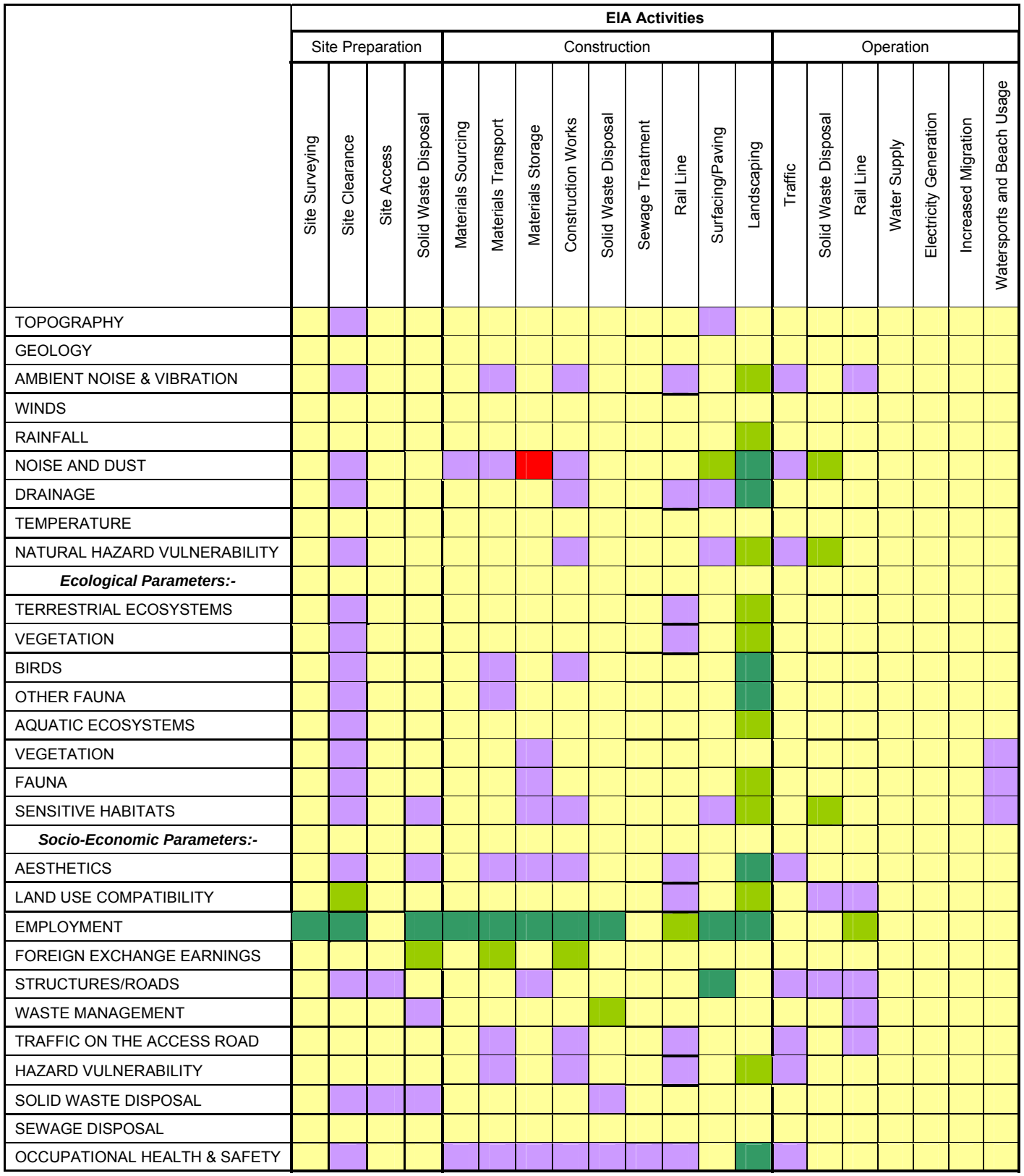
7.1.3.1 RECOMMENDED MITIGATION MEASURES

Mangroves can be replanted through seedlings. In order to overcome the deficiencies in existing replanting techniques, Encased Replanting is suggested as the mitigation method. The method focuses on isolating the seedling in a controlled environment at the actual replanting site. The encasement artificially creates an environment favourable to the seedling's initial development while protecting the plant long enough for it to become well established. The isolation physically separates the seedling from surrounding conditions that are unfavourable to early development of the tree. Seedlings of each affected type of mangrove to be replanted will be harvested as much as possible from the affected site or sourced through various ENGO's involved in replanting of mangroves across the island.

Areas in which 5 percent or more of the mangrove trees have been trimmed below 4 feet in height, destroyed, defoliated, or removed as a result of this project will be restored or mitigated. Restoration will be accomplished by replanting mangroves, in the same geographical sphere and of the same species as each mangrove destroyed, defoliated, removed, or trimmed, to achieve within 5 years a canopy area equivalent to the area affected on a mitigation ratio of 3:1.

This replanting exercise could be located in areas that have experienced significant stress during recent hurricanes to assist in the re-establishment of mangrove in those areas.

TABLE 7-2: IMPACT IDENTIFICATION MATRIX



Key

	Potential major positive impact
	Potential minor positive impact
	No potential impact
	Potential minor negative impact
	Potential major negative impact

IMPACT MITIGATION MATRIX

8 IMPACT MITIGATION

The following are mitigative actions proposed for the project. Provided below is a key explaining the type, magnitude of each impact identified.

TABLE 8-1: IMPACT MITIGATION MATRIX (PRE-CONSTRUCTION PHASE)

	Proposed Mitigative Measures																				
	Detailed Topographic Surveys	Effective Site Management	Scheduling of Construction Activities	Waste Management Plan	Placing of Solid waste Receptacles	Regular Solid waste collection	Road Paving and Surfacing	Dust Monitoring & Management Techniques	Proper Vehicle Maintenance	Installation of Sediment Traps/Silt screens	Security & Fencing	Positive Impact No Mitigation	Community Relations	Flora & Fauna Relocation/Landscaping	Portable Chemical Toilets	Disposal in approved landfill	Regulate & supervise Train Operation	Noise Monitoring & Management	Regular Servicing of Chemical Toilets	Limit Amount of Area Disturbed	Transport by Rail
Clearing of Site Vegetation	■	■	■	■	■	■		■		■				■		■				■	
Levelling of Site	■	■	■					■		■											
Transportation of Construction Material		■	■	■			■	■	■												■
Increase in Noise & Vibration		■	■						■				■				■	■			
Increase in Dust		■	■				■	■					■								
Disturbance of flora and fauna		■	■											■						■	
Aesthetics		■	■	■	■			■		■	■		■								
Increased Traffic		■	■														■				■
Increased Employment												■	■				■				■
Road Wear		■	■				■		■				■								■
Increased Sedimentation of Coastal Waters		■								■											
Change in the Natural Drainage Patterns	■	■															■			■	
Solid Waste Generation & Disposal		■		■	■	■										■					
Disturbance of Marine Communities		■								■								■			
Increased Earning Potential for Community												■	■								
Traffic Inconveniences		■	■				■										■				■
Sewage Management		■	■				■								■				■		
Transportation of Large Equipment		■	■				■										■				■
Transportation of Solid Waste to Landfill		■	■				■									■					

TABLE 8-2: IMPACT MITIGATION MATRIX (CONSTRUCTION PHASE)

