

ADDENDUM

TO

ENVIRONMENTAL IMPACT ASSESSMENT

SUBMITTED DECEMBER 2010

FOR THE PROPOSED CEMENT PLANT AND QUARRY OPERATION BY
CEMENT JAMAICA LIMITED AT PORT ESQUIVEL INDUSTRIAL COMPLEX,
ST CATHERINE AND ROSE HALL DISTRICT
CLARENDON, JAMAICA

September 2011



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TABLE OF CONTENTS

1.0	Introduction	9
2.0	Background	9
3.0	Purpose	10
4.0	NEPA's Specific Comments of February 19, 2011 and Reponses	
4.1	Water Resource Requirements	11
4.2	Flooding and Drainage	16
4.3	Flora and Fauna	20
4.4	Sewage Treatment Options	38
4.5	The Port Environment	41
4.6	Road Construction	45
4.7	The Belt Conveyor	46
4.8	Health Impact Assessment	48
4.9	Use of Red Mud	55
4.10	Use of Clay	61
4.11	Co-Generation Plant and Coal Fired Power Plant	66
4.12	Air Quality Review	72
4.13	Process related Air Quality Issues	76
4.14	Dispersion Model Report	88
5.0	NEPA's General Comments of February 19, 2011 and Reponses	
5.1	General Comment No.1	89
5.2	General Comment No.2	93
5.3	General Comment No.3	95
5.4	General Comment No.4	96
5.5	General Comment No.5	97
5.6	General Comment No.6	97
5.7	General Comment No.7	97
5.8	General Comment No. 8	98

5.9	General Comment No. 9	98
5.10	General Comment No. 10	100
6.0	NEPA's Additional Comments of March 29, 2011	
6.1	Quarry Restoration/Reforestation	101
6.2	Monitoring Plan	102
6.3	Drainage	104
6.4	Geology and Hydrology	104
7.0	NEPA's Additional Specific Comments	
7.1	Best Dress Feed Mill	120
7.2	Additional Application Required	121
	REFERENCES	122

APPENDICES

Appendix 1	NEPA comments on EIA dated February 19, 2011
Appendix 2	Royden Reittie Letter for Water Reallocation
Appendix 3	NIC Letter for Water Reallocation
Appendix 4	Project Storm Water Drainage Plan
Appendix 5	Flora, Fauna and Ecological Study of Limestone Quarry Site
Appendix 6	Flora, Fauna and Ecological Study of Cement Plant & Clay Quarry Site
Appendix 7	Health Impact Survey Form
Appendix 8	Preliminary Clay Mining Plan
Appendix 9	Power Plant Specifications
Appendix 10	Revised Air Dispersion Modelling Report

LIST OF FIGURES

Figure 1	Map showing Project Location
Figure 2	Drainage layout plan for Cement Plant Site
Figure 3	Drainage layout plan for Clay Quarry Site
Figure 4	Drainage layout plan for Limestone Quarry Site
Figure 5	Map of Life Zones in Jamaica
Figure 6	Map showing Forrest Type within the project area
Figure 7	Areal view of proposed limestone quarry site
Figure 8	View of proposed area for limestone quarry from the main road at Bodles
Figure 9	Quadrant overlaid on area proposed for limestone quarry
Figure 10	Photo of some plant species of the limestone quarry site
Figure 11	Photo of features found in the limestone quarry proposed site
Figure 12	Transect Sampling and line intercept of the limestone quarry site
Figure 13	Photo of fauna seen in the limestone quarry site
Figure 14	Species dispersion pattern in the limestone quarry area
Figure 15	Photo of stone gathering due to human intrusion
Figure 16	Wet areas of the plant site
Figure 17	Photo of line intersect during flora and fauna survey of plant site
Figure 18	Photo of ground board sampling on plant site
Figure 19	Photo of the sampling of flora and fauna in various zones of plant site
Figure 20	Photo of different scenes during the rapid ecology study of plant site
Figure 21	Photo of different types of fauna present on the plant site
Figure 22	Photo of equipment used in data collection
Figure 23	Photo of examples of aquatic life on the plant site

Figure 24	Photo of example of insects on the plant site
Figure 25	Photo of sceneries from the plant site
Figure 26	Highway 2000 corridor development plan 2004 – 2025
Figure 27	Photo of Port Esquivel – Port Facility
Figure 28	Photo of the area proposed for the Limestone Quarry access road
Figure 29	Conveyor belt route shown on Google Map
Figure 30	Photo of typical conveyor crossing highway
Figure 31	Photo of typical belt conveyor
Figure 32	Photo of Interview being conducted during the Health Impact Survey
Figure 33	Photos of the Red Mud Deposit at Windalco Ewarton Works
Figure 34	Map showing Clay Deposit
Figure 35	Photo of Mined out area in Salem County NJ – 1994
Figure 36	Photo of restored clay mine in Salem County NJ – 2001
Figure 37	Map Showing Clay Mining Phases
Figure 38	Cross-Section of Clay Mining
Figure 39	Photo of a typical co-generation power plant
Figure 40	Ash handling system
Figure 41	Cement plant model
Figure 42	Aerial view of deposit area before limestone quarrying
Figure 43	Aerial view of deposit area after limestone quarrying
Figure 44	Eastern view of deposit area before and after limestone quarrying.
Figure 45	South-eastern view of deposit area before and after limestone quarrying
Figure 46	Location map of the district of Lodge, St. Catherine

Figure 47	Flat topography of the district of Lodge, St. Catherine
Figure 48	Geology of the district of Lodge, St. Catherine and surrounding areas
Figure 49	Lodge project sample sites
Figure 50	Brown Clay from Lodge Prop. Hole #1
Figure 51	Trench 2.0m deep with Brown Clay at Base - Lodge Prop. Hole #2
Figure 52	Brown Clay from 4.0m depth - Lodge Prop. Hole #3
Figure 53	Brown Clay extracted from 3.0m depth - Lodge Prop. Hole #4

LIST OF TABLES

Table 1	List of existing permits for water extraction in the project area.
Table 2	Chemistry of dry stack red mud
Table 3	Concentration of elements in dry Jamaican Red mud
Table 4	Model Results – Proposed Cement Facility
Table 5	Priority Air Pollutant Emission Rates for Proposed Cement Plant
Table 6	Relationship between SO ₂ emissions, and energy consumption
Table 7	Main parameter of absorption tower
Table 8	Bag Filters and PM emission for cement plant
Table 9	Reference list of coal fired power plants
Table 10	Monitoring Plan matrix
Table 11	Lodge Project area sample sites
Table 12	Generalized log lodge prop borehole # 1
Table 13	Generalized log lodge prop borehole # 2
Table 14	Generalized log lodge prop borehole # 3
Table 15	Generalized log lodge prop borehole # 4
Table 16	Results of chemical analysis of samples from project area
Table 17	ASTM Specification C618-92A for some chemicals
Table 18	Comparison of Lodge Clay with ASTM 618-92A specifications

1.0 INTRODUCTION

As indicated in the December 2010 Environmental Impact Assessment submitted to the National Environmental Planning Agency (NEPA), Cement Jamaica Limited (CJL) proposes the construction of a cement production facility at the Port Esquivel Industrial Complex and Rose Hall District St. Catherine/Clarendon. The facility is to be built and operated using the most modern design and technological standards, will be nominally capable of producing 1.5 million ton per annum of clinker (the main component of cement). The proposed locations are as shown in **Figure 1.0**.

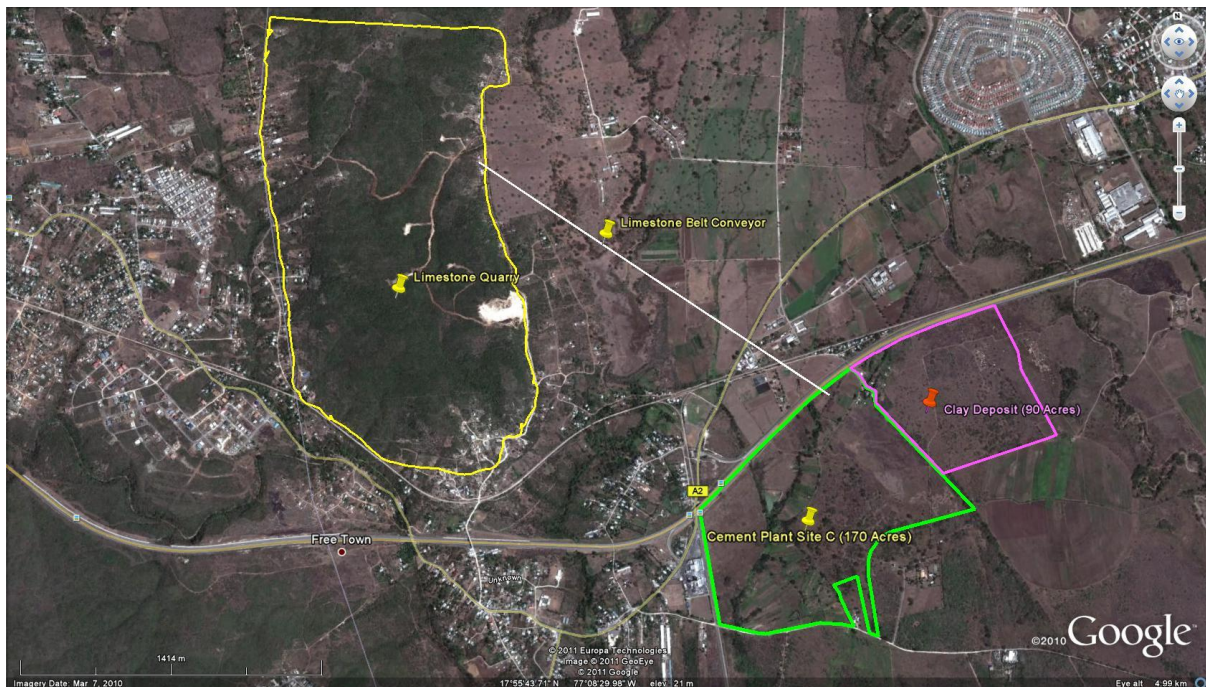


FIGURE 1.0: PROPOSED CEMENT PLANT, CLAY QUARRY & LIMESTONE QUARRY LOCATION

2.0 BACKGROUND

The EIA that was submitted in December 2010 to the NEPA presented a detail description of the project, applicable laws, and the existing environment. It also describes the key impacts of the proposed development on the environment and local people throughout the construction, operation, and decommissioning phases of the project and presented mitigation measures to minimize the potential negative impacts.

The EIA was reviewed by NEPA and other relevant agencies and a public presentation was made on February 5, 2011. Comments were raised by NEPA, other Agencies, Environmental Groups and other Interested Parties on the Environmental Impact Assessment (EIA) of the proposed

Cement Plant and Quarry Operation by Cement Jamaica Limited at Port Esquivel Industrial Complex and Rose Hall District St Catherine/Clarendon. The National Environmental and Planning Agency (NEPA), as a part of its permitting process, requires that the projects proponents/the environmental consultant responsible for conducting the EIA to provide appropriate responses to comments received on the EIA.

Based on their review and comments received from other stakeholders, NEPA determined that the EIA, submitted in December 2010 was inadequate. The shortcomings of the original EIA were compiled by NEPA in two documents identified as “Comments on EIA”, dated February 19, 2011 and “Additional Comments on EIA” dated March 29, 2011. In discussions with NEPA it was agreed that an ADDENDUM to the EIA should be written and submitted to the Agency addressing all the concerns raised in the comments and a second public presentation made.

This document is therefore the ADDENDUM to the EIA which address all comments received. The document structure is such that the comments received from NEPA are stated first and are underlined while the responses that address the comments follow immediately after each comment.

3.0 PURPOSE

The purpose of this September 2011 ADDENDUM is two-fold:

1. To provide a formal written response to the all comments (specific and general) identified by the National Environmental and Planning Agency (NEPA) in its “Comments on EIA’ – February 19 2011 and its “Additional Comments” – March 29, 2011.
2. To identify and provide details of the two (2) significant changes having positive environmental impact to the scope of the project that have been fully defined during the last six months, specifically:
 - a. The power plant has been reduced in size from 54 MW to 39 MW, thereby significantly decreasing its environmental impact because 23% of the total power will be generated from waste heat from the cement plant.
 - b. A clay deposit, suitable for use as a raw material component in the manufacture of cement, has been identified adjacent to the proposed cement plant location. This land has been acquired by Cement Jamaica Limited, thereby, creating a significant positive environmental impact in as much as the importation of clay by truck from other locations in Jamaica is no longer expected to be required during the first 30 years of operations. As a result, a clay pre-mining plan (and

mining permit application) now accompanies this submission. 20% of the raw material component for cement clinker is clay.

4.0 NEPA's COMMENTS OF FEBRUARY 19, 2011 AND RESPONSES

This section of the addendum addresses the comments that were received from NEPA on February 19, 2011, (**Appendix 1**) along with the corresponding responses. NEPA's comments are listed first and underlined with the subject of the comment in red. The responses immediately follow each comment.

NEPA's SPECIFIC COMMENTS

4.1 Water Resource Requirements

- The EIA must clearly account for the total water demand requirements for a project of this magnitude and there are discrepancies in the stated water demand; Page 19 of the document refers to a demand of 30,000US gallons/day (114m³/d) however other sections (pg. 32) of the document refers to 12,000,500 and 225m³ per day.
- The EIA must clearly identify all proposed sources of water supply. Additionally clarification is required on the information presented on page 19 of the document in relation to the capacity of an existing deep well of 14700m³/hr. Clarifications on the basis and method of calculation for the statement made that the water demand for the project will result in a 5% increase in water demand for the Port Esquivel Industrial Complex. The EIA did not clearly state/take into consideration that there is a water supply shortage in the general area as is evidenced by the fact that the WRA has placed a moratorium on the drilling of new wells and the capacity of existing wells have been allocated to specific developments.
- A consultation with the Water Resources Authority is mandatory to determine the true state of existing and potential water resources in the area and the impact of the development on them.

RESPONSE

A thorough review of the water requirements for the project was done and a breakdown of the correct water demand is set out below. The total water requirement is 9,822 m³/d or rounded off to the nearest thousand approximately 10,000 m³/d.

Project Total Water Demand

The total water demand of the project (5000 tpd clinker + 39 MW power generating station):
~10,000 m³/day (420 m³/hr);

The water demand is broken down as follows:

1. Cement Plant Production and Instrumentation **1,200 m³/d**
2. Net Addition to Cement Plant Circulating Water Demand **720 m³/d**
3. Waste heat power generation water **2,160 m³/d**
4. Coal fired Power plant water **5,040 m³/d**
5. Fire fighting supplemental water designed for 2 days supply **270 m³/d**
6. Net Domestic Water Consumption **120 m³/d**
7. Potable water **132 m³/d**
8. Unforeseen water **180 m³/d**

Therefore, the total water demand is **9,822 m³/d**. If we consider a 1% transmission loss from pipeline leakage and other factors, then the total requirements becomes

1) Usual Conditions:

$$1.1 \times [1,200 + 720 + 2,160 + 5,040 + 120 + 132 + 180] \text{ m}^3/\text{d}$$

$$= 1.1 \times 9,552 \text{ m}^3/\text{d} = \mathbf{10,507 \text{ m}^3/\text{d}}$$

2) Unusual Conditions (after 2 days of fire fighting):

$$1.1 \times [9,552 + 270] \text{ m}^3/\text{d}$$

$$= 1.1 \times 9,822 \text{ m}^3/\text{d} = \mathbf{10,804 \text{ m}^3/\text{d}}$$

3) Of the aforementioned total of about 10,500 m³/d, the total potable water requirement, considering the amount of pipeline leakage and other factors, is

$$1.1 \times 132 \text{ m}^3/\text{d} = 145 \text{ m}^3/\text{d}. \text{ CJL is prepared to provide this potable water demand for itself.}$$

However, it could alternatively be foreseen depending on availability that the potable water demand could be provided by the municipal water authority in the event that the municipal water authority prefers to sell potable water to CJL in which case the total fresh water demand for the project is:

$$a) \text{ Usual: } 10,507 \text{ m}^3/\text{d} - 145 \text{ m}^3/\text{d} = 10,362 \text{ m}^3/\text{d}$$

$$b) \text{ Within two days after fire fighting: } 10,804 \text{ m}^3/\text{d} - 145 \text{ m}^3/\text{d} = 10,659 \text{ m}^3/\text{d}$$

A series of consultations were held with the WRA and it was agreed that the water requirements for the project could only be met from either one of two approaches.

1. Conduct a detail study of the aquifers in the project area to determine the feasibility for the sustainable extraction of the additional volume of water require by the project. If the study identifies the availability of the required water then it could be granted.
2. Negotiate with entities that have existing permits for extraction for a reallocation to the project.

Option 2 was pursued by the project proponents and commitments have been received for the reallocation of existing extraction rites from Royden Reittie (**Appendix 2**) and the National Irrigation Commission (NIC) (**Appendix 3**) as follows:

- Lodge Farm 1 - licensed to Royden Reittie - Rated Capacity - 1472 m³/day
- Lodge Farm 2 - licensed to Royden Reittie - Rated Capacity - 4335 m³/day
- Marine Terminal - licensed to NIC - Rated Capacity - 8187.39 m³/day

The total volume of water available for the project is therefore **13,994 m³/day** compared to the project maximum possible demand of **10,804 m³/day**.

These arrangements have been discussed with the WRA and there was no objection to the aforementioned arrangements.

It should be noted all three of the wells are no longer in service and will be re-dug in consultation with and permission from the WRA.

TABLE 1: List of Existing Water Permits

Map Code	Name	Owner	Aquifer	Static Water Level (mbgl)	Status/ Use	Licensed Yield (m ³ /day)	Capacity (m ³ /day)
1	Bannister (Colbeck well 2)	National Water Commission	Limestone	50.29	P/PS		7304.33
2	Bodles #2	National Irrigation Commission	Limestone	31.70	NP due to vandalism/IR	9157	
3	Bodles (Domestic)	Ministry of Agriculture	Limestone	36.88	P/DO	1555	
4	Bodles (Rose Hall)	Jamaica Public	Limestone	29.87	NP/IN	11000	

		Service					
5	Bodles Citrus	Agricultural Development	Limestone		P/IR		4420.76
6	Bodles Experimental Farm	Jamaica Public Service	Limestone	20.46	NP/IN	1000	
7	Bodles JPS#1 Replacement	Jamaica Public Service	Limestone	20.42	P/IN	1635	
8	Bodles JPS#2 Replacement	Jamaica Public Service	Limestone	20.42	P/IN	1635	
9	Bodles Livestock	Ministry of Agriculture	Limestone	34.14	P/IR/DO	1308	
10	Claremont (Called Bowers by NIC)	National Irrigation Commission	Limestone	40.84	P/IR		844.90
11	Colbeck (Machado)	Government of Jamaica (c/o National Land Agency)	Limestone	65.23	NP		3270.60
12	Colbeck (Public)	National Water Commission	Limestone	36.88	P/PS	1818	
13	Colbeck Castle	B.C.R. Industries Company Limited	Limestone	45.42	NP/IR/DO	7703	
14	Free Town 2 (Content 2)	National Water Commission (Previously West Indies Paper Production)	Limestone	10.67	P/PS		
15	Lodge Farm 2	Century Farms (Mr. Royden Reittie)	Limestone	8.11	P/IR		
16	Longville Park 1	West Indies Sugar Co.	Limestone		NP		3434.13
17	Longville Park 2	West Indies Sugar Co.	Limestone	13.36	NP		1836.99

Addendum to EIA for Cement Plant & Limestone Quarry, St. Catherine/Clarendon – Cement Jamaica Ltd

18	Longville Park 3	West Indies Sugar Co.	Limestone	17.41	P/Stock		3085.26
19	Longville Park Farm A(#1)	J. Bunting	Alluvium		DES		3668.52 (fallen over the years)
20	Marine Terminal	National Irrigation Commission	Limestone	20.73	DES		8187.39
21	Marlie Mount	National Water Commission	Limestone	23.62	P/PS		2291.23
22	Marlie Mount, Old Harbour	Watch Tower & Bible Tract Society	Limestone	28.04	P/DO	547	
23	Old Harbour (Vaz) #1	Jamaica Public Service	Limestone		P/IN	1635	
24	Old Harbour (Vaz) #2	Jamaica Public Service	Limestone	26.82	P/IN	1635	
25	Palmetto Gully B (Freetown B)	National Irrigation Commission	Limestone	11.58	NP/IR	4000	
26	Palmetto Gully A (Freetown A)	National Irrigation Commission	Limestone	12.19	P/IR	27255	
27	Port Esquivel	Glencore Alumina Jamaica Limited	Alluvium	9.23	P/IN/DO	820	
28	Rhodens	Gore Development Ltd	Limestone	25.60	NP/DO	4360	
29	Sandy Bay	National Irrigation Commission	Limestone	42.67	P/IR	4543	
30	Succaba Pen 1 - Old Harbour	National Water Commission	Limestone	35.49	P/PS	6816	
31	Thetford 1	National land Agency (NIC)	Limestone	21.09	IR	5515	
32	Thetford Hall # 4a	National Irrigation Commission	Limestone	29.35	P/IR	6814	
33	Villa Farm (replacement)	Villa Farms Limited	Limestone	14.63	P/Agriculture	2725	

NEPA's SPECIFIC COMMENT

4.2 Flooding and Drainage

- The EIA states that the plant site is susceptible to storm surges from hurricanes, there are however no records/references provided to support the statement that surges have/may reach that distance and elevation inland.
- A proper hydrological assessment is required to consider the impact of increased run off on the gullies and waterways in the vicinity of both sites and to determine the potential for any localized flooding either onsite or adjacent offsite areas is properly assessed.

RESPONSE

The mention of the proposed plant site susceptibility to hurricane was not in terms of storm surges, but rather has to do with storm/hurricane force winds that could impact the site in such events.

A comprehensive drainage plan to include the entire project area was done. The methodology employed is summarized as follows:

- Perform Field investigations;
- Collect Topographical and geographical analysis;
- Perform Hydraulic analysis of the existing and proposed drains and drainage features;
- Prepare engineering designs and drawings for drainage infrastructure.

The conclusions of the assessment are as follows:

Plant Site:

The proposed cement plant will result in increased run-off rates and volumes. As such, it will have significant downstream impacts on the existing waterway and several buildings within the floodplain of the waterway. Given the long term development plans for the general area, the relevant authorities and other interest parties must seriously look into developing and implementing a master (regional) drainage plan.

For its purposes, CJL has proposed a site drainage plan that includes the upgrading (clearing and widening) of the waterway immediately downstream (off-site) of the southwest corner of the project site. This is to ensure the free flow of water from the project area and its main perimeter drains.

Low Impact development measures (rooftop run-off storage, infiltration trenches, etc.) have also been included CJL's internal drainage plans for the plant so that the travel time of water is increased to allow for storage and infiltration thereby reducing downstream peak discharges and allowing for optimization of drain sizes. Hence, any adverse impacts downstream of the site have been minimized.

Limestone Quarry Site:

During the operation of the quarry, post development runoffs from the catchments are expected to increase in the Mammee and Clarendon Gully. However, as shown in the hydrology report dated May 2010 (submitted as an Appendix to the EIA), the increases in flows are not expected to significantly affect the flows - except at box culvert 3 which flows under an existing local road. However, there are no historical flood events at the site of box culvert 3.

Nevertheless, the existing drains which lead to the western Mammee Gully should be upgraded and utilized to convey the flows from the site as they are doing presently. In addition, the operation of the quarry will be done in phases starting from the north to the south which will minimize the added capacities required of the existing drains.

As per CJL's design, detention ponds are intended to be constructed to reduce peak flows and sediment transport. This, too, will minimize the added capacities required in the existing drains.