	Proposed Mitigative Measures																					
	Detailed Topographic Surveys	Phasing of Building Plans	Scheduling of Construction Activities	Waste Management Plan	Placing of Solid waste Receptacles	Regular Solid waste collection	Road Paving and Surfacing	Dust Management Techniques	Proper Vehicle Maintenance	Landscaping Measures	Effective Site Management	Security & Fencing	Installation of Sediment Traps	Scheduling of Heavy Vehicles	Positive Impact No Mitigation	Continue with Community Relations	Portable Chemical Toilets	Disposal in approved landfill	Regulate & supervise Train Operation	Noise Monitoring & Management	Regular Servicing of Chemical Toilets	Limit Amount of area Disturbed	Transport by Rail
Impacts - Construction Phase																							
Increased Employment																							
Levelling of Site																							
Transportation of Construction Material																							
Increase in Noise																							
Increase in Dust																							
Occupational Health & Safety Concerns																							
Aesthetics																							
Increased Earning Potential for Community																							
Increased Traffic																							
Road Wear																							
Increased Sedimentation of Coastal Waters																							
Change in the Natural Drainage Patterns																							
Solid Waste Generation																							
Sewage Disposal																							
Accommodations for workers																							
Disturbance of Marine Communities																							

Key

	Minor mitigable impact
	Major mitigable impact
	No impact

TABLE 8-3: IMPACT MITIGATION MATRIX (OPERATIONAL PHASE)

	Proposed Mitigative Measures									
	Community Wide Plan	Operation & Maintenance Plan	Regulatory Monitoring	Waste Management Plan	Placing of Solid waste Receptacles	Regular Solid waste collection	Security & Fencing	Landscaping Measures	Positive Impact No Mitigation	Transport by Rail
Impacts - Occupational Phase										
Sewage Treatment Management										
Drainage Patterns										
Solid Waste Management										
Water Conservation										
Energy Conservation										
Aesthetics										
Regulatory Compliance										
Fugitive Dust										
Increased Earning Potential for Community										
Transport of Equipment to Refinery										

Key

	Minor mitigable impact
	Major mitigable impact
	No impact

ENVIRONMENTAL MONITORING

9 ENVIRONMENTAL MONITORING

In keeping with its Environmental Health and Safety policies as well as the legislation and regulations of the Government of Jamaica, Jamalco has an extensive Environmental Monitoring Programme which is carried out on all aspects of its operations.

In respect of section 17 of the NRCA Act of 1991 the company is required to submit the results of its Monitoring Programme to NEPA on a regularly scheduled basis.

Among the parameters reported to NEPA on a regular basis by Jamalco are:

- Raw materials used
- Water quality
- Effluent quality
- Hazardous materials used
- Water consumption
- Fuel specifications
- Materials and chemical consumption. This category includes:
    - Solvents
    - Flocculants
    - Oils and lubricants
    - Acids
    - Refrigerants

Jamalco also provides monthly monitoring reporting to the Jamaica Bauxite Institute (JBI). In addition to the above named, ongoing activities, Jamalco will implement a monitoring programme during the duration of this project.

The Monitoring Plan for this project will be finalised by Jamalco to include features of any permit or licence they receive for the project. Therefore, all relevant conditions and requirements will be addressed in the Monitoring Plan.

The Monitoring Plan to be devised for the project will be implemented during the pre-construction and construction phases of the project. Monitoring involves the observation, review and assessment of onsite activities to ensure adherence to regulatory standards and the recommendations made to reduce negative impacts. The Plan must be

comprehensive and address relevant issues, with a reporting component that will be made available to the regulatory agencies based on a mutually agreed frequency. It is recommended that a minimum monthly monitoring report be submitted to NEPA.

The monitoring report will include at a minimum:

- An overview of the project
- Status of the project
- Parameters being monitored
- Raw data collected
- Tables/graphs (where appropriate)
- Discussion of results with respect to the development in progress, highlighting parameters which exceed standards
- Recommendations
- Appendices with photos/data, etc.

At a minimum, the following activities will be monitored in the various phases:

9.1 PRE-CONSTRUCTION PHASE MONITORING

- Dredging of the Dock Area
    - Before dredging exercises begin, the area to be dredged will be properly identified and demarcated either through buoy placement or other means.

    This will be overseen by the on-site supervisor and NEPA staff will be invited to participate in the demarcation and observation of dredging activities.

- Dust Management
    - Portable monitors will be located at the site to collect Total Suspended Particulates (TSP) data through the construction phase of the project.
    - If fugitive dust becomes a problem, measures will be implemented to effectively reduce or remove the source of dust. This may include:
        - Removal of dried dredged spoils for final disposal in an approved area or use as backfill material
        - Covering of spoil piles

    - Irrigation methods such as sprinkling with water to reduce dust on roadways and stockpiles

- Surface Water Run-off Management
    - During site clearance activities, regular surveys will be undertaken to determine the extent of new cleared land and the potential for run-off into marine waters. Effective drainage features will be put in place, their performance observed and modifications made as necessary to ensure protection of the marine environment. If needed silt screens, silt curtains or sediment traps will be put in place. ONLY A SMALL AREA OF PREVIOUSLY undisturbed area is slated for clearance.

Inspection can be done by the on-site supervisor and a log kept

- Disposal/Re-Use of Dredge material
    - Jamalco proposes to use dredged spoils for backfilling and grading on the project site. This would limit the amounts of other materials that would have to be brought in to the site for backfill.
    - If excess dredge spoils is generated, the materials will be disposed of in an approved location for which permission is being sought from NEPA.

This may be done by the on-site supervisor

- Solid Waste Management
    - Ensure that proper solid waste collection devices (skips/drums) are located throughout the project area.
    - Ensure that all solid waste is properly collected and stored for removal by Jamalco to its approved landfill at the refinery.

This may be done by the on-site supervisor and a log kept

9.2 CONSTRUCTION PHASE MONITORING

- Dredging of the Dock Area
    - All requisite licences and permits will be in hand and where required posted at the site.

- Dredging must be carried out by professionals under favourable weather conditions.
- Dredge spoil must be properly stored and maintained at the site or placed in the designated backfill area.
- Daily visual water quality monitoring will be carried out to ensure that construction activities are not impacting the marine environment in excess of what is anticipated and approved. If it is observed that large sediments/silt plumes are being dispersed, then corrective actions will be taken. If necessary, work will be stopped until condition improves or other contributing factors are rectified.

This may be done by the on-site supervisor

- General Construction Activities and Stockpiling of material
  - Daily inspection of the dock construction should be carried out to ensure they are following the plan as designed and approved, and no silting of marine waters and dust pollution occur as a result of the construction activities

This may be done by the on-site supervisor and a log kept

- Surface Water Run-off Management
  - During site clearance activities, a daily survey should be undertaken to determine the extent of new cleared land and the potential for run-off into marine waters. Effective drainage features will be put in place, their performance observed and modifications made as necessary to ensure protection of the marine environment. If needed silt screens, silt curtains or sediment traps will be put in place.

Inspection can be done by the on-site supervisor and a daily log kept

- Solid Waste Management
  - Ensure that proper solid waste collection devices (skips/drums) are located throughout the project area.

- Ensure that all solid waste is properly collected and stored for removal by Jamalco to its approved landfill at the refinery.

This may be done by the on-site supervisor and a log kept

- Wetland Modification Adherence (Mangrove and Seagrass)
  - All required Wetland Modification permits/licences will be obtained prior to the start of work activities.
  - Before wetland modification exercises begin, the area must be properly identified to ensure no more than is needed is removed. Trees to be removed may be tagged to assist in identification.

This may be overseen by the on-site supervisor and a NEPA staff

9.3 OPERATION PHASE MONITORING

- Solid Waste Management
  - Ensure that proper solid waste collection devices (skips/drums) are located throughout the project area.
  - Ensure that all solid waste is properly collected and stored for removal by Jamalco to its approved landfill at the refinery.

This may be done by the on-site supervisor and a log kept

- Surface Water Run-Off Management
  - Periodic surveys should be undertaken to determine if constructed drainage features are operating properly and that no uncontrolled sources of sediment or silt on the site are contributing to increase sediment loading of the waters in the area.

Inspection can be done by the on-site supervisor

ENVIRONMENTAL MONITORING

10 ENVIRONMENTAL MANAGEMENT

Jamalco is an ISO 14001 and ISO 9000 certified facility. Jamalco's ISO 14001 certification was issued by Det Norske Veritas (DNV) in November of 2002. The associated Environmental Management System (EMS) is accredited by ANSI RAB.

The EMS covers Jamalco's operations and includes activities associated with the railway transportation system, the bauxite alumina refinery, plant waste storage and disposal sites and the port at Rocky Point.

In keeping with the mandates of its ISO 9000 quality certification, Jamalco abides by their Quality Policy, which states:

Jamalco is committed to being "The Alumina Supplier of Choice"

- "Jamalco will relentlessly pursue continual improvement in everything we do to:
- Consistently provide product that meets customer and other applicable requirements for quality
- Enhance customer satisfaction by consistently meeting and exceeding their expectations
- Be cost effective and remain competitive in the global market
- Operate in a safe and environmentally responsible manner"
- Excellence Through Quality

Jamalco has a highly qualified technical, administrative and support staff within its Environmental Management Department, many trained to the tertiary level. All employees within the Department report to the Manager, Environmental, Health & Safety, a senior manager in the company who in turn reports directly to the Managing Director.

All aspects of Jamalco's operations have an environmental management, health and safety component. Environmental Standard Operating Procedures, guidelines and

instruction have been developed by Jamalco to govern operations in all areas. As a result, all technical and support staff have a responsibility to insure that they operate in a safe and responsible manner regardless of the task being undertaken.

Many aspects of environmental management at the facilities are monitored through the use of checklists, periodic reporting and internal audits. These provide timely indications as to the effectiveness of the procedures and provide indications as to the need for changes where applicable. The monitoring and checks also inform process operations and controls.

10.1 TRAINING

Jamalco has a commitment to the improvement and advancement of all its employees. A major component of this commitment is the provision and facilitation of training for employees at all levels.

Specific to environmental management, Jamalco provides training in the following areas, which are designed to keep relevant employees and contractors informed and ensures competence in performing their duties. The training program achieves the following:

- Conformance with Jamalco's EH&S policy
- Identifies significant actual and potential impacts of their work
- Defines associated benefits of improved personal performance
- Identifies the roles and responsibilities in achieving conformance with the EMS
- Relays proper environmental operating procedures for managing environmental related aspects of their duties
- Reinforces Jamalco's policy that only properly trained and experienced individuals are allowed to work unsupervised

.

RISK AND OCCUPATIONAL HEALTH AND SAFETY

11 RISK AND OCCUPATIONAL HEALTH AND SAFETY

11.1 RISK ASSESSMENT AND HUMAN HEALTH RISK

Four main categories of risk have been identified, which must be avoided or minimized in the temporary barge dock for all aspects of the project. These are:

1. Natural Hazards
2. Manmade Hazards
3. Accidents
4. Structural Failure

The associated risks are described below and actions suggested for avoidance, minimization, prevention and solution are illustrated in the table below:

TABLE 11-1: RISKS AND THEIR PREVENTATIVE ACTIONS

Category	Risk	Source	Prevention	Solution
Natural Hazards	Hurricane	Nature	None	Implement 72 hour shutdown procedure; coordinate with ODPEM
	Earthquake	Nature	None	Plant and facilities designed to withstand earthquakes greater than 7.0 on the Richter Scale
	Flood	Rainfall	Proper design of structures and drainage features	Proper design, construction and maintenance
	Lightning	Nature	None	Lightning arrestors
Manmade Hazards	Fire	Various (electrical, mechanical, accidental)	Proper Training, maintenance and monitoring	Employ state of the art fire fighting systems to control and extinguish
	Explosion	Various (explosive environment, human error, and equipment malfunction)	Preventative maintenance, instrumentation and fail-safe systems	Continual training, audits, testing and monitoring
	Equipment Failure	Various	Proper maintenance, instrumentation and fail-safe systems	Continual training, inspection, audits, testing and monitoring
Accidents	Electrocution	Electrical contact, Human error	Training, education	Lock-out, tag-out procedures
	Contravening Safety Procedures	Ignorance, negligence	Training, supervision and audits	Educative discipline

Category	Risk	Source	Prevention	Solution
	Falls	Unsafe Structures, negligence	Training, education, with updates	Provision and use of proper equipment
	Suffocation	Confined/poorly ventilated Space, negligence	Training, following standard procedures	Adequate ventilation, buddy system, signage
	Spills	Vessels, pipeline, negligence	Training, Implementation of Jamalco's spill management procedures	Implementation of Jamalco's spill prevention and management procedures

APPENDICES

APPENDIX I: REFERENCES

APPENDIX I: REFERENCES

- Adams, C.D., 1972. *Flowering Plants of Jamaica*. University of the West Indies.
- Conrad Douglas & Associates Ltd, 2004. *Environmental impact Assessment for 2.8 Million tonne Per Year Efficiency Upgrade at Jamalco*
- Downer and Sutton. 1990. Birds of Jamaica. A photographic Field guide. Cambridge Press.
- Golder Associates Ltd, 2006*. Report on Consolidated Geotechnical Investigation, and Geophysical Survey Jamalco*, *Rocky Point, Jamaica, Barge Unloading Facility***.**
- Raffaele J*. etal*. 1998. A Guide to the Birds of the West Indies. Princeton University Press.
- Wunderle .Jr, J.M.1994. Census methods for Caribbean land birds. Gen. Tech. rep. S0-98. New Orleans, La: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station

APPENDIX II: APPROVED TERMS OF REFERENCE

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NATIONAL ENVIRONMENT & PLANNING AGENCY

10 & 11 Caledonia Avenue, Kingston 5, Jamaica W.I.; Tel: (876) 754-7540/3 Fax: (876) 754-7595-6 Hotline: 1-888-991-5005
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RECEIVED AUG 14 2006

Ref. Nos. 2005-13017-EP00216
2006-13017-EP00017
2005-13017-BL00055

August 11, 2006

Mr. George Morgan
Environmental Health & Safety Manager
JAMALCO
Halse Hall
May Pen
Clarendon.

Dear Mr. Morgan

Re: Applications for Permits under Section 9 of the Natural Resources Conservation Authority (NRCA) Act, 1991, in respect of the Port and Harbour Development and Wetland Modification associated with the Port and Harbour Development, at Rocky Point, Clarendon

The National Environment and Planning Agency offers no objection to the revised Terms of Reference submitted with cover letter dated July 14, 2006 for the Environmental Impact Assessment (EIA) in connection with the captioned application.