All drains from the site to the gullies will be retrofitted with check dams to reduce the discharge velocities and sediments from the site. Check dams must be cleaned (at minimum, after each major rainfall event) to ensure it stays clean and feasible.

Silt fences are also to be employed as deemed necessary.

Clay Quarry Site:

The operation of the quarry should commence activities in the southern end of the site thus, initially creating a detention area for site storm water management purposes. This will minimize the adverse impacts of erosion and sediment transport on downstream properties.

The drainage plan designs associated with the respective sites are presented in the figures which follows (**Figures 2, 3 & 4**).

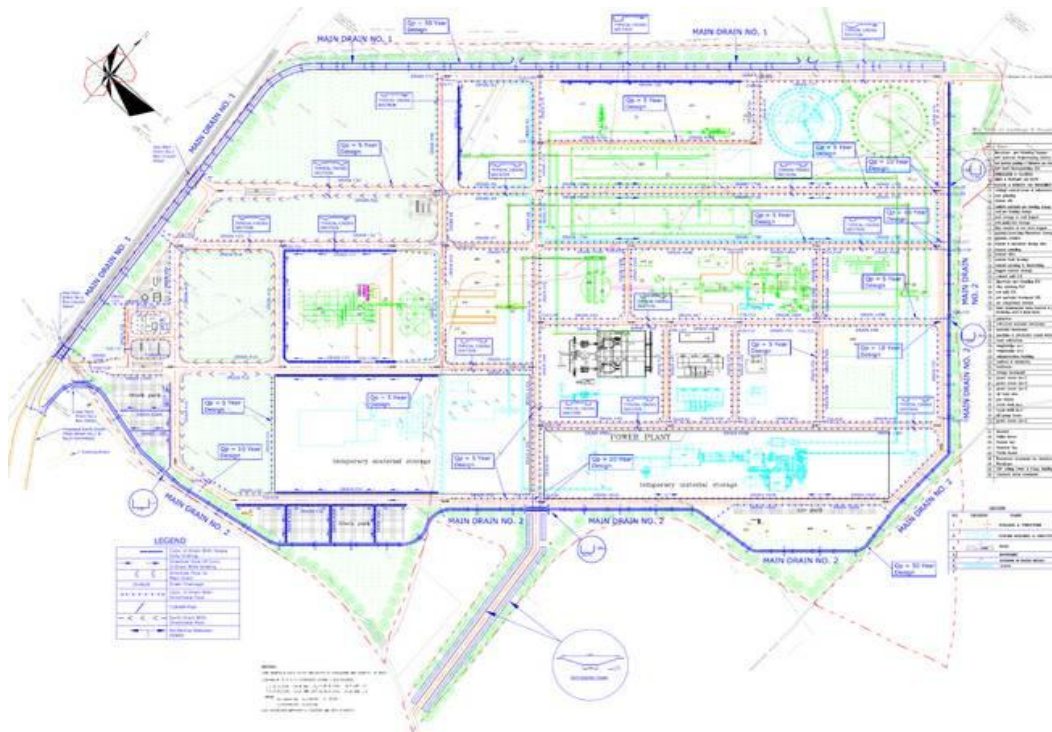


Figure 2: Drainage layout plan for cement plant site.

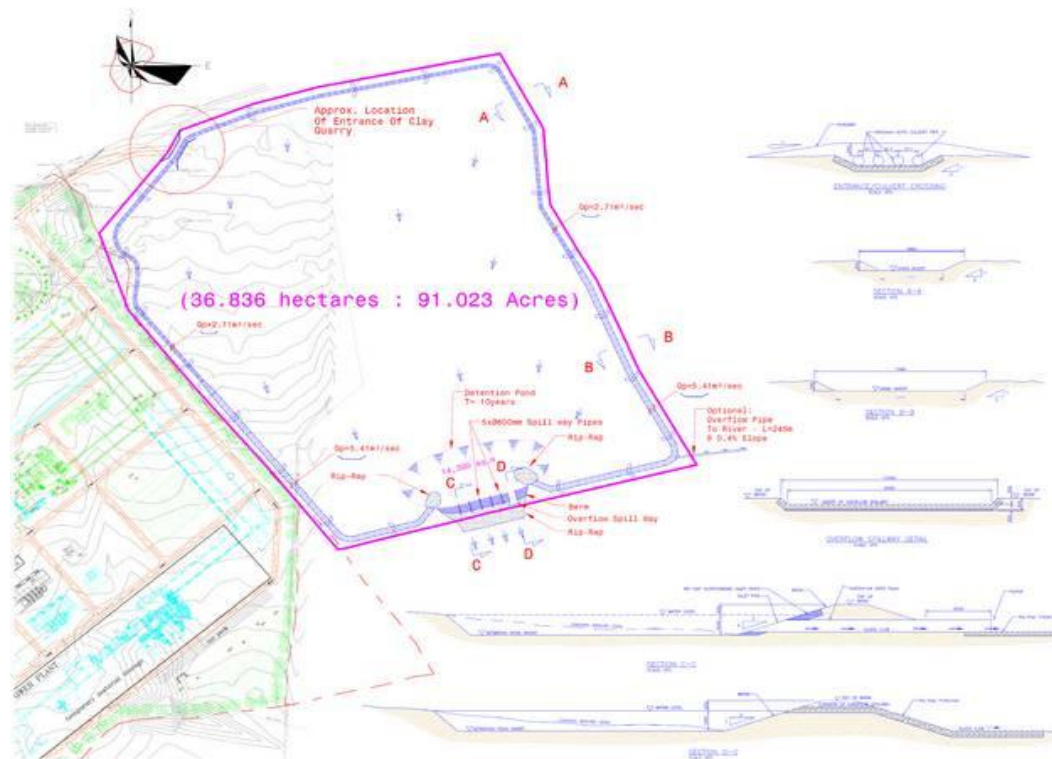


Figure 3: Site drainage plan for clay quarry site.

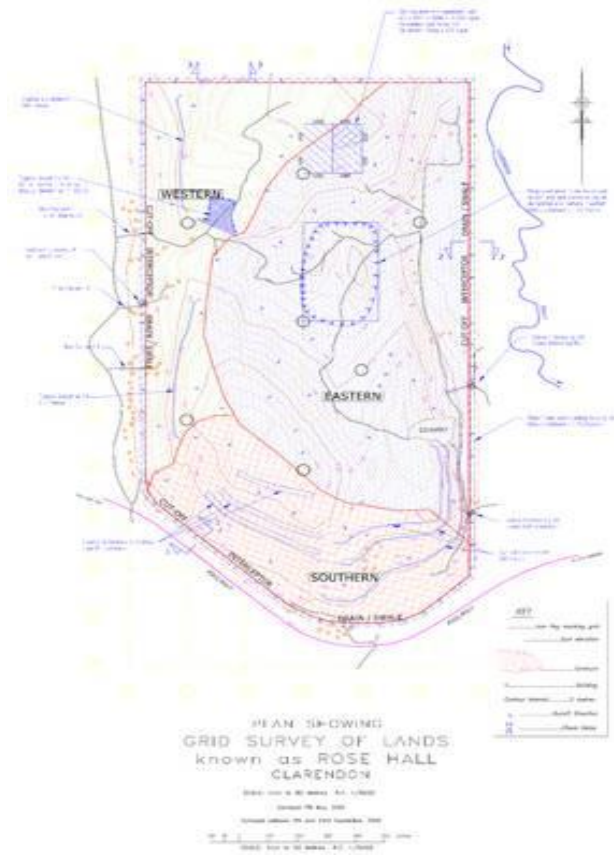


Figure 4: Site drainage plan for limestone quarry

The complete drainage plan design report is included as **Appendix 4**

NEPA's SPECIFIC COMMENT

4.3 Flora and Fauna

The information provided in the EIA is inadequate and the methodology employed must also be clearly stated. A detailed assessment of the flora and fauna resources present at both sites, through a literature review and a rapid ecological assessment at the very least must be conducted for both locations and the findings presented.

RESPONSE

A very detailed flora, fauna and ecological assessment of the sites proposed for the limestone quarry, the clay quarry and the cement plant was conducted. The findings are presented in two reports attached as **Appendix 5 and 6**, which include descriptions of the methodology employed. The methodology employed along with summary of the findings is presented below in this document.

Limestone Quarry

The project area falls within the Tropical dry forests of St Catherine. Dry forests are known to provide habitat for a number of endemic species of Flora and Fauna some of which are classified as rear, threatened, and endangered on the International Union for Conservation of Nature (IUCN) red list and at various schedules of the Endangered Species Act (2000).

Tropical dry forests are the predominant forest type in the island stretching in an almost unbroken band along the alluvial plains and narrow pre coast zones around the island; this is visible on the map in **Figure 5** which shows the Life Zones in Jamaica adopted from Holdridge (Forestry Department 1971).

Flora and Fauna are very similar within this zone and especially within the close areas of each parish. The project site is no exception as it is almost entirely enclosed by this forest type. There is very little variation of environmental factors such as topography, soil, or climate within the project area which would indicate that there should be little habitat variation/diversity or biological community. It is noted that within these localize zones the endemism may be high, but species richness may remain constant throughout the zone.

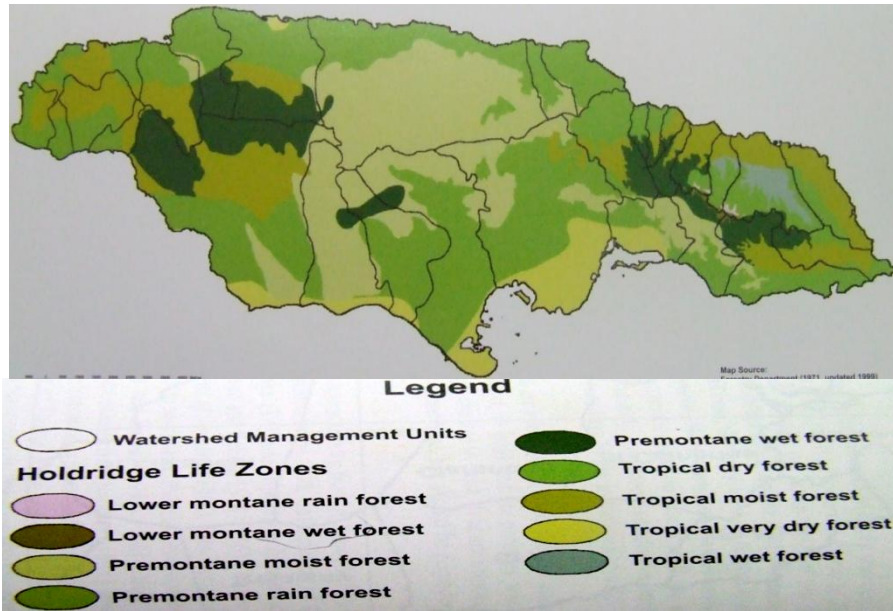


Figure 5: Jamaica map showing life zone Courtesy Forest Department

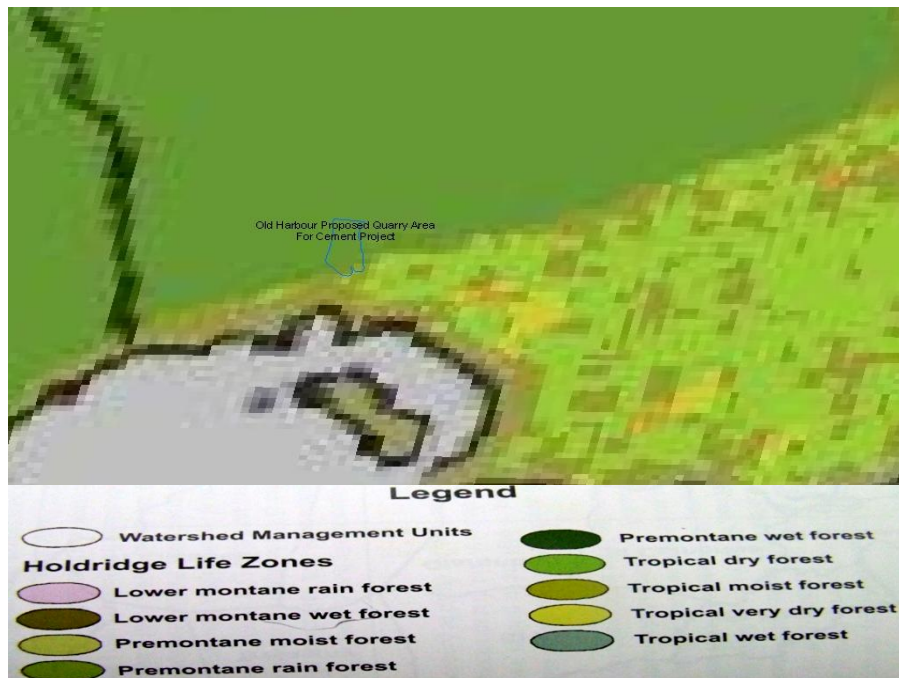


Figure 6: Showing the forest type within the project area

SURVEY OBJECTIVES

The project propose to permanently change the topographical feature of the landscape as it clears the vegetation and lowers the elevation of the hills (at least within the inner sections), as the limestone is excavated as the main resource of the project.

The units under survey include all Flora and Fauna residing in the project area and were surveyed (see methodology) using a mix of approaches including a compilation of a floristic list and a description and measurement of the form of the vegetation (physiognomy).

The survey objective was to:

- Enumerate the existing condition of the biological environment and to identify concerns and mitigation, which may arise out of displacement of flora and fauna residing within the project area.
- List the flora and fauna observed within the area and tell their status frequency of occurrence and classification.
- Develop conservation plans for any species of flora and or fauna classified as important and needing special attention and or intervention as a result of possible displacement occurring due to the project's activities.

AREA SURVEYED

The target area (named the Old Harbour Hills) is bordered by the Rose Hall, Bodles, and Freetown communities in Parish of St Catherine to the East and Sandy Bay and Rosewell in Clarendon to the West.

This area falls just adjacent to, and outside of the Rio Minho Watershed and the Portland Bite protected areas. It is in a dry limestone forest at an elevation range of 28 m – 130 m and is predominately limestone aggregates with thin patches of shallow soil scattered throughout. It covers an approximate topographical area of 200 Hectares (500 acres) in a very rough trapezoidal shape. It can be seen from the main road leading from Freetown to Old Harbour (on your left) and from Old Harbour to Freetown (on your right).

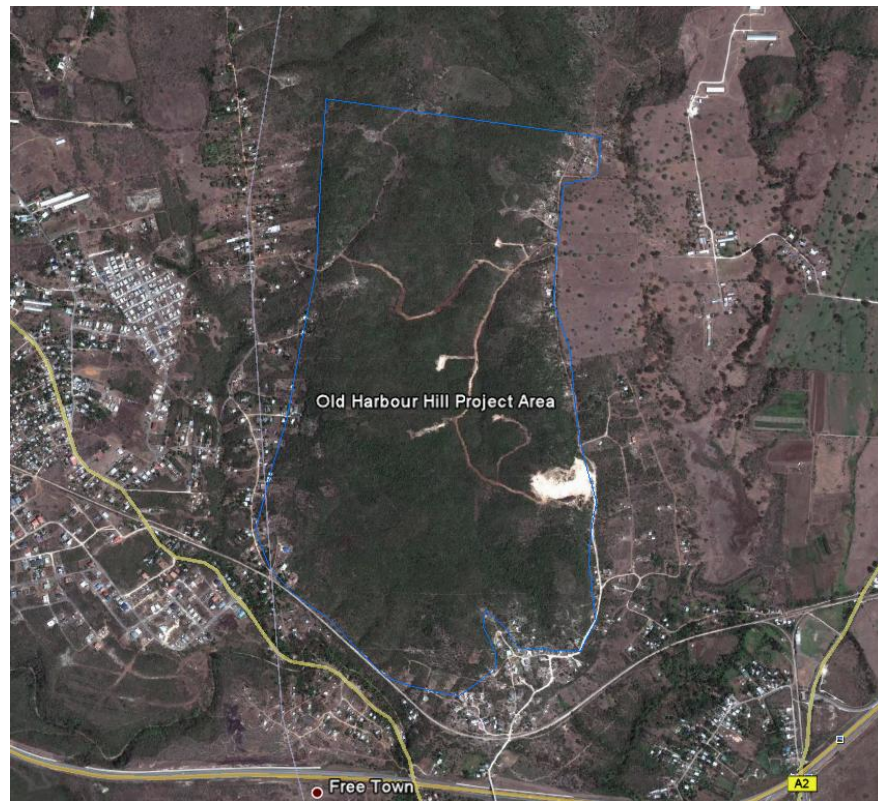


Figure 7: Aerial view of the proposed project area showing neighbouring communities.



Figure 8: View of project area from main road at Bodles

METHODOLOGY

Surveying flora and fauna have varied approaches to describe the community according to the desired usage of the information to be collected. In this instance, the data is to be used as a measure of the status of flora and fauna within the project area so as to ascertain the need for any mitigation measures to be put in to place for species that may reside within the project area that have that special need.

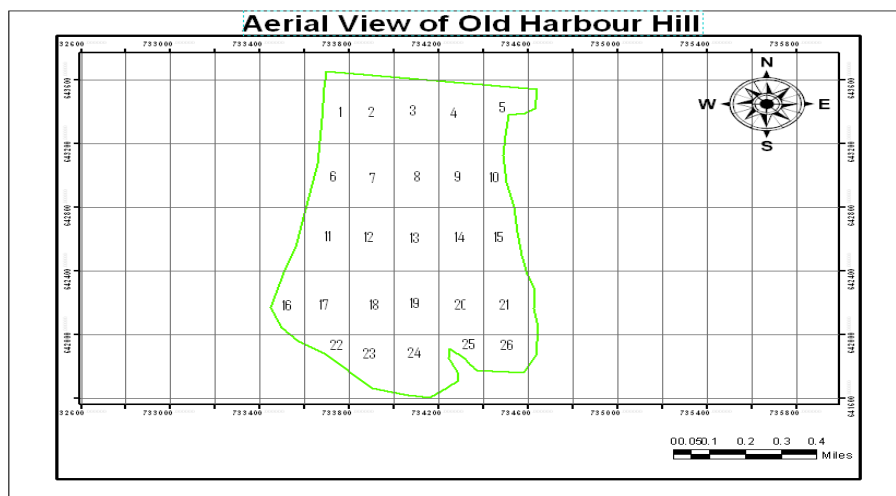
The Flora and Fauna were approached and measured differently, although the specific aspects of the community organisation were measured for both. They include **species diversity, zonation, and stratification** from which their status was obtained using literature from FORESTRY DEPARTMENT, MINISTRY OF AGRICULTURE, NEPA, as well as INSTITUTE of JAMAICA.

The 200 Hectare project area was viewed from an aerial photograph using Google Earth version 2011 and grids of 1 hectare overlaid using ArcGis version 9.2. The density of the flora was noted and formed a basis for consideration in the planned visits to the site for data collection for both Flora and Fauna.

These grids were grouped into rectangular quadrants of 80,000-m² sampling area, making a total number of 25 quadrants.

From the aerial photographs and walkthrough, matching points using hand held GPS (Garmin *etrex* and Milligan platinum equipment) the density of the vegetation was ascertained and used in determining the best technique (**Point – Quarter sampling, Quadrant, and or Plot/Quadrant method**) for the given sub area (group of 8 grid of 1 hectare). The Fauna was assessed using **Line Transect** (strip-census) method.

Figure 9: Quadrant overlaid on project area



Flora Analysis

A walk through was done in each of the five quadrant selected and all species were examined and recorded. Plots of 100 m² (7.07 x 14.14 m) were then used to sample the population density by counting all species within these 100 m² plots. The other twenty quadrants were walked through and species counted using the **TRANSECT SAMPLING method** with the **line-intercept technique**. Any Flora that was not seen in the other five quadrants, or of special status seen in these quadrants, were counted whether or not they fell on an intercept. Some plants were rarely seen or were confined to a few quadrants in “contagious” pattern.



Figure 10: Lilies undergrowth



pokeweed



wild bamboo

Fauna Analysis

Note that the main aim of the analysis of the Fauna population was to ascertain the identification and status of the resident or visiting species and the importance of the project area for their food, habitat, or range.

Figure 11: Coal burning activity



Cleared area for agriculture activity



Canine remains found in area



The approach used was the strip census where a distance of 100 m was covered within 15 minutes and the number of animals seen recorded (as species seen per 100 m unit area), or

line-intersect technique where transect line was established at random within the project area using lines created by overlaying ArcGis and hand held GPS equipment. An observer walked this line and fauna flushed or otherwise observed were counted and the distance was measured from observer to animal (or Group of animals). The assumptions made were as follows: animals were randomly distributed, the sighting of one animal does not influence sightings of others, and all members (eg. all ages and both sexes) are equally likely to be flushed and observed.

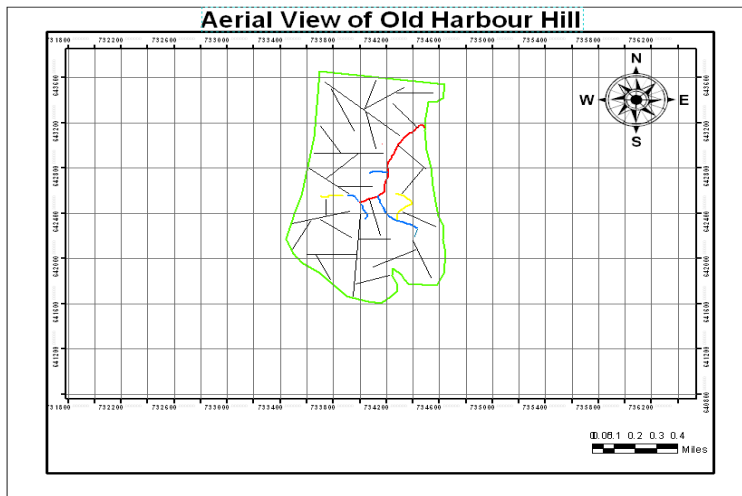


Figure 12: *TRANSECT SAMPLING method with the line-intercept on map of area*

Trail (roadside) count was another method used to record Fauna, as animals were sometimes easier recognised as they crossed these open spaces. As the trails and roadways are traversed during Flora measurements as well as entering and exiting of the project area, all fauna sighted are counted and recorded. Bird calls and nests (nesting sites) were used as indicators of presence and residence of birds. Butterfly and moths species, pollinators of the flora, as well as other invertebrates, lizards, snails were noted.



Figure 13: *Bee hive in rock*

Nest of nightingale

Old-man bird

Early morning to evening and evening to morning observations were conducted to ensure fauna were noted through movements (sight) and calls (hearing) for both diurnal and nocturnal

species. In addition, interviews were conducted with persons working within the area (coal burners, loggers, farmers, herbalists and residents of the peripheral communities) which yielded additional information suggesting that there have been no sightings by themselves or heard of any sightings of fauna that we have not seen or heard within the area ourselves.

Limitation

Some limitations during the observation of Flora and Fauna over the period were the capture for counting of some species especially small shrub and tree invertebrates. These were mainly bugs which were identified only to the order, but not to the species level as some did not fall to the ground when foliage was shaken or whacked, but instead flew away and were too small to be photographed from a distance with the camera equipment we had. Time limits increased the possibility of biases in trapping, photographing, and indirect sign indices, as the number of visits to the area, seasonality of fruiting and flowering, fauna feeding, breeding and migrating habits all added to the limitations of this survey.