On this basis, you should proceed with the execution of the EIA. Please note that on completion, twelve (12) copies and an electronic copy of the EIA report are to be presented to this office.

The Agency wishes to apologize for the delay in providing you with a response.

Yours sincerely

Trevor Ramikie
for Chief Executive Officer/Government Town Planner

cc. Ms. Deonne Caines –Conrad Douglas & Associates
Ms. Frances Blair –Manager, Applications Secretariat Branch, NEPA

Any reply or subsequent reference to this communication should be addressed to the Chief Executive Officer, to the attention of the officer dealing with the matter, and the reference quoted where applicable.

Managing and protecting Jamaica's land, wood and water
A Government of Jamaica Agency

Introduction

Conrad Douglas and Associates (CD&A) will work closely with our clients, Jamalco and their partners, to complete a high quality EIA report that addresses all environmental and engineering concerns that may be associated with the construction of a temporary barge unloading facility at the existing Jamalco Rocky Point Port.

The Jamalco operations comprise the Clarendon Alumina Works refinery located in Halse Hall, Rocky Point Port Facilities, the Lands and Mining operations in Woodside and South Manchester respectively, and a trafficking office in Kingston.

Clarendon Alumina Works is currently a two-digester refinery with a production capacity of 1.25 million tonnes of alumina annually. Bauxite is mined in Harmons Valley, South Manchester and transported to the refinery via rail. Shipping facilities are located at Rocky Point and commodity movement between the refinery and the port is also via rail, which is operated by Jamalco. The operation currently employs approximately 600 persons and is managed by Alcoa Minerals of Jamaica for the joint venture.

Between the last quarter of 2004 and 2007 the facility will be upgraded to produce 2.8 million tonnes of alumina annually. The mining, refining and port operations will be modified/expanded in order to facilitate the upgrade.

The modification to the Rocky Point Port Facilities will involve:

- the addition of a new rail spur from the existing Jamalco rail line,
- a temporary barge unloading dock with a 600mt ringer crane,
- dredging of port,
- modifications to mangrove plant community, and
- other additional changes (see figure below)

In keeping with the NRCA Act of 1991, Jamalco is required to conduct an EIA on the proposed operations. This includes port modifications such as linkages to and from the existing rail corridor, dredging of dock area, and wetland modification (mangrove). The EIA will be submitted to the National Environment and Planning Agency (NEPA), for review and permitting in order to facilitate implementation of the plans.

A detailed description of all elements of the project during the pre-construction, construction and operational phases will be prepared. The elements analyzed will include the infrastructure of the project including: drainage features; roads; waste generation, and management; and utility requirements.

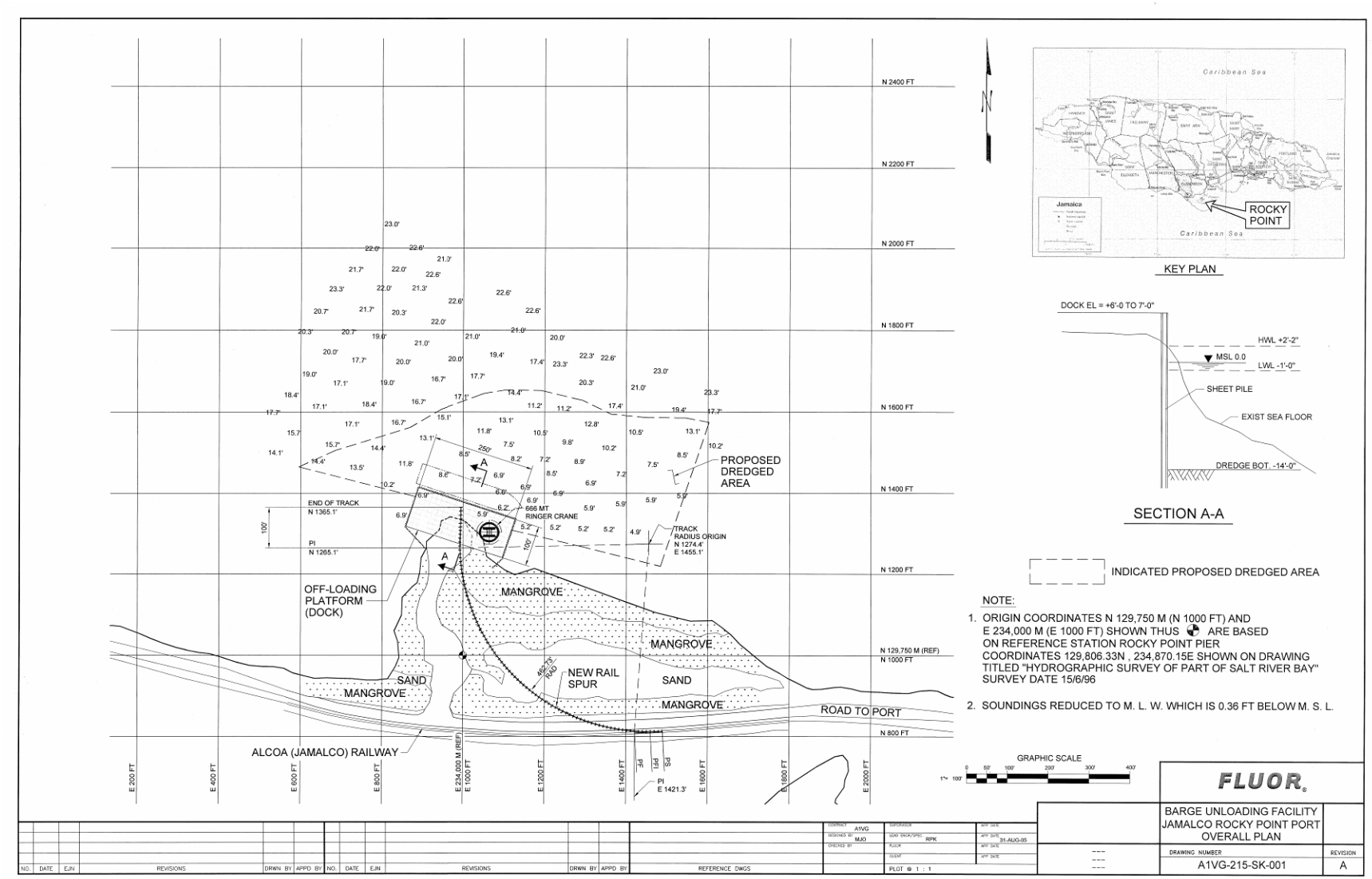

FIGURE 11-1: BARGE UNLOADING FACILITY, JAMALCO ROCKY POINT PORT PLAN

Terms of Reference

The Environmental Impact Assessment will:

1) Provide a complete description of the existing site proposed for the barge unloading facility. Detail the elements of the project, highlighting areas to be reserved for construction and the areas which are to be preserved in their existing state.
2) Identify the environmental issues of concern through the presentation of baseline data which will include social and cultural considerations. Assess public perception of the proposed development.
3) Outline the Legislations and Regulations relevant to the project.
4) Predict the environment and health impacts of the project on the environment, including direct, indirect and cumulative impacts, and indicate their relative importance to the design and function of the facilities.
5) Identify mitigation actions to be taken to minimise adverse impacts and quantify associated costs.
6) Design a Monitoring Plan which will 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, the following tasks will be undertaken:

Task 1: Description of the Project

CD&A will provide a comprehensive description of the project explaining details of the works and infrastructure proposed for the barge facility, noting areas reserved for construction or modification such as wetland, and areas to be dredged. Areas to be reserved for construction, areas to be preserved in their existing state as well as activities and features which will introduce risks or generate impact (negative or positive) on the environment will be noted. This will 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, as well as pre-construction, construction, and post construction plans.