RESULTS

The flora of the area is varied, in keeping with the expectations of dry limestone forest of 28 m – 130 m elevation and within this proximity (less than 5 miles) to the sea. Plants are listed in **Tables 2-5** of the full (**Appendix 5**) report and will show the relative species occurrence (frequency), the distribution pattern, and the quadrants in which they were found. The table outlines species status as reported by the Institute of Jamaica, IUCN listing. The dominant species of flora in frequency and distribution was noted as the lignum vitae, Red birch sweet wood.

CONCLUSION

Approximately 69 tree species and 52 shrubs made up the Flora seen in the area. For the Fauna, 32 species of birds, five (5) other species of vertebrates, and over 31 species of invertebrates were recorded. In total, in excess of 189 species of Flora and Fauna were recognised within the project area.

The endangered species observed within the proposed project area that was not also observed in the surrounding areas is soapberry (*Sapindus* spp). Due to its potential value, attention should be given to its long term future.

Other plants of significance which were observed included the Lignum vitae, the national flower, guinep (food, probably introduced), flame of Jamaica (aesthetic), and hard woods

(economic, e.g., coal burning). Numerous medicinal shrubs were also observed, for example Virvine, pokeweed, etc.

In terms of fauna observation, the wide variety of bird and insect species observed would have been due to the number of plant species which provide a source of food and shelter to these species. One social insect of significant economic importance, the honey bee, was observed hiving in rocks within the area and are frequently found within the flora canopy. This is significant since their survival is hinged on a constant supply of pollen producing plants.

There were at least three types of dispersion patterns noted within the project area, namely uniform, random and contagious (also referred to as patchy, clumped or clustered)

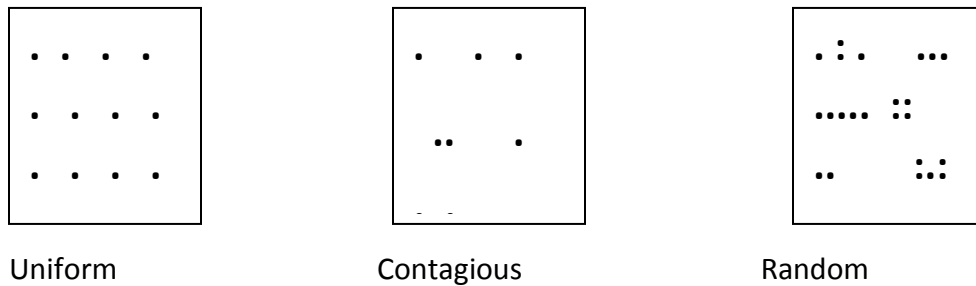


Figure 14: *Species dispersion pattern in the limestone quarry area*

The area had signs of years of disturbance by farming activities clearing of vegetation and habitation by people over time. **Figure 15** shows stone heaping in what looked like farming activity. This activity may be responsible for some of the distribution patterns observed for many species as well as the open and close forested areas. This mixture of diversity and the noted human intrusion gives the impression that some species were dispersed by this intrusion likewise some others patterns of dispersion.



Figure 15 *Stones gathered due to intrusion by human*

Cement Plant and Clay Quarry

AREA SURVEYED

The survey covers the area proposed for the cement plant and clay quarry. This area falls adjacent to and is bordered by the Hi-Pro Feed Manufacturing Plant, Rail road, Highway 2000, Boodles Research Centre of Excellence, and a farming community. It is a few hundred meters from Port Esquivel. The proposed Project Site is within a commercial industrial zone as evidenced by the fact that Old Harbour town centre is approximately 3 Km away and Century Dairies is just outside the boundaries of the ethanol plant which is fifteen hundred meters away.

The plant site exhibited differing biological community structure, as well as habitat variation. Some feature differences include the present of water bodies, three lotic (one from Bodles the second from the direction of Hi-Pro and the third the irrigation canal), one lentic (a pond near the centre of the site), a major grassland open field area, and a segregated farming community. The soil type is predominately clayey.



Figure 16: Wet areas of plant site Lotic

Lentic

Lotic

METHODOLOGY

Surveying flora and fauna have varied approaches to describe the community according to the desired usage of the information to be collected. In this instance, the data is to be used as a measure of the status of Flora and Fauna within the project area, to ascertain the need for any mitigation measures to be put in place for species that may reside within the project area which may have that special need.

The Flora and Fauna were approached and measured differently, although the specific aspects of the community organisation were measured for both. They include all the criteria listed in the objective and guided by literature from FORESTRY DEPARTMENT, MINISTRY OF

AGRICULTURE, NEPA, EFJ, as well as INSTITUTE of JAMAICA.

The data that was analyzed to give the information needed was collected in a number of ways; the main collection methods are listed and discussed below. The use of these chosen methods was in keeping with the type of vegetation, practicability, terrain, contiguous stages in ecological successions and transition zones.

PLANT (FLORA) ECOLOGY

The main methods used in the collection and analysis of this data were the **line-intercept** technique and the **belt transect**. The **line-intercept** involves the tabulation of data collected on the plants lying on a straight line cutting across the area (community) under study. This allows for the estimates of densities to be calculated. The **belt transects** uses a long strip marked out in the area within which all the organisms are measured /counted. The belt was divided into intervals and each treated as a plot.

Procedure

Line-intercept

A 100m cord line was stretched between the two points marked on the habitat chosen for analysis and the cord marked into 1m long span for the grass land areas and 10m long spans within the more stratified forested areas where plants are more widely spaced. Beginning at one end all individuals intercepted by the cord line were recorded and each segment was treated as a separate unit of transect. The data was then analyzed to give frequency and species diversity.



Figure 17: *Line-intercept passing through varying stratification levels (night photo lighted by flash)*

Belt transect

The directional orientation of each belt was selected on the map outline of the project area within each community to be studied, by connecting two points chosen at random and then geo-referenced for a match. GPS coordinates were then taken and stakes used to mark the actual points on the ground effectively creating a long strip of the terrain or belt. The data collected in these belts helps in determining the overall species composition, population dynamics, richness and evenness in the area and within each chosen community or habitat.

Where there seemed to be (or was obviously) a noted community transition, the orientation was modified slightly with a bias along the transition or recognized gradient. This was replicated three times within each of the communities chosen.

Each transect was divided into contiguous segments which made it easier to analyze for the frequency of species within the habitat using the presence or absence of individual species in each interval.

The results are presented in table form in the result section of the full report (***Appendix 6***), where each species identified are rated in these categories

Fauna Analysis (terrestrial and aquatic)

For this section of the project area, a similar approach was employed as used in the quarry segment. In addition to those previously used, ***drop boards and pit fall traps*** were more frequently employed along the line transects for those cryptozoans and nocturnal that were not easily counted during the day time or moved very quickly during the night-time and as the leaf litter was sparse in this area. Sticky traps and sweep net were frequently employed. ***Grab sampling*** used in the analysis of aquatic species was backed up by ***photograph***, long and short handled scoops and dip nets and ***wilding sampler***. The relative shallow depth of the water enabled these methods to provide enough data for adequate rapid ecological analysis. Snails, fish, crayfish, frog/ toad, aquatic insects and birds were some of the fauna identified.



Figure 18: Drop boards for sampling ground dwelling hidden animal (spider under lifted board)

The approach used were the **strip census** where a distance of 100 m was covered within 15 minutes and the number of animals seen recorded (as species seen per 100 m unit area), or line-intersect technique where transect line was established at random within the project area using lines created by overlaying ArcGis and hand held GPS equipment. Fauna flushed or otherwise observed along the line were counted and the distance measured from observer to animal (or Group of animals). The assumptions made were as follows: animals were randomly distributed, the sighting of one animal does not influence sightings of others, and all members (e.g. all ages and both sexes) are equally likely to be flushed and observed.



Figure 19: Fauna and Flora counted and sampled along strips as they pass through varying zones and habitat

Trail (roadside) count was another method used to record fauna, as animals were sometimes easier recognised as they crossed these open spaces. As the trails and roadways are traversed during flora measurements as well as entering and exiting of the project area, all fauna sighted were counted and recorded. Bird calls and nests (nesting sites) were used as indicators of the presence and residence of birds. Butterfly and moths species, pollinators of the flora as well as other invertebrates, lizards, snails were noted. Carrion, body parts/segments and or bones were also used as indicator of presence of a species within the area.

Early morning to evening and evening to morning observations were conducted to ensure fauna were noted through movements (sight) and calls (hearing) for both diurnal and nocturnal (terrestrial and aquatic) species.



Dragonflies foraging

Orio resting

Foraging grasshopper

Garden spider



Beehive in a log

Leopard Frog in lentic waterway

Crab borrowing

Cochoo in casha tree



Snail eggs on grass

Silver perch piping in lentic waterway

Zebra butterfly being measured

Figure 20: Some aspects of the environment as they were sampled/measured during the rapid ecology study

Interviews were conducted of persons working within the area (coal burners, loggers, farmers, herbalists and residents of the peripheral communities). These interviews revealed that there is no awareness of the presence of any fauna other than those identified during the survey. This helped to confirm the identity of flora and fauna within the area as well as the land use history that made it easier to distinguish the transition from farm holdings to other habitat.

Limitation

The main limitation was that time did not allow for a fulsome seasonal variation that takes place over an annual cycle. As the area was studied it was also noted that there are differences within the community at varying times of the year as rain and dry periods cause the wetlands to swell and recede, resulting in varying levels of habitat components such as food, shelter, space,

water (as well as natural enemy/predators). The niche width (or the diversity of resources used) for each species identified was a high estimate due to the seasonal presence or abundance of some plants due to conditions stated above and others as a result of weather and time of year. For this reason, richness measure may be less than optimal, although adequate when both areas are analysed together.

Results

The flora of the area varied however there are many similarities. Grassland is the dominant habitat type. However, there are other habitat types within the area as follows:

- Aquatic:
 - **lentic** (a fairly large pond) and
 - **lotic** (two main streams of water pass through the area);
- **Farmed plots** (a number of holdings or seemingly abandoned holdings of up to five acres of cultivated plots);
- **Contagious forested areas** (of mainly leucenia trees and logwood); and
- **Highly stratified forested areas** which include areas of human intrusion of varying time periods of currently occupied and recently reforested after abandonment.

There is also a strip of abandoned traverse way used during the construction of highway 2000 that is mostly re-growth and/or new growth with leucenia and highway crab grass as well as various small shrubs and climbing legumes. The many and varied grass types are compounded by the current and previous land usage of farms such as:

- The Century (dairy) Farm which had many pastures within the area;
- Intermittent flooding of the area during torrential rainfall with water runoff from the boodles research station which also rear cattle among other livestock that forage grasses.

The functional role of a species with its environment or **niche** was examined and found to be varied and diversified, however not very different from the wider surrounding areas. Honey bees were found living in trees as they pollinate the many flowering plants within the area. The bees also provide fodder for dragonflies, spiders, birds and other predatory animals within the “larger” ecosystem. At least one farmer keeps bees on his holdings. There are other lentic and lotic water within close proximity of the area extending the habitat range of many of the fauna seen within the area.

A similar niche occurred for the crabs in and around the lotic wetland area where they benefit from the softened moisturized soil to excavate burrows and the more constant lush vegetation there for food.

The carrying capacity or maximum population size of each species that the area can sustain indefinitely is quite variable due mainly to the fluctuation of food, space, water and cover.

These fluctuations occur due to human activities within the recent past and continue presently as they clear areas for farming, housing, logging, and coal burning. This, among other factors such as flooding, varying soil type and habitat, has given the area a diversity of community structure and therefore the population dynamics and diversity is quite with the range of the neighbouring areas that fall within this type of environment.

Species evenness and richness seem also to be in keeping with the general wider environment within the areas of intrusion and habitat diversity and structures. The dynamics of the study area seem good for both flora and fauna given the varying life stages that were observed from juvenile to adult/mature in more than 70% of the total species identified. Birds hatch and reproduce, plants cut down re-grow from ratoon or seeds, and when given space the seeds of other trees grow and begin a new cycle.



Moorhen and young

Trumpet snails and crayfish

Bones of juvenile dog

Mosquito fish

Figure 21: *Richness in the area as in the varied habitat and niche*

Plants are listed in **Tables 2-5** of the full report (**Appendix 6**) and will show the relative species occurrence (frequency), the distribution pattern, and species dependence as they were found. Species' interaction to the biotic and physical environment of the area does, in fact, support many and varied types of niche. However, most species are not more dependent on the area than the surrounding areas. As a result, these communities, habitat, and niche when interrupted should see the displaced flora and fauna moving to neighbouring areas, especially since they are of very similar environmental conditions.

Conclusion

Approximately 60 tree species and 111 shrubs make up the flora seen in the area. As for the fauna, there were 60 species. In total, in excess of 265 species of flora and fauna were identified within the project area.

The wide variety of fauna (e.g. bird and insect species) observed is due to the variety and source of food and shelter to these species. One social insect of significant economic importance, the honey bee, was observed hiving in a cavity of a tree within the area and these

bees are frequent within the flora canopy. This is significant since their survival is hinged on a constant supply of pollen producing plants of which there are many including those cultivated by the farmers.

The area showed signs of many years of disturbance by farming activities such as the clearing of vegetation and habitation by people over time. This activity may be responsible for some of the distribution patterns observed for many species as well as the open and close forested areas. This mixture of diversity and the noted human intrusion gives the impression that some species were dispersed by this intrusion.



Figure 22: Some equipment used in data collection species identification and verification in the field

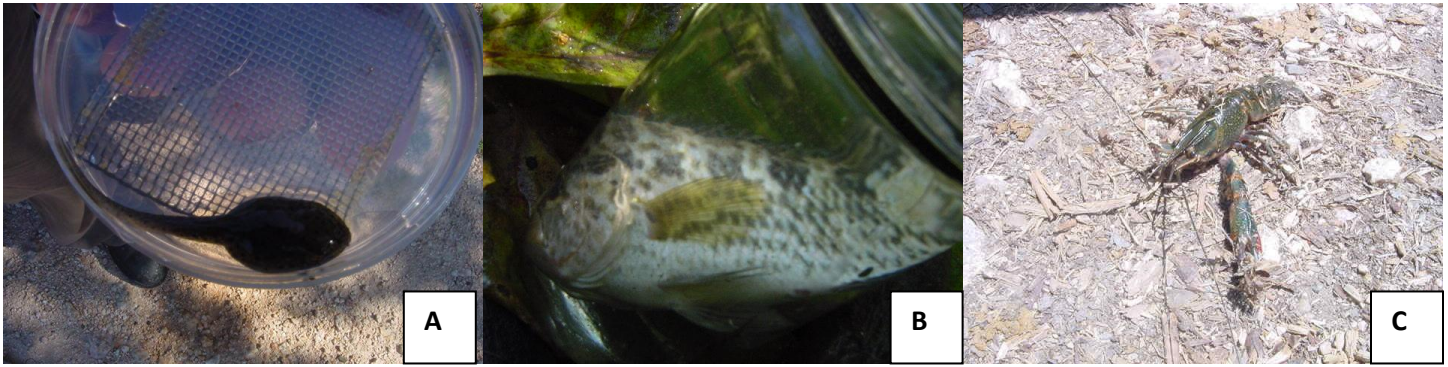


Figure 23: Aquatic life at various points in the area: A-Leopard Frog larva; B-June Fish?? C- Australian Red crayfish



Figure 24: Some of the beneficial insects and arachnids observed: A-Bumble bee; B-Argiope spp; C-Pirate bug



Figure 25: Sceneries of the some of the water ways observed

NEPA's SPECIFIC COMMENT

4.4 Sewage Treatment Options

The EIA must provide more detailed descriptions of the sewage treatment system(s) being proposed for both locations (plant and quarry site). This information must include, but not be limited to, the capacity, layout, location and method of discharge of treated effluent.

RESPONSE

Sewage treatment

A description of the proposed sewage treatment facility is set out below, which includes the calculations necessary to determine required volume and expected quality of final effluent and disposal. The system described is specific to the plant site, but will also apply to the limestone quarry site, except for sizing. The number of persons to be located at the quarry will be no more than forty at any given time; therefore, the sizing for the sewage treatment facility at the quarry site will be designed for twenty five percent of the capacity of the system described below.

Layout drawings are provided separately and the position of the sewage treatment facility is identified on the plant site general layout.

Detailed Description

To protect the environment, all of the domestic sewage from this project will be disposed into regulating reservoir after a two-stage biochemical treatment. Industrial wastewater will be disposed into a neutralizing tank after filtration and the resultant effluent will be recycled to the water green belt, used for dust suppression on the roads, or circulating as make up water, or will be discharged.

The components of the system are as follows:

- One sewage regulating pond, with effective volume of 100 m³;
- One recycle water operating room equipped with two sets of two-stage biochemical treatment devices with capacity of 3m³/h;
- One set of quartz sand filter and activated carbon filter;
- One set of chemical feeder and disinfectant generator.
- One set of sludge drying bed.

The two-stage biochemical treatment device includes: primary sludge, contact aeration basin and secondary sludge. After a two-stage biochemical treatment, sewage will be filtered by

quartz sand filter and activated carbon filter, and after being disinfected, sewage will be recycled to water green belt, road or as circulating make up water or will be discharged.

The maximum number of workers on the plant site will not exceed 443 and the domestic water quota for each person is 300 litres/day. Therefore, the total amount is up to 132 m³/day.

Domestic sewage is 120 m³, it is proposed to establish two sets of two-stage biochemical treatment device with capacity of 3 m³/h to meet the demand to dispose domestic sewage.

- Net Domestic Water Consumption **120 m³/d** (demand of 240 m³/d contains backwater of 120 m³/d to be used for irrigation of green spaces and dust suppression)
- Potable water **132 m³/d**

Activated sludge treatment is now considered the conventional means of large-scale treatment of sewage. The main aim of treatment is to reduce biochemical oxygen demand (BOD) and suspended solids (SS) to acceptable levels. This is achieved by removing solids and aerating the wastewater to satisfy the oxygen demand of the wastewater. The system will achieve the required standard of treatment which generally is a reduction of BOD to less than 20 mg/L, and SS to less than 30 mg/L. In fact, the

Removal of SS and BOD produces sludge, and the sludge has to be treated prior to reuse or disposal. The Primary sludge treatment process consists of a vertical sedimentation basin in which the upward velocity of sewage in the primary sludge treatment process is 0.5~0.8mm/s. Water coming from the primary sludge will be treated in an aeration basin which has two levels with a 2.5~3.3h of retention period and a gas-water ratio of 12:1, and a novel combined packing method which is designed to avoid blockages effectively. After this primary treatment, sewage water will flow to the secondary sludge treatment process, which is also a vertical sedimentation basin having an upward velocity of sewage of 0.3~0.4mm/s. Design parameters for two-stage biochemical treatment are as follows:

Inflow:

BOD₅ = 200mg/l,

COD_{cr} = 400mg/l,

SS = 220mg/l,

Outflow:

BOD₅ = 20mg/l,

COD_{CR} = 70mg/l,

SS = 70mg/l.

The amount of industrial wastewater is about 480 m³/day (including backwashing water for water treatment and other industrial wastewater), sewage will be filtered by quartz sand filter and activated carbon filter, and then will be recycled to water green belt, road or as circulating make up water or will be discharged.

Design parameters for quartz sand filter are as follows:

Filtering surface 3.14m²,
Rate of filtration 8~10m/h,
Height of filter bed 1200mm.

Design parameters for activated carbon filter are as follows:

Filtering surface 3.14m²,
Rate of filtration 8~10m/h,
Height of filter bed 2000mm.

Design parameters for two-stage filters are as follows:

Inflow:

BOD₅ = 20mg/l,
COD_{cr} = 70mg/l,
SS = 70mg/l,

Outflow:

BOD₅ = 10mg/l,
COD_{cr} ≤ 60mg/l,
Turbidity value ≤ 5mg/l.

Domestic sewage in plant will have a two-stage biochemical treatment, and industrial wastewater will be disposed into neutralizing tank after filtration and will be recycled to water green belt, road or as circulating make up water.

In total, about 21,900 m³ of treated sewage will be discharged every year. Water quality of the discharged sewage is:

BOD₅ = 10mg/l,
COD_{cr} ≤ 60mg/l,
turbidity value ≤ 5mg/l.

NEPA's SPECIFIC COMMENT

4.5 The Port Environment

A more detailed description of the Port Esquivel Environment is required especially with respect to the impact of this new development on the existing land uses and adjacent developments. A more in-depth description of the port facilities is required inclusive of current needs and any proposed expansion or modification to the existing port.

RESPONSE:

The Port Esquivel shipping port, operated by Windalco, primarily serves for the export of alumina and the import of raw material needed by the bauxite plants. During normal operation, Windalco's operations take up approximately 30% of port's occupancy. The other main user of the port is Jamaica Broilers for their ethanol and animal feed operations. During normal operation, Jamaica Broiler use less than 10% of the port's occupancy. At peak operation, the cement project will require just under 50% of the port's occupancy. Based on the existing industries utilizing the port facilities on an ongoing basis combined with the inclusion of the cement operations occupancy would increase to approximately 80%.

The general area in the vicinity of the port is zoned for industrial development as shown in the **Figure 26** below of the Highway 2000 corridor development plan. However, the only development that is slated to come on stream in the near to medium term is the LNG facility. The LNG project will incorporate the development of its own berthing facility and will, therefore, not impact the operations of the existing port facility.

The proposers of the cement project are also prepared to undertake the development of their own pier should development in the Port Esquivel area increase to the extent where the existing port is unable to accommodate the traffic. However, based on current usage and known future demand, the existing port facility is capable of adequately dealing with the increased occupancy. Therefore, no expansions or modifications to Port Esquivel are planned.

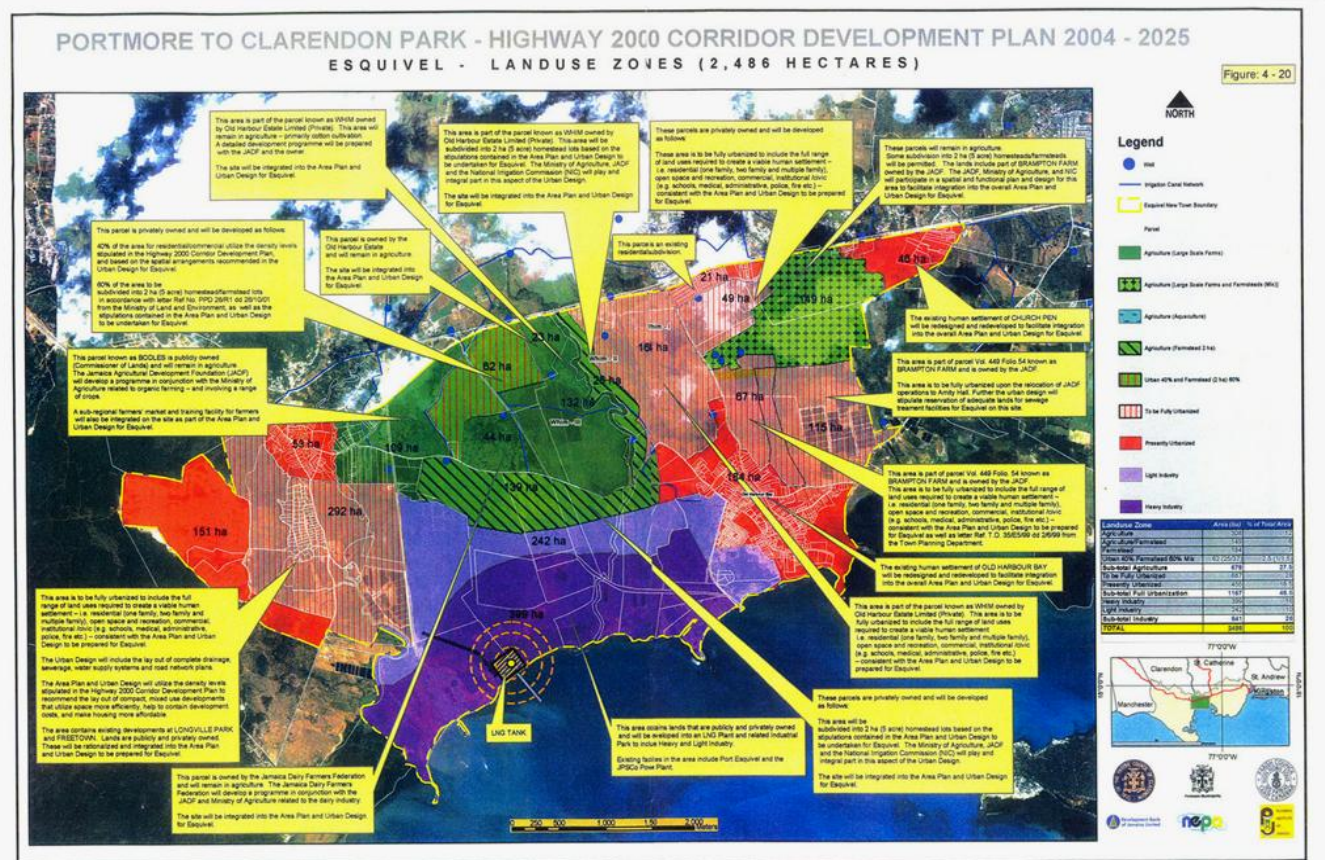


Figure 26: Highway 2000 corridor development plan 2004 - 2025

The information below was obtained from the Caribbean Shipping Association and provides details of the capabilities of the Port Esquivel Port Facility.