Task 2: Description of the Environment

For this EIA Report, CD&A will generate baseline data which will be used to describe the study area in terms of:

i) physical environment

ii) biological environment

iii) socio-economic and cultural constraints.

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

Baseline data will include:

(A) Physical

i) A detailed description of the existing **geology** and **hydrology.** Special emphasis will be placed on storm water run-off, drainage patterns, impact on groundwater and coastal waters. Any slope stability issues that could arise will be thoroughly explored.

ii) **Water quality** of any existing wells, rivers, ponds, streams or coastal waters in the vicinity of the project. A complete water chemistry report will be detailed; Quality Indicators will include but not necessarily be limited to oil and grease, nitrates, phosphates, total and faecal coliform, and total suspended solids.

iii) Climatic conditions and air quality (TSP) in the area of influence including wind speed and direction, precipitation, relative humidity and ambient temperatures,

iv) Noise levels of the undeveloped site and the ambient noise in the radius of influence.

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

vi) Availability of solid waste management facilities and procedures.

(B) Biological

CD&A will present a detailed description of the flora and fauna of the area, with special emphasis on rare, endemic, protected or endangered species. Migratory species will also be considered. Generally, species dependence, niche

specificity, community structure and diversity will be considered. This will include an extensive assessment of the marine environment, including but not limited to:

- landscape impacts of excavation and construction
- Loss of natural features, habitats, and species by construction and building
- Impact on coastal, surface and ground waters
- Impact of dredging and spoil disposal
- Risk assessment
- Loss and replanting of mangroves
- Oil/fuel spills and their clean-up
- Solid waste management
- Hazard vulnerability

(C) Socio-economic & cultural

Population demographics, land use, planned developments, socio-economic and cultural-community consultation/canvassing, and issues related to community structure, Public Health and Safety, and the projected impact of the project from a socio-cultural perspective will be detailed.

Task 3: Legislative and Regulatory Considerations

The EIA will outline the pertinent regulations and standards governing environmental quality, safety and health, protection of sensitive areas, protection of endangered species, siting and land use control at the national and local levels. The examination of the legislation will include at a minimum, legislation such as the NRCA Act, policies and regulations from the Water Resources Authority, the Watershed Protection Act, The Clean Air Act, Public Health Act, Beach Control Act, Building Codes and Standards, Development Orders and Plans and any appropriate international convention/protocol/treaty where applicable.

Additionally, consideration will be made for the Protected Area status and RAMSAR significance of the Portland Bight Protected Area. The site was given RAMSAR designation on 2nd February, 2006, as Portland Bight Wetland and Cays (RAMSAR Site No. 1597).

Task 4: Identification of Potential Impacts

CD&A will identify the major environmental and public health issues of concern and indicate their relative importance to the design of the treatment facility. Identify potential impacts as they relate to (but are not restricted by) the following:

- change in drainage pattern
- flooding potential
- excavation and construction
- loss of natural features, habitats and species by construction and operation
- pollution of surface and ground water
- air pollution
- capacity and design parameters of proposed sewage handling/treatment facility
- socio-economic and cultural impacts
- risk assessment
- noise
- leaching of substances or chemicals into ground water supply

The EIA Report will distinguish between significant positive and negative impacts, direct and indirect, long term and immediate impacts and will identify avoidable as well as irreversible impacts. We will characterize the extent and quality of the available data, explaining significant information deficiencies and any uncertainties associated with the predictions of impacts where necessary. A major environmental impact will be determined only after examining the impact (positive and negative) on the environment and by the number and magnitude of mitigation strategies which will be required to reduce the risk(s) introduced to the environment. Project activities and impacts will be presented in matrix form with separate matrices for pre and post mitigation scenarios.

Task 5: Mitigation

We will prepare guidelines for avoiding, as far as possible, any adverse impacts due to the proposed project and utilising of existing environmental attributes for optimum development. For those impacts which are unavoidable, mitigative measures will be

proposed. In the report, we will quantify and assign financial and economic values to mitigating methods.

Task 6: Monitoring

CD&A will design a plan to monitor implementation of mitigatory or compensatory measures and project impacts before, during and post construction. An Environmental Management Plan for the long term operations of the site will also be prepared.

An outline of the 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 will 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 will incorporate a control site where no impact from the development is expected.
- Frequency of reporting to NEPA

The Monitoring report will also include, at a minimum:

- Raw data collected.
- Tables and graphs, where appropriate
- Discussion of results with respect to the progress of work, highlighting any parameter(s) which exceed the expected standard(s).
- Recommendations
- Appendices of data and photographs.

Task 7: Project Alternatives

The EIA process will include the examination of alternatives to the project including the no-action alternative. This examination of project alternatives will incorporate the history of the overall area in which the site is located and previous and potential future uses of the site itself.

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

APPENDIX III: NOISE RECORDING DATA

APPENDIX III: NOISE RECORDING DATA

Period length	(0:1:0.0)	H:M:S.mS
Total number of periods	1451	
Number of periods before trigger	0	
Number of periods after trigger	1451	
Trig time	(2006/8/2 15:32:24.0)	Y-Mo-D H:M:S.mS
Measurement effective duration	(24:0:0.0)	H:M:S.mS

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(2006-08-02 15:36:24.000)	70	57.7
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(2006-08-02 15:38:24.000)	70	55.2
(2006-08-02 15:39:24.000)	70	54.2
(2006-08-02 15:40:24.000)	70	65.2
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(2006-08-02 15:42:24.000)	70	68.2
(2006-08-02 15:43:24.000)	70	65.5
(2006-08-02 15:44:24.000)	70	60.3
(2006-08-02 15:45:24.000)	70	60.1
(2006-08-02 15:46:24.000)	70	60.8
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(2006-08-02 15:51:24.000)	70	57.3
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(2006-08-02 16:06:24.000)	70	57.5
(2006-08-02 16:07:24.000)	70	58.1
(2006-08-02 16:08:24.000)	70	57
(2006-08-02 16:09:24.000)	70	59.1

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(2006-08-02 16:18:24.000)	70	59.7
(2006-08-02 16:19:24.000)	70	57.9
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(2006-08-02 16:34:24.000)	70	58.2
(2006-08-02 16:35:24.000)	70	58.7
(2006-08-02 16:36:24.000)	70	59.5
(2006-08-02 16:37:24.000)	70	58.8
(2006-08-02 16:38:24.000)	70	57.1
(2006-08-02 16:39:24.000)	70	59.1
(2006-08-02 16:40:24.000)	70	60.1
(2006-08-02 16:41:24.000)	70	60.1
(2006-08-02 16:42:24.000)	70	60.5
(2006-08-02 16:43:24.000)	70	59.3
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(2006-08-02 16:45:24.000)	70	59.6
(2006-08-02 16:46:24.000)	70	58
(2006-08-02 16:47:24.000)	70	59.9

Time:	Standard	LAeq
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(2006-08-02 17:12:24.000)	70	57.4
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(2006-08-02 17:27:24.000)	70	58.4
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(2006-08-02 17:32:24.000)	70	59.1
(2006-08-02 17:33:24.000)	70	59.3
(2006-08-02 17:34:24.000)	70	57.8