Figure 27: Port Esquivel – Port Facility

LOCATION: Latitude: 17° 53' N - Longitude: 77° 08' W

ADMINISTRATION: Port Authority of Jamaica

15-17 Duke Street, Kingston, Jamaica.

Radio frequency: VHF Channel 11 (working VHF Channel 17).

WORKING HOURS: Mon-Sun: 07.00-17.00

APPROACH: Dredged channel of around 1 nautical mile with a depth 9.45 meters.

HAZARD: Close reefs on both sides of the entrance channel.

TRANSPORTATION: Inland transportation is by rail and road.

IMPORTS AND EXPORTS: Imports: Grain - **Exports:** Alumina, molasses, bauxite.

WEATHER: Winds: E, ESE, SE, SSE 57 per cent; N, NNW, NW 32 per cent. **Wind speed:** 10 knots 60 per cent; 10-21 knots 35 per cent - Windiest months are March, June, July, and August. Strongest winds from E, ESE, SE - **Tides:** MHW 30.48 cm-25.4 cm.

ANCHORAGE: On NW side of Pigeon Island in depth of 13-15 meters.

PILOTAGE: Agents alert Pilotage Department on ship's ETA and ETD at least three hours before required time. Pilot boards and guides the ships in and out of the channel. Pilotage is charged according to grt.

TOWAGE: None.

TRAFFIC: Vessel calls per year:

Container: 0 - **Cruise:** 0 - **Ro-ro:** 0 - **Bulk:** 168 - **Breakbulk:** 0 - **Other:** 0

Cargo handled per year: Over 1 million tonnes.

Cargo handled per day: 5,000 to 5,999 tonnes.

EQUIPMENT: None.

STORAGE: **Open storage:** Available - **Covered storage:** None

Air draft: No restrictions. - **Refrigeration capacity:** None.

BUNKERS: Available with notice.

PROVISIONS: Available.

WATER: Adequate supply of water available.

FACILITIES: **Maximum draft alongside:** 11.1 meters - **Longest vessel:** 198 meters LOA.

Facility	Length (meters)	Depth (meters)
Alumina Wharf	198	11.1
Cargo Pier	61	4.9

Cruise: None - **Bulk:** Alumina export facilities - **Ro-ro:** None.

Tankers and LPG carriers: One berth.

NEW FACILITIES: None notified.

PRIVATE WHARFS: Alumina Jamaica Ltd.

MEDICAL AID: Facilities in Old Harbour.

NEPA's SPECIFIC COMMENT

4.6 Road Construction

More detailed information is required on the proposed new road which will be constructed to link the quarry site to the main road. A cross-section of the road, actual alignment, slopes, width, length and a description of the corridor is required.

RESPONSE:

Description of Limestone Quarry Access Road

The access road is designed to connect the limestone quarry (or other facilities related to the limestone quarry) to the outside (i.e. the cement plant site). The access road to the quarry begins at the main road to Old Harbour Town (at a point 200 meters north of railway) and ends at the dump/unloading platform of limestone crushing station. The new access road to be built will be along the length of the belt conveyor to the unloading platform of limestone crushing station. The access road will be used for the quarry access and the maintenance of the long belt conveyor.

The new access road to be built is about 2 km in length. For the route alignment, please see **Drawing 1** which was submitted along with this addendum. The road pavement will be a limestone base or concrete?) width is 7 m. The fill-up road shoulder is 1 m in width. The excavation road shoulder is 1.5 m in width (see **Drawing 2**, submitted with this report, for the cross section design). The average slope is less than 3% (1.7 degrees). See **Drawing 3** for the design of drainage culvert under road.



Figure 28: A view of the area through which the road will be constructed

The area through which the road will be constructed is a part of the Ministry of Agriculture Bodles property. This area consists primarily of abandon pasture lands, interspersed with a few trees mainly logwood trees. There is no activity currently taking place in the area to be impacted by the road construction.

NEPA's SPECIFIC COMMENT

4.7 The Belt Conveyor

The EIA must provide more detailed descriptions of the proposed conveyor belt including, but not limited to, the actual alignment and/or alternate alignment, the capacity of the system, detail of the biodiversity along the corridor, width of the corridor, natural resources to be impacted by construction and operation, method of construction especially in the vicinity of the highway and measures to prevent any environment and safety impacts are to be presented.

RESPONSE:

Description of Limestone Long Belt Conveyor

The belt conveyor from limestone quarry to the cement plant site is about 2 km. The preliminary alignment is presented on the drawings which accompanies this submission. There is no transfer station between the limestone quarry and cement plant site, in order to reduce the dust emission caused by any such transfer station. All other possible route for the belt conveyor would still take it across the Bodles pasture lands and would not facilitate a continuous conveyor but would require the inclusion of at least one transfer station.

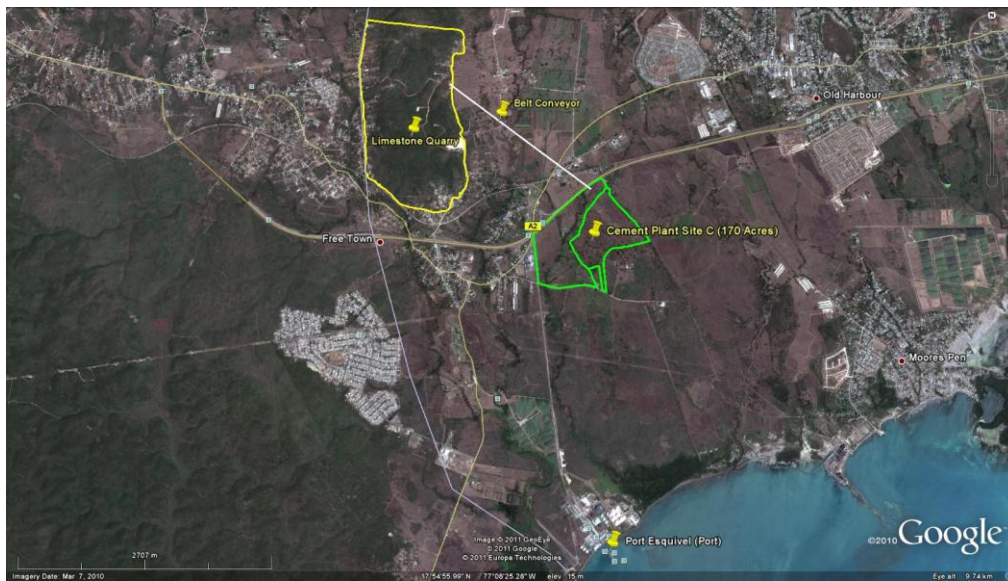


Figure 29: Belt Conveyor Route

The conveyor route is dominated by grassland which is typical of that general area, the flora' fauna and general ecological setting is expected to be very similar to that of the grasslands present on the plant site and which was described in details in section 4.3 of this document.

The belt conveyor is designed for a width of 1,400 mm and the maximum capacity is 1,600 tph, which is designed to meet the requirement of the cement production lines. The width of belt conveyor corridor is 4 meters. In addition to the space occupied by the belt conveyor (1.4 m), the corridor has a walkway of 800 mm in width on each side of the belt conveyor.

The conveyor will be elevated so as to avoid the occupation of farm land. The use of an elevated design will also prevent interference from unauthorized persons. For the typical design, please see the accompanying drawings. The individual spans between two adjacent support columns are generally between 10 m to 36 m (the actual spans will be designed according to the actual circumstances and topography). For example, in the special case of the belt conveyor passing over Highway 2000, the span can be over 50 m. The elevation of the belt conveyor corridor will also depend on the actual circumstances (in all cases, the design will meet the road, rail, farmers, etc. clearance requirements below the belt corridor).

The attached **Picture 5** is a typical photo of a long belt conveyor from limestone quarry to cement plant for a typical project built by the EPC Contractor. As shown, the belt conveyor is covered by a special protective cover to avoid dust spill and rain.



Figure 30: Photo of typical conveyor crossing the highway



Figure 31: Photo of a typical belt conveyor

NEPA's SPECIFIC COMMENT

4.8 Health Impact Assessment

The approved Terms of Reference for the development included a requirement for the conducting of a Health Impact Study. The Report did not include this critical request. This requirement is being reiterated and this study must include those communities within the sphere of influence (zone of influence) of both the Cement Plant and Quarry.

RESPONSE:

Health Impact Assessment

As a part of the requirement of the Terms of Reference for conducting the EIA for the development of the cement plant and quarry at Port Esquivel, St Catherine and Rose Hall, Clarendon; a Health Impact Assessment was required to be conducted. A Health Impact Assessment (HIA), can be defined as “the estimation of the effects of a specified action on the health of a defined population” Its purpose is to assess the potential health impacts – positive and negative – of policies, programmes and projects; and to improve the quality of public policy decision making through recommendations to enhance predicted positive health impacts and minimize negative ones.

Approach

The approach to fulfil this requirement was as follows:

- ❖ Discussions were held with both NEPA and the Ministry of Health to agree on a TOR for the required HIA.
- ❖ A TOR which is generally used by the MOH for such assessment was supplied as follows:

MINISTRY OF HEALTH

TERMS OF REFERENCE FOR A HEALTH IMPACT ASSESSMENT FOR THE PROPOSED CEMENT PLANT AND QUARRY OPERATION BY CEMENT JAMAICA LIMITED AT PORT ESQUIVEL INDUSTRIAL COMPLEX, ST. CATHERINE AND ROSE HALL DISTRICT CLARENDON*

1. BACKGROUND

The HIA is defined as *“a combination of procedures or methods by which a policy, programme or project may be judged as to the effects it may have on the health of a population”* – ‘Gothenburg Consensus Paper’ by the World Health Organization Regional Office for Europe (1999).

HIA takes into account the opinions and expectations of those who may be affected by a proposal. There is overwhelming evidence that development can have a beneficial effect on health and well-being: through the creation of employment, promotion of economic advancement and providing circumstances, which can improve living standards. Development can also have adverse effects, however, through the creation of problems such as noise, water and air pollution, increased risks of injury and resultant ill-health.

Development/s may also impact on the social and emotional status of individuals and communities through, for example, alienation and dis-empowerment. Some community members are particularly susceptible to both the physical and social effects. The HIA treat human communities as an important part of the ecosystem to be protected. The HIA seeks to ensure that both the positive and negative impacts on health are effectively examined.

2. INTRODUCTION

Cement Jamaica Limited proposes to

The policy of the Ministry of Health requires that HIAs be done either as part of the proposal, or as a stand-alone document on development projects that have a high potential to impact negatively on human health. The HIA Report of the proposed operation by Cement Jamaica Limited will predict the future consequences for health of the facility and provide the evidence-base to inform decision-making.

3. REQUIREMENTS

Cement Jamaica Limited will submit one year air quality data (.....) collected in the vicinity of the plant and quarry to the Ministry of Health and subsequently engage a team of Consultants to conduct a modified Health Impact Assessment.

The Consultants will:

- Describe the environmental setting and contaminants known or suspected to exist and/or released within the study area

- Prepare a detailed profile of communities located within a 2 Km radius** (Zone of influence)

- Identify the mechanisms of eco-toxicity associated with contaminants and likely categories of receptors that could be affected

- Identify and provide an analysis of actual and potential impact on human health and the health determinants for known emissions associated with the operation (cement processing and quarrying activities)

- Consult with members of the community to ascertain the impact of the facility. Convene at least eight focus group meetings and key informant interviews with community members residing in the study area

- Consult with the Medical Officers (Health) St. Catherine and Clarendon and Medical Practitioners in the public and private sectors within the wider Old Harbour/Freetown Region to determine the prevalence of respiratory illnesses and the leading causes of morbidity and mortality within in the study area (2005-present)

- Consult with environmentalists, public health officials and social workers to collect relevant data on environmental public health and social conditions within the study area

- Predict the impact of the findings on the health services

- Submit recommendations for an ongoing monitoring and surveillance programme, including costs

- Produce a Health Impact Statement Report (final report) on findings, conclusions and recommendations

4. OTHER REQUIREMENTS

- The HIA is to be conducted by a team of professionals approved by the Ministry of Health and shall include at minimum a Medical Practitioner, Medical Epidemiologist and a Environmental Management Specialist

- Cement Jamaica Limited is responsible for selecting and remunerating the Consultant/s for the project

- The study design for the retrospective study and the format for focus group meetings is to be approved by the Ministry of Health
- The Ministry of Health is to be advised of the commencement date of the study
- The original copy of the study is to be submitted by the Consultant/s to the Chief Medical Officer under confidential cover and copies made available to Chief Executive Officer – NEPA, and the management of Cement Jamaica Limited
- The HIA is to be completed withinmonths of the agreed TOR and two updates on work progress shall be provided to the Ministry of Health.

***To comply with condition --- NEPA's Permit**

**** Zone of influence/study area**

- ❖ Subsequent discussions with the MOH it was agreed that the TOR could not have been applied in this instance as there were some requirements that were impractical for example; ***“Cement Jamaica Limited will submit one year air quality data (.....) collected in the vicinity of the plant and quarry to the Ministry of Health and subsequently engage a team of Consultants to conduct a modified Health Impact Assessment”.***
- ❖ It was then agreed that the approach that was practical at this time was to:
 1. Identify the main components of the project that could impact the health of the community in the sphere of influence.
 2. Determine the likely health impact that could be expected.
 3. Conduct a survey to establish baseline data on existing level of illnesses that may be caused by the cement plant operations.
 4. Recommend a monitoring programme to monitor actual health impact during the life of the project.
 5. During the construction phase of the project the HIA as set out in the above TOR would be implemented, commencing with the first requirement for the collection and submission of one year of air quality data.

Methodology

The methodology employed involved:

- Conducting research to determine the health impact associated with, limestone mining operations, cement plant operations and coal power plant operations. – **The major health impacts were found to be upper and lower respiratory disease, asthma, cardiopulmonary diseases and birth defects.**
- Identification of target communities. – These were determined to be communities within a two kilometer radius of the project, including the following:- Aviary, Roswell, Freetown, Sandy Bay, Rose Hall, Bodles Junction, Bodles Crescent and Rodons Pen. Most of these communities are unplanned low income settlements.
- Determination of the current status of the prevalence/frequency of associated health impact namely; lung cancer, heart disease, asthma, sinus problems and birth defects. This was done through a survey conducted in the targeted communities, as data related to the specific area were not available from the health facilities.
- Identification of mitigation that may be implemented to reduce the potential impact of the project on the health of communities within the sphere of influence.

Survey Results

The survey was spearheaded by a public health specialist. A survey form (**Appendix 8**) was designed and the person who assisted in conducting the survey trained in the use of the form and surveying techniques. The survey was executed, the data collected using the forms and the data analysed via an excel programme.

The result of the survey revealed that the existing levels of the identified illness potentially associated with the project among residence within the sphere of influence (2 km) of the project were as follows:

- | | |
|------------------|----------|
| ➤ Lung Disease | - ~ 2% |
| ➤ Heart Disease | - ~ 1% |
| ➤ Asthma | - ~ 12% |
| ➤ Sinus Problems | - ~ 24% |
| ➤ Birth Defects | - < 0.2% |



Figure 32: Interview being conducted during the Health Status Survey

Mitigation

Cement operations directly emit particulate matter (PM) as well as gases that undergo chemical reactions to form fine particles in the atmosphere, such as SO₂ and NO_x. The emissions of PM, SO₂ and NO_x increase the ambient concentration of PM less than 2.5 microns in diameter (PM_{2.5}). Exposure to PM_{2.5} has been consistently linked with increased mortality from cardiopulmonary diseases, lung cancer (Cohen et al., 2005; Pope et al., 2002), and numerous other respiratory illnesses and associated morbidity (Pope, 2000).

It is recommended that the project incorporate modern pollution controls such as, vegetation barriers, programme of wetting of exposed areas and roadways, bag filters, electrostatic precipitators (ESPs), and flue-gas desulfurization (FGD) which can reduce sulfur dioxide emissions by 90%, resulting in substantial human health risk reductions. Continuous emission monitoring should also be done and an appropriate system put in place to take action if and when parameters exceed permissible levels. A programme to monitor health impact of the project should also be developed and implemented.

NEPA's SPECIFIC COMMENT

4.9 Use of Red Mud

The document indicated that red mud (bauxite waste) will be used as an additive in the cement manufacturing process. No details on the environmental and occupational health hazards which could emanate from this application were included. The potential for other environmental challenges due to the susceptibility of the kiln process to flux formation and the impact on the emissions containing pollutants was not considered. There was insufficient information provided on the source of the red mud, the method of removal from the storage areas and its subsequent transportation to the site.

RESPONSE:

BAUXITE/RED MUD

Red Mud is the main product of making Alumina from bauxite via the Bayer Process. It is the residue after the soluble alumina minerals in the bauxite are extracted in the caustic (NaOH). Besides the essentially non soluble constituents of bauxite, such as iron and titania minerals, the red mud also contains some undigested soluble minerals and other components such as sodium-aluminium hydro-silicates formed during the course of processing, as well as the lime which is used as the flux in the clarification of the liquor.

The mud is commonly washed and sent to a designated area for disposal. The red mud is commonly called bauxite tailings.

These tailings are generally disposed of in ponds, rich in NaOH, and thus highly caustic with a pH between 13 and 13.5. It is thus of high toxicity. At this stage the tailings is regarded as hazardous material.

In recent years attempts, have been made to reduce the amount of adherent liquor in the mud which results in a mud with a higher solid content, lower caustic content, and hence lower toxicity. Different methods of disposal are being used since then.

It must be noted that the review of Basil Convention which controls the trans boundary movement of waste, has adopted a pH of 11.5 for bauxite residue as hazardous waste criterion. Thus, if the pH value of this mud (as a result of the reduction of its caustic content) reaches below 11.5 then the relatively dried mud is no longer regarded as hazardous.

In 1985 ALCAN adopted the dry stacking technology and installed a dry stacking method of disposal in their Ewarton Plant, in Jamaica.

Usually in the dry stacking mud process, the residue is thickened to high density slurry of between (48% to 55%) or even higher by advanced thickener and flocculation technologies at the alumina plant.

The residue slurry in the case of the (Ewarton plant) is deposited on a terraced slope and allowed to consolidate and dry before successive layers are deposited.

All draining and surface water flows from this slope are recovered and pumped back to the plant to recover the soluble sodium salts. The dry stacked residue is also commonly “under drained” to heighten the consolidation of the residue and any further liquid recovered is also returned to the refinery. The combination of this dry stacking in well-drained deposits leads to a relatively dry and a “very stable deposit of residue” (according to the International Aluminium Institute, April 2011).

Independent confirmation of the non-toxic, low-caustic, and non-hazardous nature of the Ewarton deposit have been received from International Development Research Centre Project Material Specialist (Dave McLeod, by means of personal communication) who stated that the pH of the stacked material is above 9, but well below 11; and from PFC Engineering’s Geological Engineer (Phil Band, by means of personal communication) that although the exact level of pH could not be recalled, the material was confirmed to be non hazardous.

In fact, the project commissioned by IDRC in 1986, (IDRC FILE 3-P-86-1039), produced bricks from the dry stacked red mud deposit in Ewarton. These bricks were subsequently used to construct a building used as a sports club. The project was reviewed Glanville (1991) who was satisfied that “health and safety standards were met”.

Cement Jamaica Limited is proposing to garner the semi-dry to dry red-mud from the dry-stacked residue in Ewarton to become part of the raw material mix for the production of Ordinary Portland Cement.

The Company plans to secure some 116,000 tons per year of only dry material to be removed by regular front-end loader and transported in closed railway cars, each with 60 tonnes of material from the plant in Ewarton directly to the Plant site in Old harbour where the material will be kept in dry storage (covered storage) before it is dispensed as part of the raw material mix.

Below is the chemistry of the dry stack red mud (**Table 2**) and the concentrations of elements in Jamaican red mud which show no chemical concentrations that are high enough to be regarded as hazardous or detrimental.

TABLE 2: Chemistry of dry stack red mud

RED MUD CHEMISTRY							
Column1	OXIDES	SGS	Column4	SINOMA	Column5	MGD	Column6
	AL2O3	19.2		20.71		16.34	
	FE2O3	41.2		43.46		35.8	
	K2O	0.03		0.12		0.15	
	MnO	1.01		1.06		0.8	
	Na2O	2.23		2.28		1.73	
	SiO2	4.25		3.78		3.58	
	CaO	7.79		6.63			
	MgO	0.19		1.34			
	Cr2O3	0.17		0.36			
	V2O3	0.15					
	TiO2	5.29		4.04			
	LOI	15.7		14.75			
	TOTAL	98.32		98.32			

TABLE 3: Concentration of elements in dry Jamaican Red mud using Neutron activation analysis

ELEMENT	CONCENTRATION (PPM)
Sodium	19,500
Scandium	135
Chromium	830
Iron	322,000
Cobalt	87.2
Arsenic	91.6
Antimony	10.3
Lanthium	504
Cerium	655
Neodymium	248
Samarium	66.2
Europium	16.2
Terbium	9.23
Ytterbium	28.5
Lutetium	4.13
Hafnium	36
Tantalum	8.09
Thorium	86.2
Uranium	70.4



Figure 33: Photos of the Red Mud Deposit at Winalco Ewarton Works

"Red Mud" has been used successfully as a raw material component in the manufacture of cement for many years in many parts of the world including Greece, India, Japan and China. In

India, for example, it is reported that 2.5 million tonnes were absorbed by the cement industry in 1998-99. In general, the potential for danger to human health and the environment is low and the material is classified as non toxic and non dangerous. However, toxicity is related to the disposal method practiced and there is always a possibility of (heavy) metals leaching if the appropriate actions are not followed. Conventional disposal methods involve the construction of clay-lined dams or dikes into which Red Mud is simply pumped and allowed to dry naturally. Therefore, the storage/reservoir/settling ponds must be of a proper design in order to ensure containment/avoid a break in the dike. By the time the red mud arrives to the cement plant, it will have already been allowed to air-dry for a few years at the alumina manufacturing plant. Therefore, the storage design of the red mud at the cement plant will be of a clay-lined, roof-covered storage hall that will prevent the air-dried red mud from becoming saturated which could lead to subsequent leaching. Focus is therefore on the behaviour of the red mud in the kiln process.