Time:	Standard	LAeq
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(2006-08-02 18:20:24.000)	70	56.1
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Time:	Standard	LAeq
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(2006-08-02 18:58:24.000)	70	59.9
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(2006-08-02 19:26:24.000)	70	72.6
(2006-08-02 19:27:24.000)	70	59.3
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(2006-08-02 20:08:24.000)	70	60.4
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(2006-08-02 20:24:24.000)	70	58.8
(2006-08-02 20:25:24.000)	70	57.4
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(2006-08-02 20:33:24.000)	70	59.2
(2006-08-02 20:34:24.000)	70	57.9
(2006-08-02 20:35:24.000)	70	58.8
(2006-08-02 20:36:24.000)	70	59.2
(2006-08-02 20:37:24.000)	70	56.8
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(2006-08-02 20:41:24.000)	70	58.2
(2006-08-02 20:42:24.000)	70	59

Time:	Standard	LAeq
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(2006-08-02 20:52:24.000)	70	60.8
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(2006-08-02 20:54:24.000)	70	58.1
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(2006-08-02 20:56:24.000)	70	56.7
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(2006-08-02 21:02:24.000)	70	58.4
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(2006-08-02 21:04:24.000)	70	55
(2006-08-02 21:05:24.000)	70	54.1
(2006-08-02 21:06:24.000)	70	56.5
(2006-08-02 21:07:24.000)	70	57.6
(2006-08-02 21:08:24.000)	70	55.6
(2006-08-02 21:09:24.000)	70	53.5
(2006-08-02 21:10:24.000)	70	52.1
(2006-08-02 21:11:24.000)	70	55.1
(2006-08-02 21:12:24.000)	70	54.5
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(2006-08-02 21:14:24.000)	70	57.3
(2006-08-02 21:15:24.000)	70	53.7
(2006-08-02 21:16:24.000)	70	55
(2006-08-02 21:17:24.000)	70	55.2
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(2006-08-02 21:19:24.000)	70	57.7
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(2006-08-02 21:27:24.000)	70	53.9
(2006-08-02 21:28:24.000)	70	54.3
(2006-08-02 21:29:24.000)	70	52.3

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APPENDIX IV: SURVEY INSTRUMENT

APPENDIX IV: SURVEY INSTRUMENT

SURVEY INSTRUMENT
Conrad Douglas & Associates Limited

ENVIRONMENTAL IMPACT ASSESSMENT
For
JAMALCO's Proposed Temporary Barge Unloading Facility at its Rocky Point Port, Clarendon

Social Impact Assessment

Community Name _____ Community Code | | | | | |

SECTION 1
PERSONAL CHARACTERISTICS

1) Gender
   1. Male
   2. Female

2) Age Range
   1. Under 20
   2. 20 – 39
   3. 40 – 49
   4. 50 – 59
   5. 60 – over
   6. Not Stated/No Response

3) How many years have you been living in the community?
   1. 0 – 5 Years
   2. 6 – 10 Years
   3. 11 – 20 Years
   4. more than 20 Years
   5. Not Stated/No Response

SECTION 2
OPINIONS ON THE COMMUNITY

4) What do you like most about the community? **(*ASK & WAIT FOR RESPONSE)***
   1. Friendly people
   2. Clean environment:
   3. Availability of farmland
   4. Quiet
   5. No crime & violence
   6. Other, (specify)_____
   7. Not Stated/No Response

5. What don't you like about the community? ***ASK & WAIT FOR RESPONSE***
   1. Poor roads
   2. Lack of Utilities
   3. Crime & violence
   4. Unemployment
   5. Dirty environment
   6. Other, (specify)_____
   7. Not Stated/No Response

SECTION 3
AWARENESS OF EXISTING OPERATIONS

6. Are you aware that JAMALCO has been given a permit to expand their bauxite refinery operations?
   1. Yes
   2. No
   3. Not Stated/No Response

7. Are you experiencing any negative impacts from the bauxite operation at the JAMALCO Rocky Point Port facility?
   1. Yes (Go To Question 8 below)
   2. No
   3. Not Stated/No Response

8. If **YES ASK**: What is this negative impact?
   1. Odour
   2. Oil Pollution
   3. Dust, soot or gaseous emission
   4. Noise
   5. Damage to fishing grounds
   6. Not Stated/No Response
   7. Other, (specify)_____

9. Would you say that the existing port facility has had a positive impact on this community?
    1. Yes
    2. No

10. What positive impacts do you think the port facility has had on the community?
    1. Improved community relations
    2. Job opportunities
    3. Educational and social benefits
    4. Amenities – roads, lights, water supply
    5. Environmental conditions
    6. None of the above
    7. Other (specify)_____
    8. Not Stated/No Response

SECTION 4

KNOWLEDGE AND VIEWS ON UPGRADE PLANS

11. Are you aware that Jamalco has proposed construction of a temporary barge unloading facility in order to facilitate their expansion?
    i. Yes
    ii. No

12. What effect do you think the proposed construction of JAMALCO's temporary barge unloading facility in or near your area will have on the following: (**Answer in terms of positive, negative, no change, don't know. ASK AND WAIT)**

    i) Income/ Economic value of the community
        1. Positive
        2. Negative
        3. No Change
        4. Don't Know
        5. Not Stated/No Response

    ii) Job Opportunities
        1. Positive
        2. Negative
        3. No Change
        4. Don't Know
        5. Not Stated/No Response

    iii) Pollution
        1. Positive
        2. Negative
        3. No Change
        4. Don't Know
        5. Not Stated/No Response

13. Do you think the proposed construction will affect you personally?

    1. Yes
    2. No
    3. Don't Know/Not Sure
    4. Not Stated/No Response

14. How?

15. What do you think are the main impacts that the upgrade at the Port and its environs would have on the local coastal environment?

    1. More jobs
    2. Loss of income
    3. More dust circulating in the area
    4. Less air pollution and noise
    5. More air pollution and noise
    6. Contamination of fishing grounds
    7. Better community relations
    8. Improved environmental protection and other amenities
    9. More crime in the community
    10. Increased population
    11. Don't know/Not Sure
    12. Other (specify)
    13. Not Stated/No Response

16. Why do you think so?

    1. The present activities at the Port have caused this already. So it can only get worse.
    2. The upgrade will add new equipment that will be cleaner to operate
    3. More jobs will be available
    4. This is something common to all bauxite operations
    5. The upgrade will cause more people to pass through the community. So it gives more opportunity for crime
    6. This is something that someone told me
    7. Don't Know/Not Sure
    8. Other (specify)
    9. Not Stated/No Response

SECTION 5

17. Have you or any member of your household ever worked for a bauxite company or in the bauxite industry?
    1. Yes
    2. No
    3. Don't Know/Unsure
    4. Not Stated/No Response

18. Are you aware of any programs or activities initiated by bauxite companies in your community?
    1. Yes
    2. No
    3. Don't Know/Unsure
    4. Not Stated/No Response

19. Do you rely on the area (mangroves and sea) for your livelihood?
    1. Yes (Go To Next Question)
    2. No (Skip To Question 21)

20. How do you rely on the area (mangroves and sea) for your livelihood?
    1. Commercial fishing
    2. Sport fishing
    3. Firewood
    4. Diving / snorkeling
    5. Pleasure boating
    6. Eco-Tours (mangrove and coral reefs)
    7. Other _____

21. Do you use the sea for recreational purposes?
    3. Yes
    4. No

22. How many days per week do you use the sea?

23. When do you use the sea?
    Weekends only (Fri, Sat, Sun)
    Sun-Sat (all week)
    Mon – Fri

24. What are the areas you utilize? (Name them).

THANK YOU

Name of interviewer:
Signature of interviewer:
Date of interview:

APPENDIX V: PROJECT TEAM MEMBERS

APPENDIX V: PROJECT TEAM MEMBERS

Team members participating on the project, include:

1. Dr. Conrad Douglas
2. Paul Thompson
3. Orville Grey
4. Vance Johnson
5. Deonne Caines
6. Noel Watson
7. Burklyn Rhoden
8. Richard Farrier
9. Alva Hilton

APPENDIX VI: MARINE SURVEY VIDEO CAPTURES

APPENDIX VI: MARINE SURVEY VIDEO CAPTURES

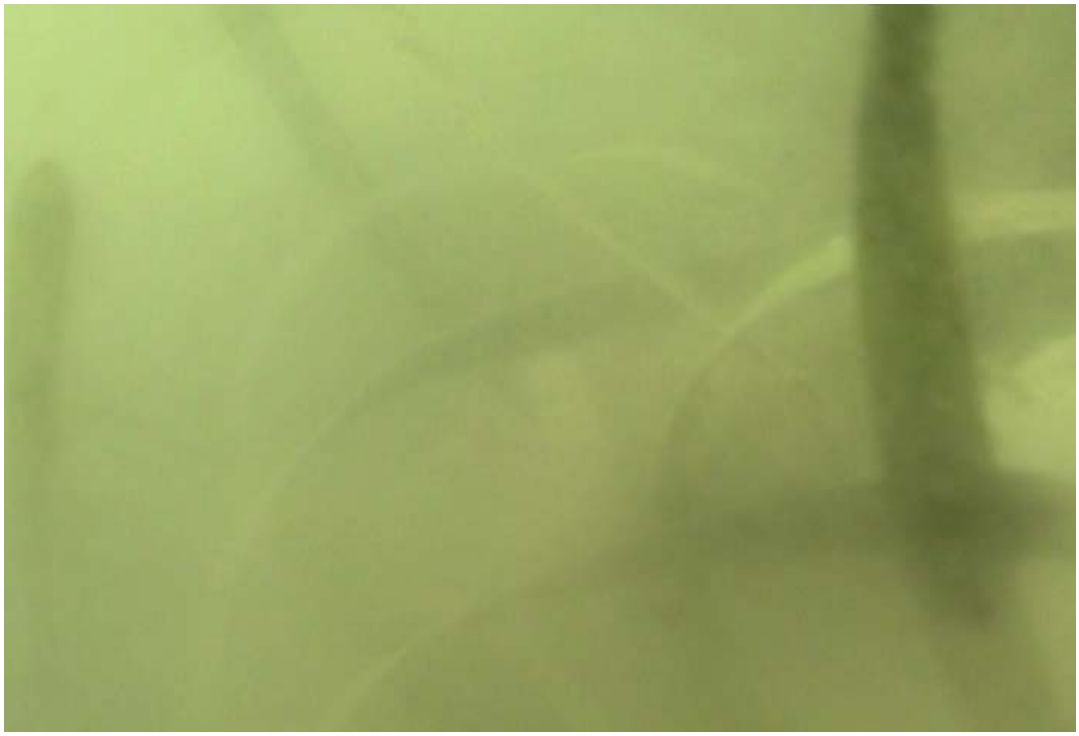

PLATE 11-1: *THALASSIA TESTUDINUM* AT 5M

PLATE 11-2: *CAULERPA SERTULARIOIDES & CAULERPA RACEMOSA*, [NOTE CEBU CLOSE UP]

PLATE 11-3: CORAL ON BOULDER AT 4M

PLATE 11-4: ENCRUSTED DEBRIS WITH WHAT APPEARS TO BE SPONGES

PLATE 11-5: MARINE FLORA & FAUNA AT 3.5M (NOTE: SILT AND SEDIMENTS ON THE SURFACE)

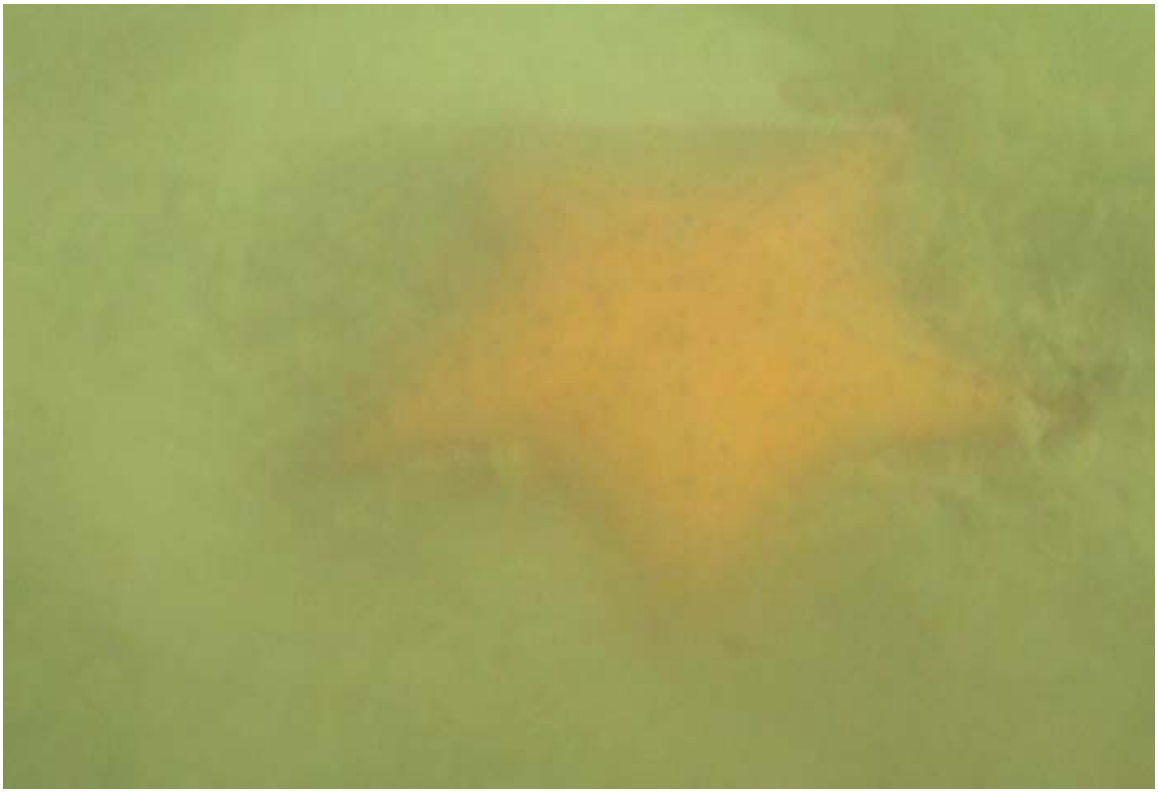

PLATE 11-6: RED SEA STAR AT 5M (NOTE: TURBIDITY ABOVE BENTHOS)