Prior to entering the cement process, the red mud has already been dewatered and it will be stored under "clay-lined, covered building" at the cement plant in Bodles. The dry solids will be transported from rail cars by truck to the cement plant, where the waste materials will be used in place of other iron-rich raw materials, which would otherwise have to be imported.

During 50 years that the cement plant is expected to be in operation, nearly 6 million tonnes of red mud waste are expected to be processed by Cement Jamaica Limited which will preserve natural resources. This is therefore a very positive impact as it provides for an environmentally safe and economically beneficial method for the disposal red mud.

Portland cement clinker is made by heating, in a kiln, a homogeneous mixture of raw materials to a sintering temperature, which is about 1450 °C for modern cements. The alumina oxide (principally from the clay) and iron oxide (principally from the red mud) are present as a flux, forming 0-18% tetracalcium aluminoferrite $(CaO)_4 \cdot Al_2O_3 \cdot Fe_2O_3$, and contributing little to the cement's strength.

The alumina and iron are used in order to produce liquid ("flux") in the kiln burning zone. Here's how: The raw-mix is formulated to a very tight chemical specification (typically, the content of individual components in the raw-mix is controlled within 0.1% or better). Calcium and silica are present in order to form the strength-producing calcium silicates. As mentioned, the alumina and iron are used in order to produce liquid ("flux") in the kiln burning zone. This liquid acts as a solvent for the silicate-forming reactions, and allows these to occur at economically low temperatures. Insufficient alumina and iron lead to difficult burning of the clinker, while excessive amounts lead to low strength due to dilution of the silicates by

aluminates and ferrites. The relative amounts of each oxide are therefore kept constant in order to maintain steady conditions in the kiln, and to maintain constant product properties. In practice, the raw-mix is controlled by frequent chemical analysis (hourly by X-Ray fluorescence analysis, or every three minutes by prompt gamma neutron activation analysis). The analysis data is used to make automatic adjustments to raw material feed rates. Remaining chemical variation is minimized by passing the raw mix through a blending system that homogenizes up to a day's supply of raw-mix.

The raw mixture is heated in a cement kiln, a slowly rotating and sloped cylinder, with temperatures increasing over the length of the cylinder up to a peak temperature of 1400-1450 °C. A complex succession of chemical reactions takes place as the temperature rises. The peak temperature is regulated so that the product contains sintered but not fused lumps. Sintering consists of the melting of 25-30% of the mass of the material. The resulting liquid draws the remaining solid particles together by surface tension and acts as a solvent for the final chemical reaction. Too low a temperature causes insufficient sintering and incomplete reaction, but too high a temperature results in a molten mass or glass, destruction of the kiln lining, and waste of fuel. According to plan, the resulting material is cement clinker.

Except for mercury, any heavy metals present in the red mud, clay or any other raw materials will naturally re-circulate between the high-temperature burning zone of the kiln and the low-temperature pre-calcining zone of the pre-heater tower. Therefore, no heavy metals (apart from Mercury) will be emitted from the exhaust gas stack of the cement plant. Over time, the heavy metals will, therefore, be concentrated in the cement kiln dust which will be continuously circulated as part of the cement manufacturing process. There is no provision to waste any cement kiln dust from Cement Jamaica Limited. Thus, the use of red mud as a raw material in cement manufacture will offer a beneficial alternative to land filling. Moreover, as shown in Tables 1A and 1B, the analysis of the red mud is absent of mercury.

NEPA's SPECIFIC COMMENT

4.10 Use of Clay

Clay is also mentioned as one of the raw materials for the project however the EIA does not provide sufficient details on the source of the material, nor on the possible environmental impacts from any mining of clay for the project. All of these issues must be detailed and suitable mitigation for all identified potential impacts provided.

RESPONSE:

Clay Information

The initial approach to source clay for the cement production process was to purchase from existing clay mine in the Tarentum area of Clarendon. Since the submission of the EIA, a more suitable clay deposit has been identified adjacent to the cement plant site. This property consists of an approximate 37 hectares of land adjoining the eastern boundary of the cement plant site and was recently acquired by Cement Jamaica Limited. The figure below identifies the site of the clay deposit.

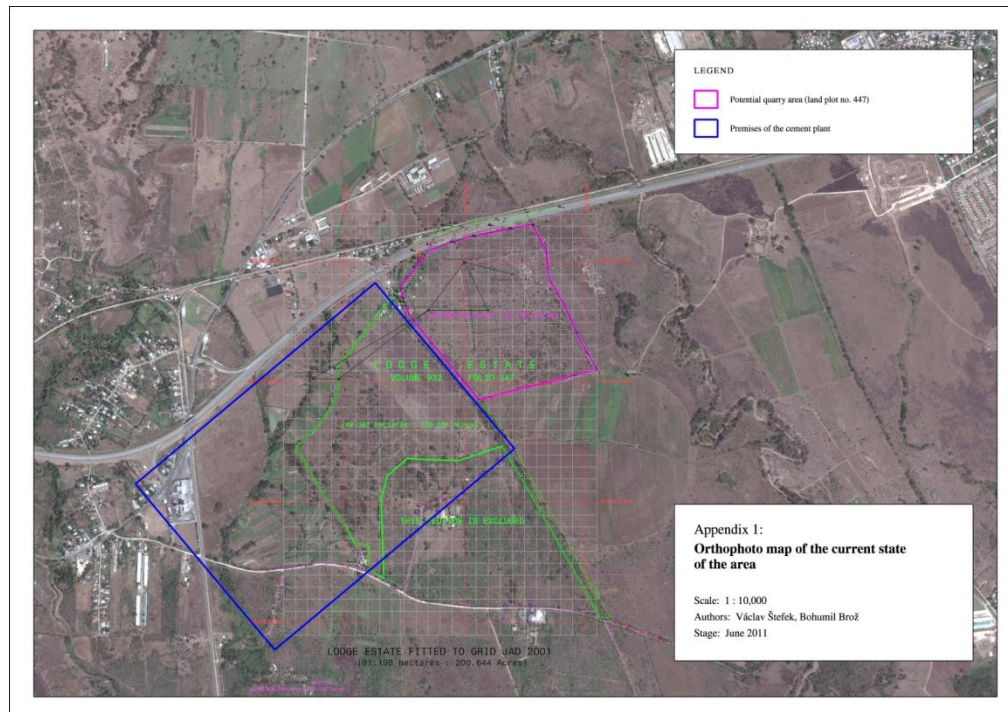


Figure 34: Map showing Clay Deposit

A preliminary clay mining plan is included as **Appendix 8**, which provides the required details of the clay mining operations.

Mining process description

The area designated for clay mining is flat, and its surface slopes gently to the south from 28-22 m ASL. In order to thoroughly extract the clay raw materials in the designated area, quarrying is proposed to take place on horizontal benches with 5 m high quarry faces, with an option involving gently sloping bench levels reflecting the gentle slope of the surface. At an extraction rate of 420,000 tonnes per year the mine should be able to provide 38 years of supply.

The proposed initial phase of quarrying, which includes the gradual construction of a main haul road, is planned from the north-western edge of the area to the south, which represents a gradual deepening as the quarry advances to lower benches. The proposed main advance of the quarry would lead from the west to the east along the southern edge of the area.

After opening a sufficiently wide working face, quarrying would continue to proceed in a northerly direction on individual benches. Individual quarry faces must be set back enough to provide sufficient room for quarrying and haulage machinery to manoeuvre in.

The proposed quarry will have horizontal benches with 5 m high quarry faces. An option to be considered are gently sloping bench levels reflecting the surface terrain, allowing for easier drainage of the quarry area by gravity, as proposed in the deposit cross-section. The option of gently sloping benches means that the base level would slope from 5 m ASL in the north to 3 m BSL in the south, where a mine water accumulation reservoir and pumping stations would be constructed. The accumulated water will be pumped to the drainage system that has been designed for the site.

The possible variability of the raw material at different levels can, to a certain extent, be eliminated by producing and combining the extracted raw material from individual quarrying areas (individual levels) and by producing a homogenous mixture for further combining. It is assumed that quarrying will occur simultaneously on several levels and that the planned combining of the raw material mixture will proceed according to a verified composition.

The quarry floor will be determined according to the deposit base and character of the underlying rock. Provided that there is a limestone floor, an uneven, broken quarry floor with various signs of karstification may be expected.

Overburden stripping and pile re-utilizing

The overburden thickness was not verified, however it is assumed to be rather small. Vegetation cover and minimal soil layers will evidently have to be removed. The overburden thickness will probably differ from area to area. The overall average thickness depends on the

character and depth of the superficial weathered rock. For example, an overburden thickness of up to 1 m would amount to a volume of up to 365 thousand m³.

After the first phase of preliminary quarry work (overburden removal at the southern edge of the quarry), it is proposed to deposit the overburden at the northern edge of the property along Highway 2000.

The purpose is to create a protective berm, which would separate the future quarry from the road. If the berm was built in its entire length of 450 m along the highway as indicated, it would allow for 8 thousand m³ of overburden to be deposited at a width of 10 m, a height of 3 m, and at a slope of 35°, or for about 23 thousand m³ at a width of 16 m and a height of 5 m. It would be possible to potentially increase the volume, if the option of a larger-scale berm was chosen. We propose to plant vegetation on the constructed berm in the final phase.

Reclamation and closure plan

A lake with a water level of 20-22 m ASL is expected to be created by natural flooding after the quarrying operations and mine water pumping are terminated. The borders of the mined-out area will be reclaimed by planting tree species or by natural succession.

A similar reclamation process was utilized for a clay mine in Salem County, New Jersey, USA and pictures are shown below.



Figure 35: *Mined out area in Salem County NJ - 1994*

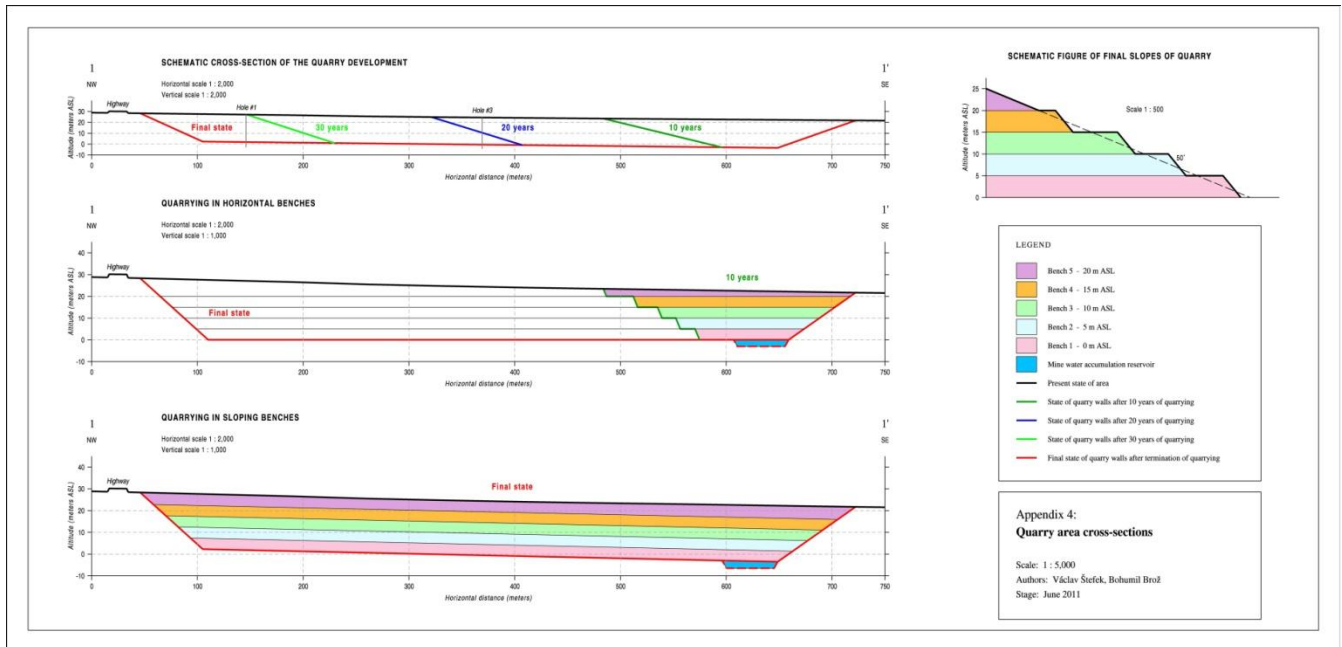


Figure 38: Cross-Section of Clay Mining

Impact and Mitigation

The main impacts resulting from the clay mining operation are:

IMPACT	MITIGATION	RESIDUAL IMPACT
Loss of land use option.	The restoration plan will provide for alternate use such as recreational.	The area is zoned for industrial development and would eventually be put to some such use.
Loss of vegetation on site clearance.	Phasing of mining operation to minimize exposed area.	Vegetation loss cannot be avoided, but successful restoration will result in long term improvement.
Destruction of fauna habitat.	Replanting of trees in the green area reserved around the site, and relocation of any species of significance.	Relocation of fauna to neighbouring area is expected.
Damage to landscape and visual aesthetics.	Planting of vegetation barrier along constructed berm.	Restoration plan should result in improved aesthetics in the long term
Release of dust emissions from quarrying operations.	Use best practice management techniques during extraction and transportation.	Negligible especially as there is no residential area in close proximity.
Noise from heavy equipment operation.	Good site management including the appropriate choice of machinery.	Negligible especially as there is no residential area in close proximity.

NEPA's SPECIFIC COMMENT

4.11 Co-Generation Plant and Coal Fired Power Plant

A proper environmental assessment is required for both the co-generation and the coal-fired power plants being proposed. This information should include details on the specifications of the systems and an assessment of all environmental and other issues related to the construction and operation of such systems. This should also be supported with detailed plans/diagrams and some statements with respect to the source, transportation and storage of the fuel source. It is essential that the review of alternatives includes a section on the fuel required for the generation of electricity.

RESPONSE:

Power Generation for Cement Plant

Introduction

Cement Jamaica Ltd intend to construct a 5000t/d clinker cement line at Port Esquivel in Old Harbour which lies in the northwest of Jamaica capital Kingston and a self-supply power station is proposed to be built to satisfy the operation of the cement plant.

The self –supply power station consists of one coal-fired power station and one waste heat recovery power station which uses the heat of exhausted gas from the cement plant operations (pre-heater and cooler of the cement manufacturing process).

The initial intent as stated in the EIA that was previously submitted was for a total of 54 MW. A review was done and the decision taken to reduce the size to 39 MW. This could be considered as a positive change which will result in the need for less fossil fuel (coal) and hence less emissions.

Character of self-supply power plant

The power plant is a self-supply power plant for the cement plant, which operates and networks with the electricity grid and supplies power for the cement plant.

Scope of design

The installation of manufacture and auxiliary devices and civil project design, contains:

- (1) General plan and layout of the plant
- (2) Layout of main house

- (3) Coal-fired power generation system
- (4) Ignition oil system
- (5) Pulverized coal preparation system
- (6) Ash & slag disposal system
- (7) Desulfurization system
- (8) Waste heat recovery power generation system of cement kiln
- (9) Chemical water disposal system
- (10) Circulating water system
- (11) Electric single line and auxiliary power system
- (12) Thermal control system
- (13) Air ventilating and conditioning
- (14) Water supply and drainage, fire fighting system
- (15) Environmental protection
- (16) Labour safety and industrial hygiene.

Design and configuration principle of system

(1) Pay attention to the safety and stability of the power supply to ensure the power supply is safe and stable to meet the power demand of plant.

(2) The selection of system and equipment will abide by the principle of proven reliable, advanced, energy-saving and environmental-protection.

(3) The power supply system should match the cement plant power load.

(4) Coal-fired boiler unit is the main unit which also be used to regulate the load of the system.

(5) Main configurations of waste heat recovery power generation system will be defined by the waste heat resources (i.e. mass and energy balance of the waste heat from cement plant operations).

(6) Make full use of the waste heat without affecting the normal production of cement line.

Main codes and standards

All systems of self-supply power station will follow the Chinese National Standards and Industrial Codes. The main Chinese Codes are as follows:

- (1) GB50049-1994 Code for design of small-size power plants;
- (2) DL/T5054-1996 Code for design of thermal power plant steam/water piping;
- (3) SDGJ6-1990 Thermal power plant steam & water pipeline calculate technical requirements;
- (4) DL/T5072-2007 Code for designing insulation and painting of power plant;
- (5) DL5053-1996 Code for design of labour safe and industrial hygiene of power plant;
- (6) DL1612-1996 Code for safety monitor of power station boiler and pressure vessel;
- (7) GB1576-2001 Code for safety technique monitor of power station pressure type de-aerator;
- (8) DL /T 5024-2005 Ground treatment Technical code of fossil fuel power plant;
- (9) GB 50016-2006 Code of design on building fire protection and prevention;
- (10) DL /T 5094-1999 Technical code for building design of building in fossil fuel power plant;
- (11) GB50229-96 Code for design of fire protection for fossil fuel power plants and substations;
- (12) GB50260-1996 Code for design of anti-seismic for power facilities;
- (13) DL/T5068-1996 Technique code for chemical design of power station;
- (14) DLGJ24-1991 Code for design of living and fire fighting water, water drainage of thermal power plant;
- (15) SDJ26-1989 Code for cable selection and laying of power plant and transformer substation;
- (16) GB50052-1995 Design specifications for the power distribution system;
- (17) GB50053-1994 10kV and the following substation design specifications;
- (18) GB50062-1992 Electrical installations in the relay and automatic device design specifications;

(19) DLGJ9-1992 Code for design of thermal automation of power plant.

1.6 Design scale and planned capacity

The total capacity of self-supply power plant is 39MW.

(1) One coal-fired power generation system configured with two (2) high-temperature, high-pressure pulverized coal boilers with the steam capacity of 70 t/h and one high-pressure pure condensing turbine generator.

(2) Waste Heat Recovery (WHR) System with one (1) horizontal SP (Suspension Pre heater) boiler and one (1) AQC (Air Quenching Cooler) boiler, and one (1) low pressure pure condensing turbine generator with capacity of 9MW.



Figure 39: Picture of a typical co-generation plant

Alternative Analysis to Coal

When a cement kiln is fired by coal, the ash of the coal acts as a secondary raw material input to the cement manufacturing process. Nowadays, cement kilns have become more efficient with average heat consumption less than 750 kcal/kg of clinker. It can be estimated that a kiln producing 5,000 mtpd (metric tons per day) of clinker leads to an energy consumption of approximately 155 Gcal/h, something around 21 mt/h of coal, or 167,000 mt/year of that fuel. At the present, the price of pulverized coal at burner tip is about 85 US\$/t, and consequently the total costs related to fuel consumption is approximately 14,000,000 US\$/year, what is a huge percentage of the cement production costs.

However, the same plant, should it operate on fuel oil alone, would consume around 18 mt/h of fuel oil, or 142,000 mt/year. With a cost of US\$ 300/mt, the fuel costs could reach up to US\$ 43,000,000 per year. After the oil crisis of 1973 and 1979, the industries were forced to seek alternatives to fuel oils, such as coal, to cut spending. In the late 1970's coal became the fuel of choice for the vast majority of cement plant and, in the 1990's, petcoke appeared as a cheaper alternative. Previously used only in refineries, today petcoke is widely used as fuel in the cement industry, due to its low cost and process tolerance to its high sulphur content.

In terms of alternative analysis, the exact same argument applies for the power plant as for the cement plant. Diesel or fuel oil is cost-prohibitive compared to coal.

All the details of the power generation plant/s (30 MW coal and 9 MW Co-generation, including environmental impacts and mitigation as well as pollution prevention technologies are set out in Appendix 9 attached to this document – “Power Plant Specifications”).

Impact and Mitigation

The main impacts resulting from the clay mining operation are:

IMPACT	MITIGATION	RESIDUAL IMPACT
Loss of land use option.		Negligible as the footprint of the plant is no significant
Loss of vegetation on site clearance.	Greening of areas around the plant.	Vegetation loss will not be significant as the footprint of the plant is relatively small.
Damage to landscape and visual aesthetics.	Landscaping of areas around the plant and painting in attractive colours.	Restoration plan should result in improved aesthetics in the long term.
Release of dust emissions from coal transportation and grinding operations.	Use best practice management techniques during grinding and transportation. Appropriately designed filters	Negligible as the mitigation is capable of preventing any significant impacts.
Noise from operation.	Equipment is design foe low noise operation.	Negligible especially as there is no residential area in close proximity.
Stack emissions from the burning of fossil fuel (coal).	Desulphurization unit, bag filter and continuous monitoring with automatic shut down	Impact should not be significant as indicated by the Air Dispersion Model
Cheaper source of energy.		Cheaper cost of production which should result in lower cost for the product to consumers.

NEPA's SPECIFIC COMMENT

4.12 Air Quality Review

- The proposed fuel of choice for the 45MW Power Plant and Kiln is Coal, the Report failed to identify or make mention of the potential impacts of Mercury, Lead and other Persistent and Priority Air Pollutants known to be common in emissions from the combustion of this type of fuel. The Report needs to identify the emission rates of each of these potential pollutants, its potential impacts on the environment as well as the control technologies that will be in place to mitigate or eliminate these impacts inclusive of proposals to deal with any contaminated material generated by the mitigation activities.

RESPONSE

A revised Air Dispersion Modeling was done, taking into consideration the potential impact of Mercury, Lead and other Persistent and Priority Pollutants known to be common in emission from the combustion of this type of fuel. The revised report (**Appendix 10**) has identified emission rates for each of the potential pollutants.

Approach for emission rates in the Air Dispersion Modelling

According to the Natural Resources Conservation Authority Ambient Air Quality Guideline Document (2006), emission rates for new sources should be computed based on the following methods:

- Published emission factors (AP42)
- Actual or representative stack test data
- Manufacturers test data
- Material balance, or
- Other engineering methods approved on a case-by-case basis

In the case of the 5000 MTPD cement manufacturing facility, manufacturer's emission data were made available from the design engineering team for the criteria pollutants (particulates, sulphur dioxide, nitrogen oxides and carbon monoxide). However, for non-criteria pollutants (hazardous or priority air pollutants, including mercury and lead), published emission factors from AP42 documentation were utilized to determine the emission rates. These emission rates as output from the stacks were then inputted into the air dispersion model to determine the predicted ground level ambient concentrations.

It should be observed that during the operational stage of the facility, actual stack test data may need to be obtained via the use of continuous emission monitors or a stack emission test exercise. In fact, according to the Natural Resources Conservation Authority (Air Quality) Regulations, 2006, an application for an air pollutant discharge licence for a new facility will need to be submitted to the National Environment & Planning Agency within eighteen months from the date on which the facility commences operations. Such application will include a new air dispersion modelling exercise, and it is contemplated that actual emission data would be available for that exercise.