PLATE 11-7: GREEN SEA URCHIN AND TURTLE GRASS AT 3M

PLATE 11-8: SEAGRASS AT 4.5M

PLATE 11-9: TURTLE GRASS AND GREEN SEA URCHIN AT 3M DEPTH

PLATE 11-10: ALGAE AND SEA URCHIN

PLATE 11-11: SEA GRASS AND SEA URCHIN, NOTE SILT LEVELS AND CONDITION OF SEAGRASS BLADES

PLATE 11-12: VARIOUS MOLLUSCS AT ROCKY SHORE

PLATE 11-13: SEAGRASS PATCHES NEARSHORE, NOTE: VISIBILITY OF WATER

PLATE 11-14: RED ALGAE & SEAGRASS

PLATE 11-15: VARIOUS ALGAE ET AL. FOUND AT SITE

PLATE 11-16: ASSOCIATED MARINE FLORA AND FAUNA

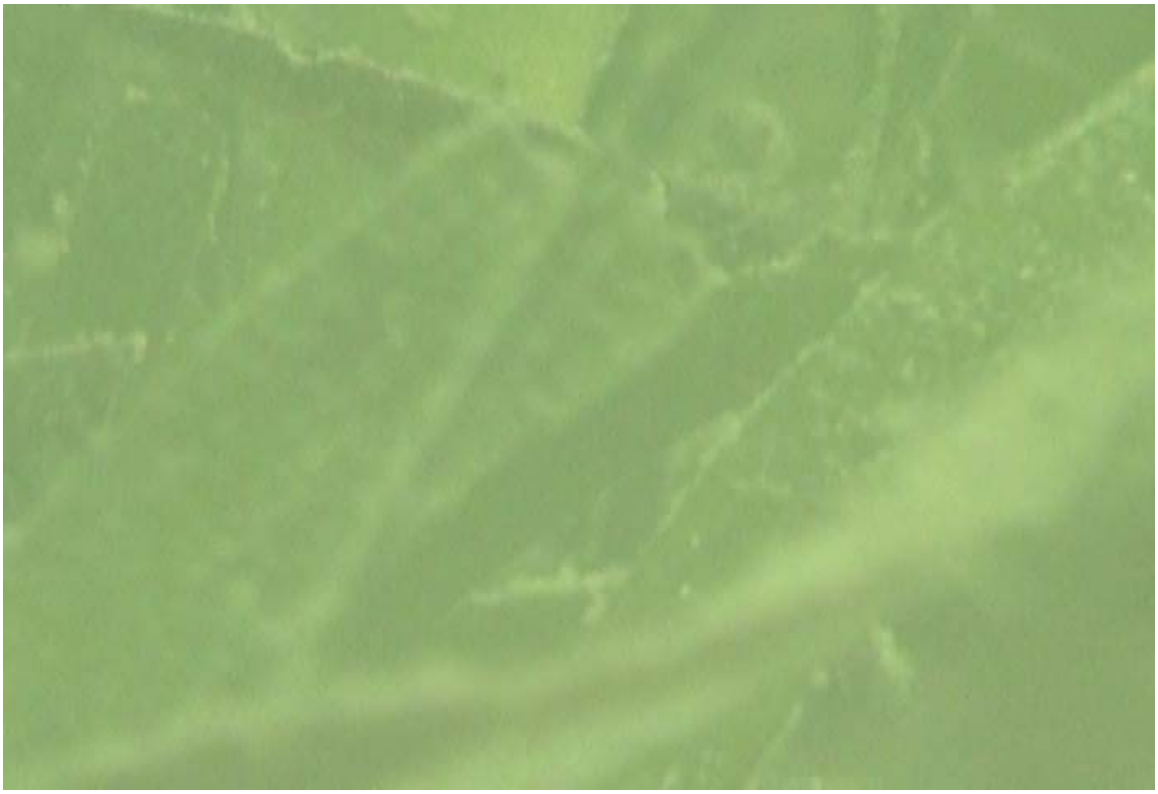

PLATE 11-17: POOR VISIBILITY AT 4.5M

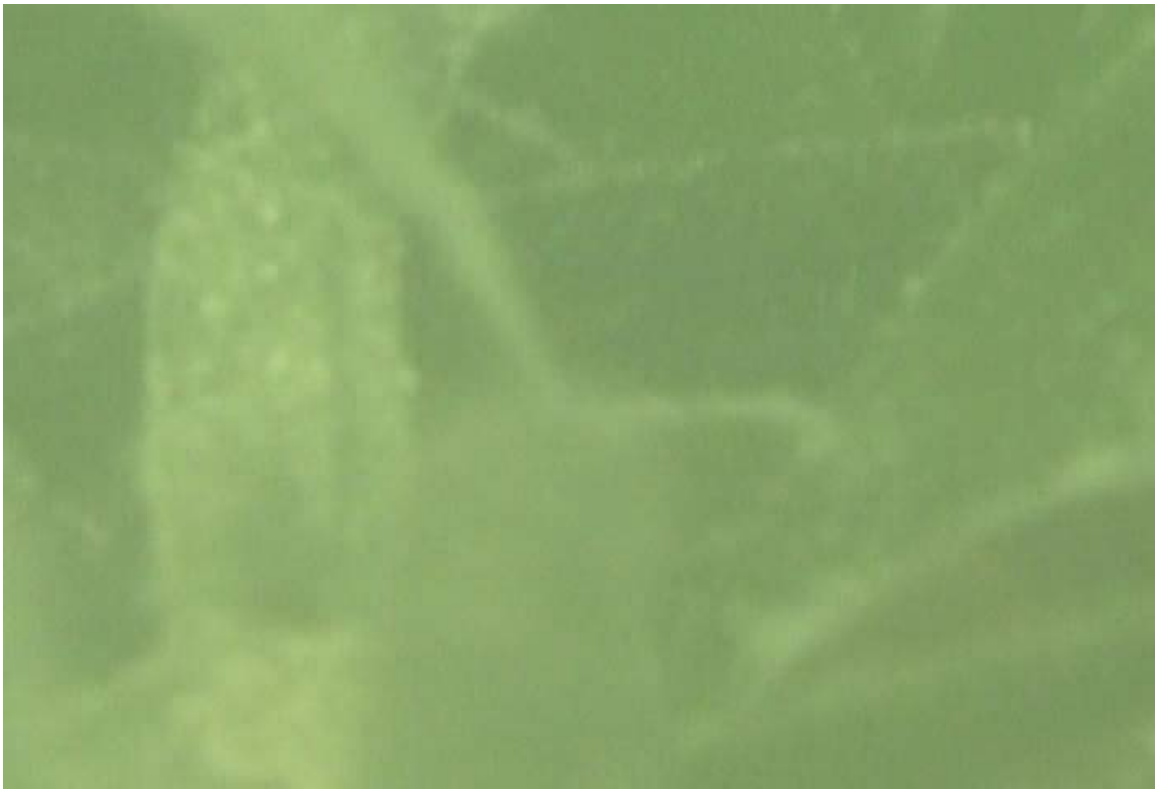

PLATE 11-18: POOR VISIBILITY AT 4M

PLATE 11-19: VARIOUS ALGAE

PLATE 11-20: MARINE CRAB IN SEAGRASS PATCH

PLATE 11-21: SEAGRASS DEBRIS ONSHORE

PLATE 11-22: SHORELINE MANGROVES, NOTE: DAMAGE FROM HURRICANE IVAN STILL EVIDENT