Table 4: Model Results – Proposed Cement Facility

Pollutant	Avg. Period	Background ($\mu\text{g}/\text{m}^3$)	Significant Impact Concentration ($\mu\text{g}/\text{m}^3$)	Jamaican NAAQS ($\mu\text{g}/\text{m}^3$)	Proposed Cement Plant Sources		
					Max Conc ($\mu\text{g}/\text{m}^3$)	UTME (m)	UTMN (m)
PM ₁₀	24-hr	9	80	150	55	272744	1983247
	Annual	20	21	60	19	274380.56	1982361.62
NO ₂	1-hr	0	N/A	400	321	272744	1990647
	24-hr	0	80	N/A	25	272244	1988647
	Annual	0	21	100	6	273544	1983347
SO ₂	1-hr	0	N/A	700	58	272744	1991147
	24-hr	0	80	280	5	272744	1991147
	Annual	0	21	60	1	273544	1983447
CO	1-hr	0	2000	40000	2.3	272744	1990647
	8-hr	0	500	10000	0.5	272244	1988647
Antimony	1-hr	0	N/A	62.5	0.00134	N/A	N/A
	24-hr	0	N/A	25	0.0001	N/A	N/A
Arsenic	1-hr	0	N/A	0.75	0.03053	N/A	N/A
	24-hr	0	N/A	0.3	0.00234	272244	1988647
Beryllium	Annual	0	N/A	0.0013	0.00002	N/A	N/A

Cadmium	1-hr	0	N/A	5	0.0038	272744	1990647
	24-hr	0	N/A	2	0.00029	272244	1988647
Chromium	1-hr	0	N/A	3.75	0.01468	272744	1991147
	24-hr	0	N/A	1.5	0.00113	272244	1991147
Cobalt	24-hr	0	N/A	0.12	0.00057	272244	1988647
Lead	1-month	0	N/A	N/A	0.00061	N/A	N/A
	3-month	0	N/A	2	N/A	N/A	N/A
Manganese	Annual	0	N/A	119	0.00043	N/A	N/A
Mercury	1-hr	0	N/A	5	0.00629	272744	1990647
	24-hr	0	N/A	2	0.00049	272244	1988647
Nickel	1-hr	0	N/A	5	0.02076	272244	1988647
	24-hr	0	N/A	2	0.00159	272244	1988647
Selenium	1-hr	0	N/A	25	0.09764	272744	1990647
	24-hr	0	N/A	10	0.00751	272244	1988647

Table 5: Priority Air Pollutant Emission Rates for Proposed Cement Plant

Description	Raw Material Grinding and Exhaust Gas Treatment,	Power Plant Main Stack
Stack ID	RMG&EX3	PPMS
Pollutant Emission Rates, g/s		
Antimony	N/A	1.25E-04
Arsenic	3.47E-04	2.85E-03
Beryllium	1.91E-05	1.46E-04
Cadmium	6.37E-05	3.54E-04
Chromium	4.05E-03	5.49E-04

Cobalt	N/A	6.94E-04
Lead	2.17E-03	2.92E-03
Manganese	N/A	3.40E-03
Mercury	6.94E-04	5.76E-04
Nickel	N/A	1.94E-03
Selenium	5.79E-03	9.03E-03

Conclusion

The following are conclusions that are presented in the revised report based on the result of the air dispersion modelling analyses for the proposed cement manufacturing facility:

1. The emission rates for PM, NO_x and SO₂ that will be emitted from the proposed cement manufacturing facility are in compliance with their respective emission standards (see Table 3-6 of the full report). It may be inferred that these emission standards would not be exceeded based on the superior suite of air pollution control technology (fifty sets of fabric filters and a desulphurization unit) to be employed by the proposed cement manufacturing facility.
2. The model predictions for the proposed cement manufacturing facility revealed compliance with the CO, PM₁₀, NO₂ and SO₂ ambient air quality standards and the all priority air pollutant guideline concentrations for the requisite averaging periods. The incremental impact of the criteria air pollutants were also less than the established values that would have created a significant air quality impact.
3. The proposed cement manufacturing facility only has a minor contribution to the overall peak modelled short term concentrations for CO, PM₁₀, NO₂ and SO₂.
4. Since the proposed cement manufacturing facility sources demonstrated compliance with the ambient air quality standards and the guideline concentrations, as well as the significant impact incremental values, it is envisaged that approval will be granted for the establishment of the facility.

NEPA's SPECIFIC COMMENT

4.13 Process related Air Quality Issues

- Bag house filters and a desulphurization unit are mentioned as controls for emissions on the kilns, various emission points and the Power Plant. The EIA mentioned that supplier's values will be maintained on each of these units - which are better than IFC and NEPA standards. The EIA must provide detailed design and specification for each of these units so that the Agency can determine their efficacy in meeting these "stated" values.

RESPONSE

Details of the desulphurization system and specifications for all the bag filters are presented below.

Desulphurization System Description and Specification

Summary

This project uses a lime-gypsum wet desulfurization process, which is proven to be a reliable technical solution to minimize SO₂ emissions (more than 95 percent of desulfurization project use this kind of technical solution). The desulfurization chemical is a mixture of lime powder and water. Micro-fine Lime is widely used in the world because it has a favourable chemical reactivity and inexpensive price. The product of the reaction between SO₂ and CaCO₃ is CaSO₃. It is then necessary to forcefully oxidize the CaSO₃ to form gypsum, CaSO₄ · 2H₂O which can be used to make cement or sold as by-product after dehydration.

This project uses a traditional single-loop spray tower. In the bottom of the tower, there are a series of tanks equipped with oxidizing gas pipes, and three layers of de-misters in the top of the tower. The gas from the boiler is desulfurized in the absorption tower, where the efficiency rate is 96% or more. The product (suspended grains of CaSO₃) will then be forcefully oxidized to suspended grains of gypsum. Moreover, as a result of the acid-base reactions, the other harmful matters (fly ash, HCl, HF, etc.) will also be largely removed.

The desulfurization chemical (lime powder) is mixed to 30% solution and then fed into absorption tower by lime slurry pump. The by-product, gypsum is pulled from slurry tank by the gypsum discharging pump, and fed into the gypsum cyclone station (primary dehydration system). The percentage of moisture found in the gypsum slurry after primary dehydration is about 50%, and this resulting slurry is then sent to vacuum belt filter for secondary dehydration. Here, the percentage of moisture will be reduced to less than 10%. In the

secondary dehydration system, the gypsum filter cake will also be washed to remove chloride, in order to make sure the chloride content is less than 100 ppm. This is to ensure the product can be used to manufacture plasterboard or as an additive for the manufacture of cement.

A description of the sub-systems is as follows:

Gas system

Exhaust gas from the two (2) coal-fired boilers is treated by a bag filter dust collector and the resultant flue gases are then combined and lead into the FGD system. The mode is 'one absorption tower for two boilers'. The gas is guided into absorption tower. In the absorption tower, the flue gases react with lime-gypsum slurry to remove the SO₂. The temperature of flue gas is reduced to the saturation temperature (about 51.5°C) in order to maximize the chemical reaction. After desulfurization, the clean gas will be demisted by demister on the top of tower. Finally, the cleaned gases will be led into stack through clean gas emissions stack, and released to the atmosphere.

This project has 5 dampers: two (2) dampers for bypass, two (2) dampers for raw gas (inlet side of the FGD system), and one (1) damper for the cleaned gas (outlet of FGD system). In normal operation, the bypass dampers are closed, while the raw gas dampers and the clean gas damper are opened. Raw gas is led into the absorption tower through the raw gas damper. In case it is necessary to stop the operation of the FGD system, the bypass damper will quickly open automatically and the raw gas damper and clean gas damper will close.

In order to prevent leakage, all of the dampers have double-baffle structure, and have a "seal gas system". The "seal gas system" has two (2) seal gas fans: one (1) fan for use and one (1) fan for standby. Its mode of operation is by gas temperature. The "seal gas fan" pressure is designed for at least 500Pa higher than the desulfurization gas to ensure there is no leakage.

Gas resistance of the desulfurization system is overcome by the forced draft fan. The FGD system has positive pressure to prevent heat damage to the fan that that the FGD system can be operated safely and continuously.

Choice of main Equipment

The main equipment of flue gas desulfurization system includes: forced draft fan, gas damper, expansion joint, etc. The Forced Draft Fan (i.e. the boiler draft fan) provides sufficient pressure to overcome the pressure losses for the desulfurization system to make sure the gas can flow through the whole FGD system from the inlet to the stack. There are two (2) sets of 75t/h steam boilers and each has a centrifugal fan, which are parallel and connected to one another to allow the gas to flow into boiler main horizontal flue. Based on Chinese Codes, DL5000-2000, the safety margin for pressure rating 1.2 and the safety margin for volumetric

flow is 1.1, and the safety margin for temperature is to add 10°C. There is no gas corrosion in the forced draft fan so the primary concern is only for the wear of the fan rotor and its maintenance and replacement over the operating life time of the main fan unit which is 30 years or more. 2 seal gas fans..Adequate capability and pressure is considered in design.

The SO₂ absorption system is the center of desulfurization system. Included equipment in the absorption tower is the spray lances, the demisters, the slurry circulation pump, the oxidization fan, etc. In the absorption tower, gas comes into contact with absorption slurry which is atomized by sprayer. As mentioned above, the product of the reaction between SO₂ and CaCO₃ is CaSO₃. CaSO₃ is oxidized by the gas from oxidization fan in the slurry tank to produce gypsum, which will be discharged into dehydration system by discharge pump. The gas flows through the secondary demister to remove tiny liquid droplets carried by clean gas. The liquid droplet quantity of gas is less than 75mg/ Nm³ (dry basis). Finally, the cleaned gases are released from the top of the absorption tower.

The desulfurization system for this project is a counter-current spray column absorption tower. Its height is 30.8m; its diameter is about 7m. The lime slurry from the slurry tank is injected into the bottom of the spray tower and the demisters (consisting of 3 spray lances). There is one circulation pump for each bank of 3 spray lances

The body of the absorption tower is a steel structure, lined with high quality imported protective lining. The absorption tower has three (3) centrifugal circulation slurry pumps (no standby pumps) and two (2) forced oxidization Roots blowers (one for operation and one for standby).

When the desulfurization system trips or the tower is down for maintenance, the absorption slurry in the tower will be discharged into the emergency slurry tank by gypsum discharge pump.

The slurry tank is equipped with (3) blenders, lying horizontally and radial to keep the tank agitated so as to prevent build-up of sediment and maximum absorption/reaction with SO₂.

In the absorption area, the steam in the gas is saturated. Therefore, the loss of water is made up by fresh industrial water (through the washing equipment of demister) and circulation water (filtrate water). Both of these two methods can be used to maintain the liquid level of the tower.

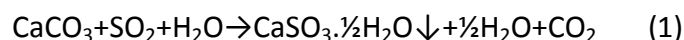
In the top of the tower, there is an exhaust damper which is closed during normal operating conditions. When the bypass damper is opened and the raw/clean gas dampers are closed. The exhaust damper is open to release the difference in pressure between the tower

and the atmosphere because the oxidization fan will still run or continue to run while cooling down.

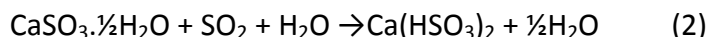
Theory of reaction

The reaction theory in the absorption tower is as follows:

SO₂ in the gas reacts with the CaCO₃ slurry to produce CaSO₃.



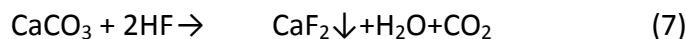
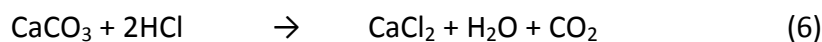
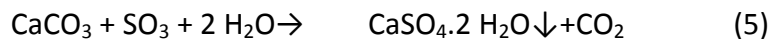
Some of the CaSO₃ reacts to form gypsum:



The CaSO₃ remaining in the slurry tank is oxidized to produce CaSO₄.



The other reactions are as follows:



The pH value in the slurry tank is controlled by the fresh lime dosing content. The reaction in the tank needs sufficient retention to produce favourable gypsum quality (CaSO₄·2H₂O).

Parameter and energy consumption that affect the efficiency of desulfurization

Table 6: Reaction Table between main operating parameter, SO₂ emissions, and energy consumption

item	value	Desulfurization rate	Energy consumption
Circulation quantity of absorption tower	↑	↑	↑
PH value	↑	↑	=
CaCO ₃ in absorption tower	↑	↑	=

activity of lime	↑	↑	=
Quantity of gas	↑	↓	↑
SO ₂ FGD inlet concentration	↑	=	=
Cl content in gas	↑	↓	=

The technical parameters for the absorption tower are given below:

Table 2: Main parameter of absorption tower

Item	unit	value
– Type of absorption tower (spray tower/liquid column tower)		spray
– Flow direction (counter-current / con-current)		Counter-current
– Quantity of gas inlet (standard conditions, wet basis)	Nm ³ /h	298,235
– quantity of gas outlet (standard conditions, wet basis)	Nm ³ /h	322,045
– Design pressure	Pa	2,000
– circulation retention time	min.	4
– time for fully discharge	H	15
– ratio of liquid/gas (L/G)	L/m ³	18.6
– quantity of gas	m/s	3

– retention time of gas in absorption tower	S	4
– chemical gauging ratio CaCO ₃ /SO ₂ (removed)	Mol / mol	1.03
– solid content of tank min/max	Wt%	15/20
– Cl content	G / l	20
– pH value		5.3~5.8
– Absorption area diameter	m	7
– Absorption area height	m	10.5
– Diameter of tank	m	7
– height of tank	m	11
– liquid level of tank (normal/max/min)	m	10.5/11/9
– capacity of tank	m ³	423
– height of tower	m	30.8
– Material		
· shell/lining		Q235/glass
· material and thickness of inlet flue		Lining C276/2mm
· sprayer		FRP/SIC
· axis/impeller of blender		1.4529
· oxidization gas sprayer		FRP

– number of spray layer/distance		3/2.1
– number of sprayer for each layer		20
– mode of sprayer		three circumference spiral type
– number of blender		3
– power of blender	KW	7.2
– blender ratio blender	KW/m ³	0.05
– number of oxidization gas spray		3
– location of demister		top
– stages of demister		2
·absorption tower gas resistance (including demister)	Pa	900

Absorption chemical make-up system

This project has dry lime powder make-up and lime slurry make-up system. First, limestone is ground in a ball mill and conveyed to the slurry make-up area. The capacity of lime powder storage is designed for 72 hours of consumption of the desulfurization system.

There is a requirement for the reactivity of the lime powder: the diameter of the grains must be less than 250 mesh and the purity of the lime should be 90% or higher.

Content and consumption of lime

The amount of lime required is based on data of coal quality (Sulphur Content). Based on the coal analysis, the required consumption of the lime powder is determined

Storage of lime powder and slurry make-up

The fine lime powder storage is stored in the slurry make-up area, having a storage capacity of 132m³. With this amount of storage and using the design coal sulphur content, the storage can satisfy three (3) days consumption for 2× 75t/h steam boilers. A rotary discharge

valve under the storage silo is used to discharge the fine lime powder into lime slurry tank to make slurry. The lime powder in the slurry tank is mixed with circulation water to a density of $1,240\text{kg/m}^3$ (30% content of solid matter) lime slurry. Two lime slurry pumps (1 for operation and 1 for standby) inject the slurry into the absorption tower. The quantity of fresh slurry sprayed into the tower is controlled based on gas volume (load), SO_2 concentration, and pH value. The remaining slurry is circulated back to the slurry tank, to prevent the slurry from settlement, agglomeration and jamming (i.e. the slurry is very sticky so the key is to keep the slurry moving at all times). The capacity of tank can satisfy six (6) hours consumption of $2 \times 75\text{t/h}$ boiler.

Choice of main equipment

1) Lime powder storage silo:

Number : 1

Capacity : 132 m^3

Dimension : $\phi 5 \times 7.3\text{m}$ Tapered height 4.5m

Number of outlets : 2

Rotary discharge valves : Capacity 3 t/h

2) Lime slurry tank

The tank is located under powdered lime storage silo.

Number of tanks : 1

Capacity : 42 m^3

Dimension : $\phi 3 \times 6.5\text{m}$

1 set of Blender:

Motor : 5.5 kW

3) Lime slurry pump

Type : horizontal centrifugal pump

Number of pumps : 2

Capacity : $15\text{ m}^3/\text{h}$

Head : 30 m

Motor : 5.5 kW

Gypsum dehydration system

Gypsum is produced continuously. For the purpose of keeping slurry concentration within operating parameters, the gypsum slurry having 18%~22% solid content must be pulled from the absorption tower. The slurry is pumped out into the gypsum slurry buffer tank by the gypsum discharge pump and the gypsum slurry buffer pump pumps the slurry into the gypsum cyclone station for the purposes of primary dehydration (so that the solid content is 50%). From here, the gypsum slurry is then conveyed to the belt filter for secondary dehydration (so that the moisture content will be less than 15%).

Discharge and buffer of gypsum

Each absorption tower has two (2) sets of gypsum discharge pumps (1 for operation and 1 for standby). The pump pushes the slurry from absorption tower to the gypsum slurry buffer tank through piping. The gypsum discharge pump can also discharge slurry from the tower into the emergency slurry tank.

Primary dehydration

The gypsum slurry buffer pump pushes the gypsum slurry into the gypsum cyclone station. Each absorption tower has one (1) set of gypsum cyclone stations. The gypsum slurry is dehydrated in the cyclone where the moisture content is reduced from 80% to 50%. The cyclone station is located on top of the gypsum dehydration workshop.

In the gypsum cyclone station, the gypsum slurry flows into the distribution equipment so that the slurry is uniformly distributed into every cyclone element. The cyclone elements accelerate the settlement by centrifugal force. The centrifugal force separates the water from the solids by throwing the heavy particles are thrown to the circular surface while the fine particles and water will stay in the center. Thus, the clear liquid will be pulled from the top through an insertion pipe while the solids flow out the bottom of the centrifuge. The latter will be transported to the vacuum belt dehydrator for secondary dehydration.

Secondary dehydration

There are two (2) secondary hydrators which will produce gypsum having a moisture content of the humidity of the gypsum after dehydration is 10% or less and the Cl content is 100ppm or less. Gypsum storage is located under the secondary dehydrator and the dry gypsum will fall from the secondary dehydrator.

Industry and cooling water system

Industrial water from the power plant is led to the desulfurization area for use with the desulfurization system. The water requirements are as follows:

- 1) Demister washing;
- 2) Cooling water and sealing water for oxidation fan and other equipment;
- 3) Water for lime slurry make-up system;
- 4) Gypsum secondary dehydration (washing) system;
- 5) All of the slurry conveying equipment, pipes, tank/storage washing water;

The industrial water must satisfy normal/emergency operation of FGD equipment. The industrial water supply system includes: one (1) industrial water tank, two (2) industrial water pumps (1 for operation and 1 for standby), two (2) demister washing pumps, one (1) for the demister washing pump and 1 of for the industrial water pump which is connected to the safety power supply of the power plant. The latter is needed so that in the event of a power failure, the pumps can still wash the demister, the equipment and the pipes. For the design conditions associated with the coal type specified for use by CJL, the total quantity of industrial water is 18.9 m³/h.

Waste water treatment system

Waste water from the desulfurization system is produced from the waste water cyclone wash. The content of waste water is related to the content of gas, ash, chemical absorption, industrial water, etc. Some of the elements in the coal (Hg, Pb, Zn, Cu, As, F, etc) will be in the gas-phase and therefore will flow with the gas into absorption tower, where these elements will dissolve into the absorption slurry and then discharge with the waste water. Therefore, the waste water will be measured for pH value, suspended solids, F⁻, and heavy metal ions such as Hg, Pb, Zn, Cu, etc. The quantity of the waste water is 0.66 m³/h. We don't plan to add a separate waste water treatment system dedicated to the desulfurization system. Rather, the water will flow to the ash ballast holding area.

Bag Filter specifications

The following table provides a listing of all the Bag Filters and their respective locations in the plant and the specification of each Bag Filter.

Table 8: Bag Filters and PM emission for cement plant

PM Emissions of the Jamaica Cement Project

Plant	Volume (m ³ /h)	Tem. (°C)	Collector		concentration (g/Nm ³)		PM Emissions		stack(m)		Shift	Note
			Type	PC	Inlet	Outlet	kg/h	kg/d	Dia.	Height		
Limestone crushing & conveying	40100	25	Bag filter	1	30	0.03	1.10	17.63	0.9	15	16	mine
Limestone preblending stock pile & conveying	8930	25	Bag filter	3	30	0.03	0.74	11.78	0.45	15	16	
Clay crushing & conveying	17800	25	Bag filter	1	30	0.03	0.49	3.91	0.6	15	8	
	8930	25	Bag filter	1	30	0.03	0.25	1.96	0.45	15	8	
Auxiliary raw material preblending stock pile & conveying	8930	25	Bag filter	2	30	0.03	0.49	7.85	0.45	15	16	
Raw material proportioning station & conveying	8900	25	Bag filter	1	30	0.03	0.24	5.87	0.45	40	24	
	6900	25	Bag filter	3	30	0.03	0.57	13.65	0.4	15	24	
	4000	25	Bag filter	3	30	0.03	0.33	7.92	0.3	25	24	
Raw material grinding & exhaust gas treatment	6000	60	Bag filter	1	30	0.03	0.15	3.54	0.4	15	24	
	11160	60	Bag filter	1	30	0.03	0.27	6.59	0.5	35	24	
	900000	150	Bag filter	1	100	0.03	17.43	418.21	4	110	24	NO ₂ =290kg/h SO ₂ =58kg/h
Raw meal homogenizing silo & kiln feeding	22300	60	Bag filter	1	30	0.03	0.55	13.16	0.8	65	24	
	11160	60	Bag filter	1	30	0.03	0.27	6.59	0.5	<10	24	
Cooler and exhaust gas & treatment kiln firing system	650000	250	Bag filter	1	80	0.03	10.18	244.29	3.75	40	24	
By-pass & gas treatment	180000	280	Bag filter	1	100	0.03	2.67	63.98	2.24	40	24	
	8900	60	Bag filter	1	30	0.03	0.22	5.25	0.45	35	24	
Clinker storage & conveying	8900	60	Bag filter	4	30	0.03	0.88	21.01	0.45	15	24	
	11160	60	Bag filter	3	30	0.03	0.82	19.76	0.5	15	24	
	22300	60	Bag filter	1	30	0.03	0.55	13.16	0.8	50	24	

Coal hopper & conveying	8930	25	Bag filter	1	30	0.03	0.25	1.96	0.45	15	8
Coal preblending stock pile & conveying	8930	25	Bag filter	2	30	0.03	0.49	7.85	0.45	15	16
Coal grinding & dosing	115000	80	Bag filter	1	40	0.03	2.67	64.04	1.5	35	24
	9000	40	Bag filter	1	30	0.03	0.24	5.65	0.45	35	24
	5000	40	Bag filter	1	30	0.03	0.13	3.14	0.4	35	24
Gypsum crushing & conveying	17800	25	Bag filter	1	30	0.03	0.49	3.91	0.8	15	8
	8930	25	Bag filter	1	30	0.03	0.25	1.96	0.45	15	8
Cement proportioning station	8900	25	Bag filter	4	30	0.03	0.98	23.48	0.45	30	24
	6900	25	Bag filter	10	30	0.03	1.90	45.51	0.4	15	24
Cement grinding & conveying	230000	80	Bag filter	2	30	0.03	10.67	256.14	2.5	38	24
	60000	80	Bag filter	2	30	0.03	2.78	66.82	1.25	36	24
	6000	80	Bag filter	2	30	0.03	0.28	6.68	0.4	15	24
Cement storage & conveying	13400	40	Bag filter	2	30	0.03	0.70	16.83	0.5	45	24
	11160	40	Bag filter	4	30	0.03	1.17	28.03	0.5	45	24
	6900	40	Bag filter	4	30	0.03	0.72	17.33	0.4	15	24
Cement bulk loading for truk	6900	25	Bag filter	2	30	0.03	0.38	3.03	0.4	25	8
	4000	25	Bag filter	2	30	0.03	0.22	1.76	0.3	15	8
Cement big bag packing	11160	25	Bag filter	2	30	0.03	0.61	4.91	0.5	25	8
Cement packing & loading	25000	25	Bag filter	4	30	0.03	2.75	21.99	0.8	25	8
				79			65.856	1,467.18			

NEPA's SPECIFIC COMMENT

4.14 Dispersion Model Report

- The EIA indicated that no actual monitoring data was available for the proposed location. The Agency is aware of at least 4 monitoring stations in that area from which such data can be obtained to support the air quality assessment. This data will provide a real representation of the potential impacts in that area from the release of emissions
- The analysis of persistent air pollutants such as lead, mercury etc. is required
- The analysis based on design characteristics for estimating emission rates is acceptable under the Natural Resources Conservation Authority Ambient Air Quality guidelines. The Report must provide the sample calculations used to estimate the emission rates from the stacks and vents.
- The study included a cumulative study by running an all source model. The model failed to identify (include) emissions from the existing Port Esquivel facility which has a number of area and volume sources. Inclusion of these data is necessary to be a real representation of the cumulative impacts.
- The EIA Report estimates truck traffic increase to approximately two hundred trucks per day. The impact of emissions resulting from road surfaces due to this increased traffic load must be included in the assessment. This may be limited to access roads to the plant and designated routes in and around the plant. These must be treated as line sources and the necessary emission factors used to estimate particulate emissions from these areas.
- In the conclusion of the dispersion model report point 3 mentioned that “certain design changes” would be needed for the achievement of compliance with PM₁₀ and NO₂ ambient air quality standards and guideline concentrations. This statement is contradictory since all predicted concentrations from the dispersion model exercise showed no exceedances. The Report must explain in detail what these design changes are and whether they have already been incorporated in the model. If they have not been so incorporated the accuracy of the model is questionable as it has predicted compliance for both parameters.

RESPONSE:

These comments are addressed in section “**4.12 Air Quality Review**” and are fully addressed in the revised - Air Dispersion Modeling Report included as an **Appendix 10**.

5.0 NEPA's GENERAL COMMENT

5.1 General Comment No.1

- The EIA indicates a 100% reuse of fly ash in the kiln. The Report must indicate storage plans for the "fly ash" and alternative use(s) during kiln shut down. The environmental and occupational health hazard associated with the use of the fly ash should also be assessed.

RESPONSE:

ASH & SLAG REMOVAL SYSTEM DESIGN and DESCRIPTION

1) Calculation of the slag and fly ash volume (single boiler)

Name	t/h	t/d	kt/a
Ash volume	2.87	63.11	20.66
Slag volume	0.32	7.01	2.30
The slag and fly ash volume:	3.19	70.13	22.95

Remakes :

Number of hours used of the unit for the whole day is 24 hours, Number of hours used of the unit for the whole year is 8000 hours.

(2) Ash takes up 90% and slag takes up 10%

FLY ASH HANDLING & STORAGE

The project has no ash disposal area, all fly ash and slag will be removed in time and transported to the fly ash storage shed and used as the additives in finish mill.

Design Principle for De-slagging System

With the technical and economic evaluation, the selection of ash removal system will rely on the type of dust collector, ash and slag quantities, ash and slag characteristics, environment protection, the requirements on water conservation and energy conservation.

The de-slagging system adopts mechanical slag handling system and pneumatic ash handling system to remove FBA and fly ash separately.

Fly ash will subject to collective pneumatic handling in the plant and carried away with trucks. The de-slagging system uses scraper slag extractor to carry slag to the outside of boiler house and then transport such slag with trucks to the fly ash storage shed and used as the additives in finish mill.

Slag Removal System

The slag removal system adopts air cooled dry slag removal system. The furnace bottom ash will fall from ash well of boiler into the air cooling dry type slag conveyer, and the big furnace bottom ash will be broken by the hydraulic cut-off valve and fall into the air cooling dry type slag conveyer. The slag will be delivered into bottom ash bin directly by air cooling dry type slag conveyer and cooled by counter-current flow of ambient air. The ambient air from the top of conveyer will be heated by slag and absorbed into the boiler by suction pressure to reduce temperature. The slag will be delivered by conveyer to the outside of boiler house. In this project the boiler will be equipped one air cooling dry type slag conveyer (1t/h). The storage space of slag will have exterior-protected construction. The bottom ash bin nearby boiler space will be instituted passage-way to deliver the slag.

The process flow diagram:

Damper of boiler under channel ash well of boiler hydraulic cut-off valve air cooling dry type slag conveyer ash crusher the storage space of slag from there it goes to the fly ash storage shed and used as the additives in finish mill.

Fly Ash Removal System

The fly ash handling system will recommend pneumatically positive pressure dense phase system. Comparing other pressure dense phase systems, it has these merits of advanced system、 low deliver speed、 low energy consumption、 low wear、 simple system and so on. Under the condition of deliver distance under 500m, this system has higher ash gas rate and quality performance. Pneumatically positive pressure dense phase system has some characteristics: safe economical, simple and low maintenance.

Each dust collector has one bin pump which is installed at the hopper's outlet. The fly ash of the hoppers will be delivered into fly ash silos through fly ash conveying pipe by pneumatic conveyance system. As the reliability and the efficiency of this system, the horizon range of fly ash conveying pipes will be controlled in 500m. The designed capacity of pneumatic conveyance system is amounting to 150% of the amount of ash discharged by the boiler. The dry fly ash or the humidified fly ash will be conveyed to the fly ash storage shed and used as the additives in finish mill by flask trucks for handling ash.

The process flow diagram:

Fly ash → Bin pump → Fly ash silo → To the fly-ash storage shed and used as additives in finish mill.

Compressed air system

Compressed air system is central air feed of power plant. For the requirement of the delivery and instrument of ash handling system and other systems, screw compressors will be used as air feed equipments, and be equipped with coolers and separators to reduce water capacity of air. The compressors shall accept piping-main scheme air feed system, which are controlled by intellectualized modules to optimize the number, parameter and operation of compressors, for reducing investment and operating cost. Three helical screw compressors (5m³/min) and build-up dryers supplying compressed air for ash handling system and service will be designed that one backup air compressor should be available when two compressors are simultaneously functioning. The capability of compressors will be determined as the type of pressure dense phase systems. The delivery and the instrument air system will be incorporative.

Control system of ash handling

The types of control mode for ash handling system are computer cell-type control, remote-control and local control. The control of ash handling system is PLC+CRT at ash handling control house. Through monitor manage and control by these equipments workers can get the message of ash handling system. The interface of ash handling system can be connected with MIS. The controlling process of fly ash handling system will be finished in the control house fly ash handling

- Proportion of clinker, Pozzolana and gypsum in PPC cement in weight:
- Clinker: 65~70 %
- Gypsum: ~5 %
- Pozzolana 25~30 %

The natural pozzolana is a natural fine volcanic ash.

- Fly ash, which is largely made up of silicon dioxide and calcium oxide, can be used as a substitute for Portland cement, or as a supplement to it. The materials which make up fly ash are pozzolanic, meaning that they can be used to bind — or cement — materials together. Pozzolanic materials, including fly ash cement, add durability and strength to concrete.
- The fly ash output is about 70 tpd. So the fly ash can be added into the cement mill as the Pozzolana additive completely for PPC cement production.

NEPA's GENERAL COMMENT

5.2 General Comment No. 2

- The EIA should reference examples of similar plants where coal is utilized as fuel, the technology applied to control emissions to the environment and if possible the monitoring results to support the assertions of compliance.

RESPONSE:

The following table provides a listing of similar project completed by Sonoma and incorporates coal fired power plants, monitoring results were not available, may be provided in the future.

Table 9: Reference list of coal fired power plants

REFERENCE LIST OF COAL FIRED POWER PLANT WITH WASTE HEAT RECOVERY POWER PLANT PROJECTS (2000~2005)

No.	Customer	Kiln type	Installed capacity	Start-up time
1	Hubei Gezhouba Cement Plant	Pre-calcining kiln	2×15MW	2000
2	Hangzhou Qianchao Building Material Co.Ltd	Pre-calcining kiln	6MW	2000
3	Henan Qiligang Cement Plant	Pre-calcining kiln	12MW	2000
4	Heilongjiang Mudanjiang Cement	Pre-calcining kiln	15MW	2001

	Plant			
5	Neimenggu Xizhuozishan Cement Plant	Lepol kiln	3×6MW	2000
6	Jilin Shuangyang Cement Plant	Pre-calcining kiln	2×12MW	2002
7	Yili Cement Plant of Xinjiang Tunhe Corporation	Pre-calcining kiln	2×7.5MW	2001
8	Guangdong Hengdali Cement Plant	Pre-calcining kiln	60MW	2002
9	Henan Yanchi Cement Plant	Pre-calcining kiln	7.5MW	2002
10	Chifeng JinFeng Copper Plant	2×6MW	2002	
11	Hebei Taihang Cement Co.Ltd	Pre-calcining kiln	15MW	2003
12	Fujian Yongding XingXin Cement Corporation	Pre-calcining kiln	12MW	2005
13	Zhejiang Jinlong Cement Co.Ltd	Pre-calcining kiln	25MW	2005

NEPA's GENERAL COMMENT

5.3 General Comment No.3

- Based on the nature and magnitude of the proposed development a detailed landscape plan should be developed for the project.

RESPONSE:

Vegetation plays a very important role in preventing pollution, protecting and improving environment. It has advantages in temperature and moisture conditioning, small climate improving, air purifying and noise weakening. Plant trees, bushes, and grass around plant buildings and along roads as may be possible to improve greening level around the plant.

The general policy and commitment of CJL is to establish appropriate vegetative coverage at all possible area of the project. The emphasis will be on planting bird feeding and fruit trees.

The figure below gives an indication of the concept to be applied in the greening and landscaping of the entire project area.



Figure 41: Cement plant model

NEPA's GENERAL COMMENT

5.4 General Comment No. 4

- The monitoring programme should include; monitoring of fuel specifications, and the by-products emanating from the combustion of coal such as mercury, hydrogen fluoride and other pollutants ; an examination of the use of red mud, clay and the generation of fly ash. Based on the magnitude of the project monitoring should also include some level of social surveys to ensure the involvement of the communities.

RESPONSE:

Monitoring Plan

The environmental monitoring plan includes two parts: one part is environmental monitoring for acceptance on completion; the other part is routine environmental monitoring during operation.

Completion acceptance monitoring

After the commissioning of the plant and before commencing full operation, the CJL should conduct environmental monitoring at designated stations to confirm that the performance of all pollution control devices conforms to the design specifications as established in the EIA.

Routine environmental monitoring

Mainly refers to conduct monitoring on pollutant source. To get the running information of environmental protection facilities, on-line continuous monitor instruments will be installed for monitoring waste gas treatment at the two ends of kiln and at the stack. Incorporated in its quality control processes will be continuous monitoring of all raw material to be used in the process. This includes material for the raw mix in the cement manufacturing process as well as additives and fuel. Parameter to be monitored will include all those that could have an impact on the quality of the emission from the plant.

Routine socio-economic and health monitoring

Periodic socio-economic and health impact assessment of the cement operation will be undertaken to monitor these aspects of the project over the life of the cement plant. This monitoring programme will include the communities within a 2 km radius of the plant as well as workers at the facility.

NEPA's GENERAL COMMENT

5.5 General Comment No. 5

- Large scale plans should be submitted showing an outline of the two project sites and an outline of the processes which will be utilized for the mining and cement processing activities.

RESPONSE:

Large scale plan for both the Plant Site and the Quarry Site are included as a part of the documents supplied with this Addendum.

NEPA's GENERAL COMMENT

5.6 General Comment No. 6

- The EIA is to specify the National Standards to which the finished cement product will adhere especially in light of the raw materials to be used in the production process.

RESPONSE:

The ASTM 150 Standard Specification for Portland cement is the standard which the finish cement product will adhere to.

NEPA's GENERAL COMMENT

5.7 General Comment No. 7

- Some of the information presented in the appendices was not written in English as is required these included – Appendix 9, Table 9.1 and 9.2 and page 18.

RESPONSE:

All information presented in the appendices that was not in English, has been changed to be in English, except for cases where the same information is presented in both English and Chinese.

NEPA's GENERAL COMMENT

5.8 General Comment No. 8

- All documents being submitted for the review must include standard metric units.

RESPONSE:

All documents being submitted for review have been check to ensure that only standard metric units are used.

NEPA's GENERAL COMMENT

5.9 General Comment No. 9

- The phasing and rehabilitation to include ecological restoration of mined out areas must be considered as a part of the analysis for the quarry site.

RESPONSE:

The Limestone Quarry Preliminary Mining Plan provides details of the rehabilitation of the various phases and final setting. It reflects a re-vegetation of the various phases which is presented in ten year spans. Visuals of each phase are also presented and the figures below give example of this.



Figure 42: Aerial view of deposit area before limestone quarrying.



Figure 43: Aerial view of deposit area after limestone quarrying.



Figure 44: Eastern view of deposit area before (Upper) and after (Lower) limestone quarrying.



Figure 45: South-eastern view of deposit area before (Upper) and after (Lower) limestone quarrying.

NEPA's GENERAL COMMENT

5.10 General Comment No. 10

- If included in either the plant or quarry areas additional details are required with respect to the construction of the Autism School which is proposed as a social intervention by the developers.

RESPONSE:

The Autism School will **NOT** be included in either the Plant or Quarry area; its proposed location is on the campus of the University of the West Indies.

6.0 NEPA's ADDITIONAL COMMENT

6.1 Quarry Restoration/Reforestation

- Due to the magnitude and scale of the quarry operation and the size of the vegetation disturbance as a result of the mining activities a quarry restoration plan should be developed for the project. In addition to this plan, a proposal for mitigation measures for possible vegetation losses should be developed and areas identified for compensatory reforestation or restoration. An adequate location (size and boundary) of the habitat that will be restored/reforested is required. In addition timelines should be established for the period of time over which the compensatory reforestation project would take place.
- A landscape plan should also be developed and submitted for the cement plant site.
- A quarry restoration plan (conceptual restoration plan) should be submitted as part of the EIA.
- Clarity is also needed on whether or not additional quarries will be required to supply material for the cement plant.

RESPONSE:

- As stated above the restoration plan for the quarry is presented in the Limestone quarry Preliminary Mining Plan with detail visuals.
The mitigation measures to compensate for the significant lost of vegetation which will result from the mining activities will focus on the re-vegetation of the area on the outer face of the quarry which has been significantly disturbed as a result of many year of human interference.

An approximate 100M width of area around the circumference of the quarry totalling about 20 hectares will be reforested, at the commencement of quarrying activities with primarily bird feeding and fruit trees. Reforestation of the mined out areas will follow the timeline for the various phases of the quarry development.
- The landscape plan for the cement plant site is for the planting of grass in all open spaces and trees along roadways. **Figure 41** gives a visual image of the landscape concept.
- The restoration plan for the limestone quarry area requires the re-vegetation of all areas that will be disturbed by the quarrying activities. The concept is presented in the visual of **Figure 43**.
- A clay deposit has been identified on property adjacent to the eastern boundary of the plant site. The development of a clay quarry is being proposed for this area, which has

already been acquired by CJL. A clay quarry mining plan along with impact and mitigation is presented in **Section 4.10** of this addendum.

NEPA's ADDITIONAL COMMENT

6.2 Monitoring Plan

- The EIA should specify a monitoring plan for air pollution emissions to include monitoring the performance of air pollution control devices and the use of automatic shut off when these devices fail.
- The EIA should also clearly state the plans for the control of Mercury emission from coal to be used in the plant.

RESPONSE:

Monitoring Plan

The environmental monitoring plan includes two parts: one part is the environmental monitoring for acceptance on completion; the other part is routine environmental monitoring during operation.

Completion acceptance monitoring

After the project putting into trial production, the company should contact environment monitoring station designated by environmental protection authority immediately, to require this authority to organize completion acceptance monitoring for facilities constructed according to “three concurrences” regime of environmental protection.

Routine environmental monitoring

Mainly refers to conduct monitoring on pollutant source. To get the running information of environmental protection facilities, on-line monitor instruments will be installed for monitoring waste gas treatment at the two ends of kiln. Detailed monitoring plan see the **Table 10** below:

Table 10: Monitoring Plan Matrix

Classification	Pollutant Source	Monitoring Parameter	Monitoring Point	Point Number	Monitoring Frequency
Waste Gas	Kiln Outlet	Particulates	Sample hole of exhaust stack	1	Continuous on-line monitoring
	Kiln Inlet	Smoke, Dust, SO ₂ , NOX	Sample hole of exhaust stack	1	Continuous on-line monitoring
	Raw Mill, Cement Mill, Coal Mill,	Particulates	Sample hole	1 for each	Once per month
	Disorganized discharge points in plant	Particulates	20 M distance to the plant, upwind and downwind	1 for each	Once per quarter
Noise	All noise producing activities	Sound Level A equivalent	Source or 1 M distance to the workshop	1 for each	Once per quarter
	Plant Noise	Sound Level A equivalent	1 M distance to perimeter of the plant	8 points	Once per quarter (covering both night & day)

The plan for the control of mercury emission is as follows:

- ❖ Monitor the levels in the raw materials and fuel source.
- ❖ Install and maintain fabric filters that will reduce the levels of emission.
- ❖ Frequent monitoring of emission levels from stack and take the necessary actions based on monitoring results
- ❖ Conduct periodic air dispersion modeling to determine impact on ambient air quality.

NEPA's ADDITIONAL COMMENT

6.3 Drainage

- The information provided in the drainage reports should be used to develop drainage and flood mitigation measures for both the Cement Plant lands and the Quarry site. A drainage plan for both sites should also be developed and submitted for assessment by the National Works Agency.

RESPONSE:

- The information provided in the drainage report was used to develop a drainage plan (**Appendix 4**) for both cement plant, limestone quarry and clay quarry sites including flood mitigation measures. The detailed plan including drawings is included in the documents submitted as a part of this addendum.

NEPA's ADDITIONAL COMMENT

6.4 Geology and Hydrology

- In describing both the cement plant and quarry sites, more specific information is required as it relates to geology, and hydrology of the two sites. The information presented in the document is somewhat general and both sites have peculiar characteristics.

RESPONSE:

Detail description of the geology and hydrology of the different site of the project is set out below.

REPORT ON GEOLOGY: PLANT SITE, AND CLAY SOURCE AREA

INTRODUCTION

Part of the district of Lodge near the southern Clarendon – St. Catherine border has been selected as the site for the location of an Ordinary Portland Cement manufacturing plant, and for the source of clay which is a major component of the raw mix for the project.

An evaluation to establish prevailing geological conditions of the general area is here undertaken. Published maps and privately produced reports provided the main source of the information used in this study, but this was augmented by limited field investigation and some exploratory drilling and sampling. Remote sensing imagery was also used.

The area of study encompasses approximately 9 km² east of Freetown, Clarendon, or 2 km south west of Old Harbour, St. Catherine along the public main road on the St. Catherine Plain (**Figure 46**). The area is bound by the north-south trending Windalco Port Esquivel road and rail on its western margin and Highway 2000 on the north. The northern-most margin is about 4 km from the sea. Locally the Lodge estate was formerly used for dominantly sugar cane cultivation and scattered mixed cultivation. Now the site is generally in ruinate, with some small scale farming. The entire area may now be designated for heavy industrial development, since in the south there is Windalcos’ Port Esquivel and the Jamaica Broilers Ethanol plant. An animal feed production plant is located just to the west of the property and the Jamaica Public Service Old Harbour Bay Power Station is located to the southeast. From this power plant leads two high voltage power lines that belt across some distance to the south of the site.

The cement plant is proposed for the north-western-most section of the area studied, whilst the area proposed for clay extraction is contiguous to and directly east of the plant site (see **Figure 1**).

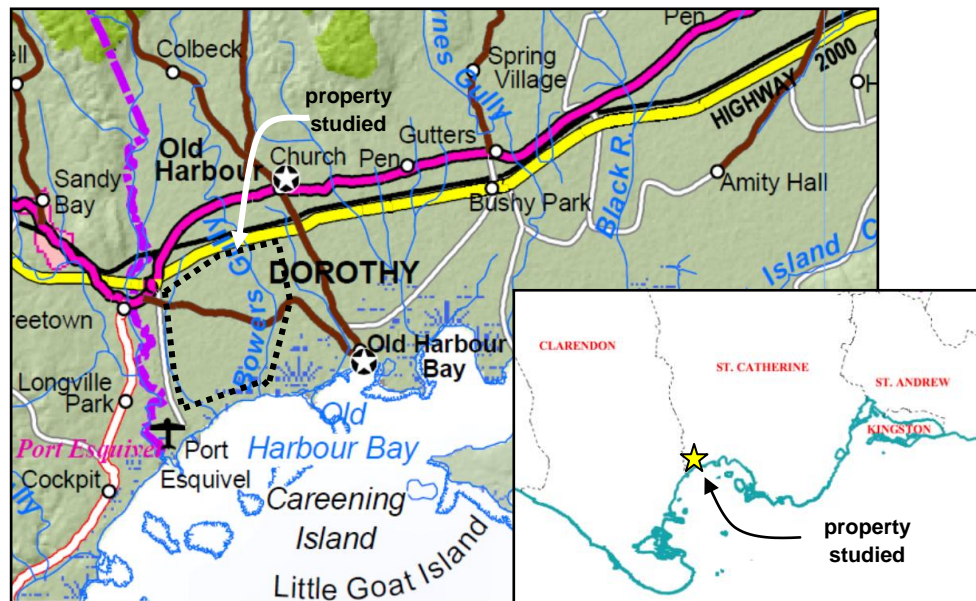


Figure 46: Location of the district of Lodge, St. Catherine on the southern coast of Jamaica.

(Base map: 1:250,000 Topographic Map, 2007; National Land Agency).

PHYSIOGRAPHY

Topography

The site slopes towards the sea from north to south (Fig. 2). Elevation ranges from 27.5 metres above mean sea level (amsl) at the north near Highway 2000, down to 12 m amsl at the centre of the property and grades down to the sea in the south. The land slopes gently towards the sea and has no prominent high points. However, it is dissected by north-south-flowing natural drainage gullies.

Drainage

Three seasonal gullies were identified over the entire Lodge District as the main drainage features on the property (Fig. 2). One occurs on the western margin near the Port Esquivel Road, another at the centre of the property emanating from a surface pond just south of the proposed clay mining area and the Bowers Gully which is well east of the area proposed for the present development. The Bowers Gully has the longest and widest channel of the three. It drains that area northwest of Old Harbour town. The western-most gully develops from that area north of the Highway 2000 and flows through the northwest section of the property proposed for the development. It then meanders along the western margin. Numerous canals also dissect the property; these were installed during periods of cultivation.

Several topographic lows or depressions on the property have become reservoirs for storm water runoff resulting in ponds. The central gully has two such ponds along its approximately straight alignment. These are outside the boundaries of both the plant site and the clay mining areas.

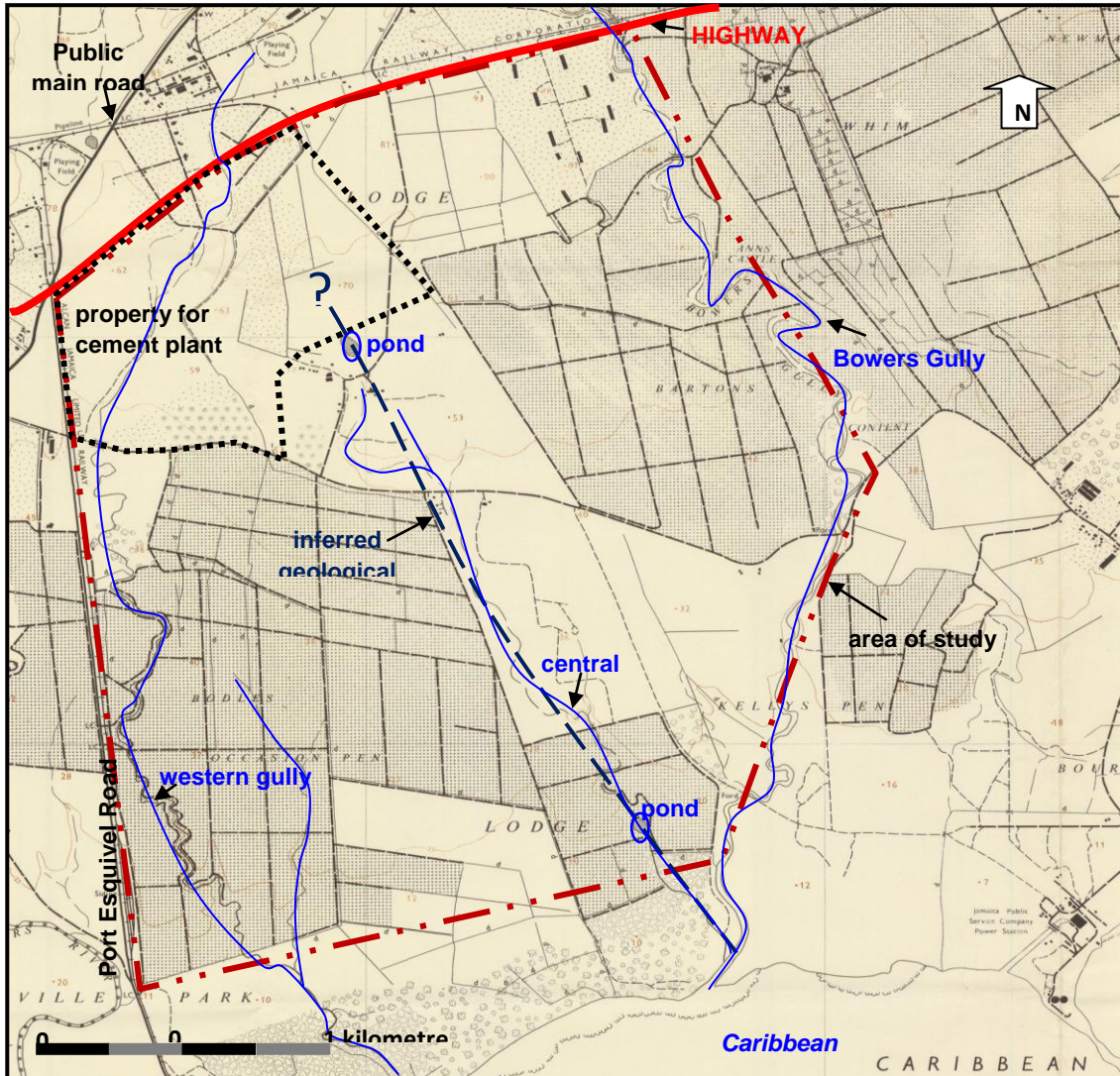


Figure 47: Flat topography of the district of Lodge, St. Catherine. The property for the development of the cement plant is indicated in the northwest by dotted line. The Lodge property is dissected by three gully courses, the largest of which is the Bowers Gully. Based on the linear alignment of the central gully a geological fault is inferred parallel to the course (dashed line). The area designated with a “?” represents an uncertainty in the continuation of the inferred fault. Dominant topographic depressions act as ponds for rainwater. Spot heights on map are in feet.

GEOLOGY.

Regional Setting.

The regional geological setting is defined by the mid to late Miocene succession of the Moneage Formation¹ which geographically is part of the southernmost section of the

¹ Lithostratigraphy and Paleogeography of the White Limestone Group, Simon F. Mitchell

Clarendon Block. The development of the mid to late Miocene succession is defined primarily by what has been termed the Mid Tertiary Quiescence. Between the middle Eocene and middle Miocene, differential subsidence allowed as much as 2.75 km of exclusively carbonate platform deposits to accumulate over the Clarendon Block in which the area of interest is located. Shallow Water Carbonates of the Monegaue Formation were formed in an environment where sections of the island were no more than a few meters above sea level at any time. During the early and middle Miocene, southward tilting of the Jamaican region is implied by the southward thickening, wedge-shaped geometry of the Newport Formation². Non-marine Quaternary deposits include extensive development of alluvium across the coastal plain along the southern margin of the island, as a result of drainage from major rivers such as the Rio Cobre and Rio Minho and have manifested in the formation of extensive alluvium plains and adjacent terraces.

Soil

Surface soil is derived from the alluvial material which dominates the St. Catherine Plain (**Figure 48**). Clay and clayey sand is dominant at the surface. It originated as material deposited during periods of flooding by the streams and rivers on that section of the St. Catherine Plains.

Jentech (2009) study indicates that the surface soil could extend to a thickness of between 5 or 6 metres depth. This is confirmed by recent trenching of the area using the back hoe down to a depth of 4-5 meters inside the area designated for clay extraction. This trenching indicates within the first five meters the alluvium is dominated by brown clays inter mixed with grey clay with sand mix as well as sand lenses up to 0.8 meter.

Two exploratory bore holes done on the plant site approximately 150 meters from each other show that the alluvium in the area could be much thicker and with significant variation in depth over relatively short distances. In borehole #1 the alluvium was found to bottom out at a depth of 82 feet, (25 meters), where the white limestone rock-head was reached, whereas in hole #2 the alluvium was found down to a depth of 107 feet (33meters) without reaching the bedrock. Logs of these boreholes shown in Appendix 1, confirm the pre dominance of clay, as well as the lithologic variations, noted above.

² Jamaica, Edward Robinson, Caribbean Geology

Bedrock

The geologic history of the area as depicted in map prepared by the Geology Division (1974) shows the young alluvium which underlay's the project area (**Figure 48**) as river sediments of varying composition resting unconformable on white Limestone. This limestone is the same as that in the hill in the northwest (Old Harbour Hill; **Figure 48**). The interception of white limestone at the base of the clays in hole # 1 described above, supports this inference.

Structure

The thick alluvium cover in the area precludes the identification of any expression of geological structure. The central gully and associated ponds which occur immediately south of the area define a linear alignment. It might be inferred that such alignment might be controlled by a pre-existing linear feature in the bed rock such as a fault, but more subsurface investigation would have to be done to confirm this.

Hydrogeology

Hydrostratigraphically, the area is classified as an Alluvial Aquifer by the Water Resources Authority. Groundwater is expected to flow southwards. Near the ethanol plant groundwater is 5 m below the surface but it is expected to be deeper at the northern section of the property. Perched groundwater may be encountered in the sand lenses. The water table however, is confined by a clay layer that drapes the limestone (*EnviroPlanners, 2010; Mines and Geology Division, 1974*).

Surface channels develop where thick layers of clay occur in the upper soil horizon and discourage percolation. This promotes surface flow. Likewise, the ponds accumulate storm water flow from the surface. From the pond water slowly drains to the groundwater table or spills over into the gullies where they are connected, e.g. the central gully (**Figure 47**).

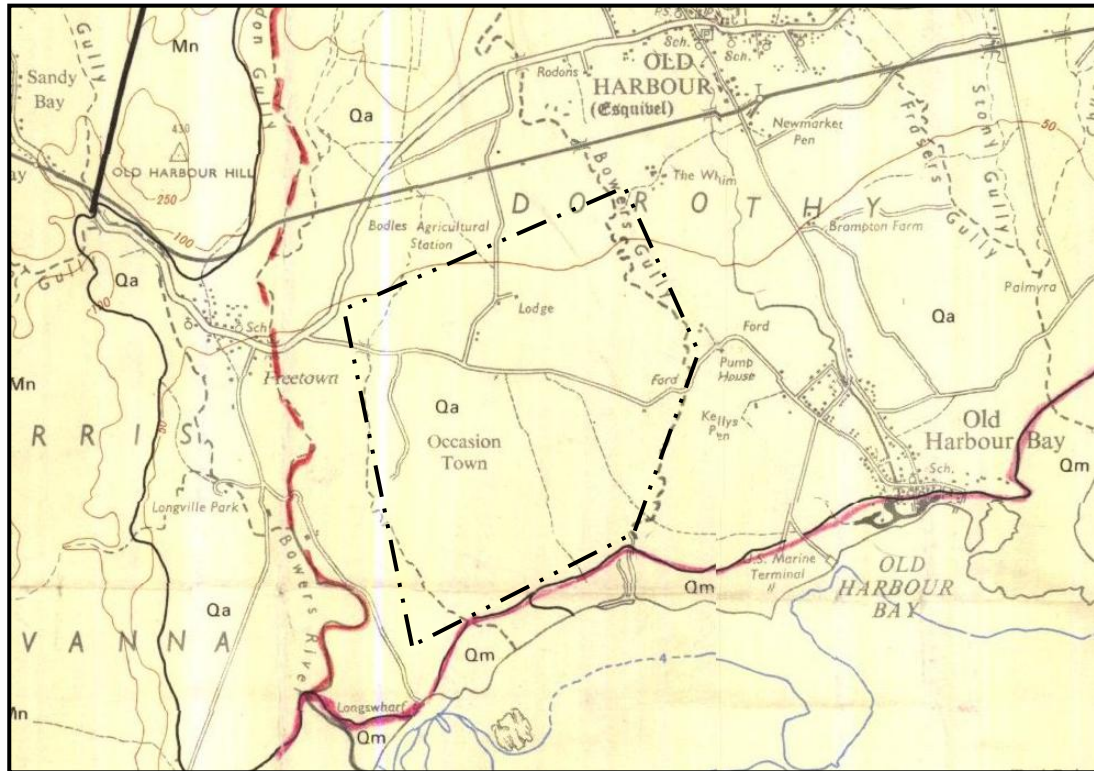


Figure 48: Geology of the district of Lodge, St. Catherine and surrounding areas. The property for development is indicated by the dashed and stippled line. Mn – White Limestone (at Old Harbour Hill in the northwest will supply raw material to the plant); Qa – Alluvium (river material. Dominantly clay and sand); Qm – marsh and swamp deposits. Heavy dark line at Old Harbour Hill is a geological fault. (Base map: Mines and Geology Division, 1974).

ECONOMIC GEOLOGY

The soil in the area is dominantly clay and is known to extend to 20 m depth (minimum) at the south near the ethanol plant and may even go deep in the general Lodge district. Sand layers do not appear to be more than 2 m thick within the upper 20 m of the alluvial profile. The clay may serve as a source of raw material for the cement plant. Exploratory grid sampling of this material will assist in confirming the resource.

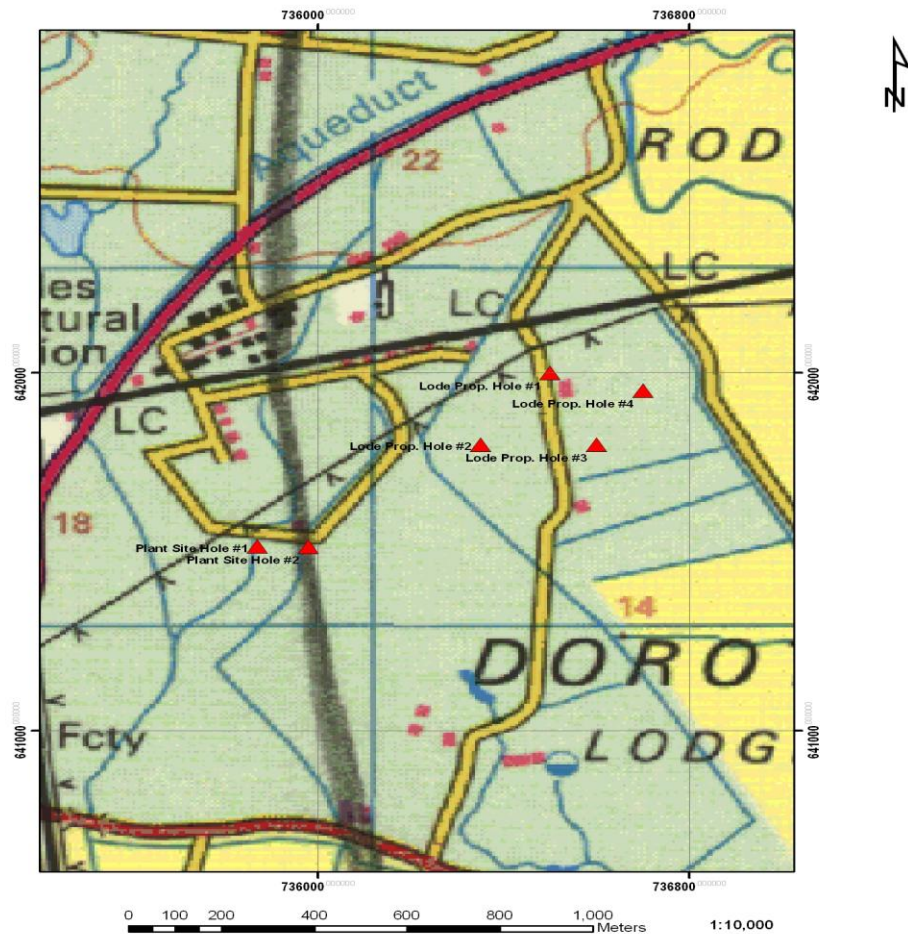
EXPLORATION

The initial assessment of the clay deposit was done by the evaluation of excavation samples from four sites and trenching down to 5m depths utilising a back hoe. Samples were extracted every meter, to produce 5 samples for each site.

TABLE 11: LODGE PROJECT AREA SAMPLE SITES

Bore Hole	Northing	Easting
Lodge Prop. Hole #1	642000	736500
Lodge Prop. Hole #2	641800	736350
Lodge Prop. Hole #3	641800	736600
Lodge Prop. Hole #4	641950	736700

Figure 49: Lodge project sample sites



LODGE PROP. HOLE #1

TABLE 12: GENERALISED LOG LODGE PROP HOLE #1

Depth	Description
0 - 0.8m	Brown Clay Loan
0.8m - 2.2m	Clay with minor silt
2.3m - 3.5m	Brown Clay
3.5m - 4.2	fine to medium sand
4.2m - 5.0m	Medium sand

Figure 50: Brown Clay from Lodge Prop. Hole #1



LODGE PROP. HOLE #2

TABLE 13: GENERALISED LOG LODGE PROP HOLE #2

Depth	Description
0 - 1.1m	Brown Clay Loan
1.1m - 2.0m	Clay with minor silt
2.0m - 3.2m	Brown Clay
3.3m - 3.7m	Brown Clay with minor amounts of fine Sand
3.7m - 4.4m	Brown Clay
4.4m - 5.0m	Fine to Medium Sand

Figure 51: Trench 2.0m deep with Brown Clay at Base - Lodge Prop. Hole #2



LODGE PROP. HOLE #3

TABLE 14: GENERALISED LOG LODGE PROP HOLE #3

Depth	Description
0 - 0.9m	Grey Clay Loan
0.9m - 1.9m	Clay with minor silt
2.0m - 3.2m	Brown Clay with minor amounts of fine Sand
3.3m - 3.8m	Fine to Medium Sand
3.9m - 5.0m	Brown Compact Clay

Figure 52: Brown Clay from 4.0m depth - Lodge Prop. Hole #3



LODGE PROP. HOLE #4

TABLE 15: GENERALISED LOG LODGE PROP HOLE #4

Depth	Description
0 - 1.1m	Brown Clay Loam
1.2m - 2.0m	Clay with minor silt
2.1m - 3.4m	Brown Clay
3.5m - 4.0m	Fine to Medium Sand
4.1m - 5.0m	Brown Compact Clay

Figure 53: Brown Clay at right extracted from 3.0m depth - Lodge Prop. Hole #4



RESULTS OF CHEMICAL ANALYSIS

During the evaluation phase, an extensive reconnaissance and preliminary mapping exercise including the collection of representative clay samples from the four sites mentioned was conducted. The samples were submitted to the laboratories of SGS for whole rock analysis. The preliminary results of the analysis are given in Table 6.0.

TABLE 16: RESULTS OF CHEMICAL ANALYSIS OF SAMPLES FROM PROJECT AREA

Sample ID	SiO ₂ %	Al ₂ O ₃ %	Fe ₂ O ₃ %	MgO %	CaO %	Na ₂ O %	K ₂ O %	TiO ₂ %
1: Hole # 1	52.8	16.9	8.67	2.06	2.15	2.00	1.48	0.92
2: Hole # 2	57.7	15.7	8.02	1.84	2.09	2.22	1.62	0.86
3: Hole # 3	55.9	15.9	8.46	1.93	2.36	2.20	1.58	0.88
4: Hole # 4	55.9	14.9	9.74	1.39	2.93	2.08	1.40	1.01

Sample ID	P ₂ O ₅ %	MnO %	Cr ₂ O ₃ %	V ₂ O ₅ %	LOI %	Sum %	S %	Cl g/t
1: Hole # 1	0.07	0.17	< 0.01	0.04	12.5	99.8	< 0.01	154
2: Hole # 2	0.09	0.14	< 0.01	0.03	9.96	100.3	< 0.01	236
3: Hole # 3	0.15	0.14	< 0.01	0.04	10.1	99.6	< 0.01	144
4: Hole # 4	0.08	0.22	< 0.01	0.05	10.5	100.2	< 0.01	46

COMPARISON OF RESULTS WITH ASTM STANDARDS

The [American Society for Testing and Materials \(ASTM\)](#) is probably the most widely recognized and used national standards-setting organization in the United States for engineering-related materials and testing. The ASTM C618 specification is the most widely used because it covers the use of fly ash as a pozzolana or mineral admixture in concrete. The three classes of pozzolanas are Class N, Class F, and Class C. Class N is raw or calcined natural pozzolana such as some diatomaceous earths, opaline cherts, and shales; tuffs, volcanic ashes, and pumicites; and calcined clays which is applicable to this project. **Table 17** below shows the chemical requirements for Class N (raw or calcined natural pozzolana) listed in the ASTM C618 specification.

TABLE 17: ASTM SPECIFICATION C618-92A FOR SOME CHEMICAL SPECIFICATIONS

Parameters	Specification
SiO₂ + Al₂O₃ + Fe₂O₃	Minimum 70%
Available Alkalis as Na₂O max	Max 1.5%

Table 4.0 shows a comparison of the results from samples obtained from Cambridge Hill and ASTM standard for Class N pozzolanic raw materials for total Silicon Dioxide, Aluminium Oxide and Iron Oxide.

TABLE 18: COMPARISON OF LODGE CLAYS WITH ASTM SPECIFICATION C618-92A

Sample Site	Results SiO ₂ + Al ₂ O ₃ * + Fe ₂ O ₃
Lodge Prop. Hole #1	78.37%
Lodge Prop. Hole #2	81.42%
Lodge Prop. Hole #3	80.26%
Lodge Prop. Hole #4	80.54%
ASTM C1692a	70% minimum

CEMCORP CEMENT

Preliminary Drilling #1

Location: Plant Site, Bodles, St Catherine.

Coordinates:

Depth (ft)	Description
0-7	Dark brown clay with few sand stone pebbles. Clay is sticky and cohesive and very plastic.
7-12	No recovery
12-17	Dark brown sand with small amounts of pebbles and clay. Few larger sandstone cobbles present.
17-22	Multi- coloured sandstone pebbles bounded by stiff brown clay.
22-27	Sandy clay with larger sandstone pebbles present.
27-32	Clay showing multi- coloured lamina of brown, pink, green. Highly weathered sandstone cobbles present as well as cobbles from volcanic sources including granodiorites.
32-37	Very stiff light green- greyish clay.
37-42	Very stiff light green- greyish clay.
42-47	Very stiff light green- greyish clay.
47-52	Very stiff light green- greyish clay.
52-57	Yellow- brown silty- sand. Small amounts of clay present. Material becoming more lithified in most sections.
57-62	Brownish sand that is relatively poorly lithified. Can be broken with little force. Sandstone present.
62-67	Coarse grained sand that is relatively poorly lithified in some parts and easily broken. Thin beds of imbricated pebbles present.
67-72	Finer sand than previous run. Core is poorly lithified in some sections but harder in others.
72-77	Fine grained brown sand interbedded with well lithified sandstone.
77-82	Yellowish clay interbedded with sandy- limestone. Secondary calcite growth present in the fractures of the limestone.
82-87	White limestone interbedded with yellow- brown clay. Limestone has recrystallised grains.
87-90	White limestone interbedded with yellow- brown clay. Limestone has recrystallised grains.

Preliminary Drilling #2

Locations: Plant Site, Bodles, St Catherine.

Coordinates:

Depth (ft)	Description
0-7	Dark brown clay. Last 2 ½ ft more sandy with larger pebbles.
7-12	Dark brown interbedded sand and clay with larger pebbles throughout.
12-17	Similar to above. Dark brown clay with small amounts of sand and larger pebbles.
17-22	Similar to above. Dark brown clay with decreasing sand and pebble content.
22-27	Similar to above. Dark brown sandy- clay with small amounts of pebbles.
27-32	First 3 ft similar to above. Remainder is sandy with multicoloured well weathered pebbles and cobbles.
32-37	First 1'3" similar to above. Sandy- clay with multicoloured pebbles. Last 1 ft consists of greenish clayey with multicoloured pebbles.
37-42	Very stiff brown clay interbedded with green and red clay.
42-47	Interbedded brown clay, greyish clay and sandstone gravels.
47-52	Grey-green sand interbedded with orange brown sand that begins to grade into finer material after 1'2".
52-57	Similar to above. Interbedded grey- green sand and orange brown sand. Small amounts of silt and clay present in last 6 inches of core.
57-62	Similar to above. Poorly lithified orange- grey interbedded sand
62-67	Poorly lithified orange and grey interbedded sand with small amounts of clay. At 66'6", material becomes noticeably coarser.
67-72	First 1' of material is similar to 62'-66'6". The remainder is coarser with pebbles and gravels. Material is poorly lithified.
72-77	5" of grey – green clay that is poorly with small pebbles. Remainder is poorly lithified dark brown sandy clay.
77-82	Dark brown coarse grained sand with small amounts of clay and weathered sandstone pebbles. Material is poorly lithified.
82-87	Poorly lithified sandy clay with considerable amounts of gravel and weathered sandstone pebbles.
87-92	Poorly lithified greyish sand with small amounts of mud and sandstone pebbles.

92-97	First 7" is stiff light green clay. Next 4'2" is coarse grained sand with weathered pebbles and rubbles that grades back into stiff light green clay for the next 3". Material is poorly lithified.
97-102	Very stiff greyish clay interbedded with light brown clay. Material is poorly lithified.
102-107	Poorly lithified sandy clay that has a greyish colour. Last 9" of material reacts vigorously with dilute HCl and is therefore carbonate sand.

7.0 NEPA's ADDITIONAL SPECIFIC COMMENT

7.1 Best Dress Feed Mill

- Where the term "The feed mill" is referred to in the document that should be replaced with the name "Best Dress Feed Mill"
- Clarity is required on the NO₂ values quoted for the Best Dress Feed Mill due to inconsistency with the values they submitted to the Agency in 2009.

RESPONSE:

- Wherever the term "The feed mill" has been replaced with the name "Best Dress Feed Mill" and this was done throughout the whole document.
- When NO₂ was being modeled, a NO₂/NO_x ratio of 0.75 was utilized as recommended by the NRCA Ambient Air Quality Guideline Document (November 2006). At the time of the reported figures for the Best Dressed Feed Mill in 2009, a NO₂/NO_x ratio of 0.1 was utilized as the recommended default value.

NEPA's ADDITIONAL COMMENT

7.2 Additional Applications Required

Based on the documents submitted to date and the various components of the project the following Permit applications should be applied for at the earliest possible date.:

- Permit for Conveyor Belt
- Permit for the sewage treatment system
- Permit for the Coal Fired Power plant and Cogeneration Plant
- Permit for any Petroleum storage tank (4000litres and above)

RESPONSE:

Application forms for the permits stated are included with this addendum documentation, except for the permit for Petroleum storage tank (4000 litres and above), which will be done when details of the final designs are done.

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