ANNEX I

AN EXPANSION OF THE HUGH PARKEY'S BELIZE ADVENTURE ISLAND
(FORMERLY SPANISH BAY RESORT)

TERMS OF REFERENCE

(TOR)

TERMS OF REFERENCE AND FORMAT FOR AN ENVIRONMENTAL IMPACT ASSESSMENT (EIA) TO BE PREPARED FOR

AN EXPANSION OF THE HUGH PARKEY'S BELIZE ADVENTURE ISLAND (FORMERLY SPANISH BAY RESORT)

A PROPOSED TOURISM DEVELOPMENT EXPANSION PROJECT AT SPANISH LOOKOUT CAYE SOUTH-EAST OF BELIZE CITY

This Terms of Reference (TOR) has been prepared following the scoping for the most critical issues that will need to be addressed by the proposed development.

In the preparation of the Environmental Impact Assessment (EIA), the EIA preparers will need to focus on addressing the main areas of concern, such as:

WATER RESOURCES, LIQUID/SEWAGE WASTE, SOLID WASTE, TRANSPORTATION, WILDLIFE, ARCHAEOLOGY, EXTRACTION OF MATERIALS AND POTENTIAL IMPACTS ON COASTLINE, BOAT RELATED ACTIVITIES AND INFRASTRUCTURE AND SOCIO-ECONOMIC FACTORS, ENERGY GENERATION.

Scoping of these issues speeds up the EIA process, cuts down its cost, improves the quality of the development and ensures that environmental concerns are clearly addressed.

This Terms of Reference (TOR) is divided into three (3) sections:

A. PROJECT DESCRIPTION AND PHYSICAL ENVIRONMENT

This section of the document deals primarily with information pertaining to the background of the project and the physical environment within which it is proposed. The EIA will need to address:

1.0 THE PROJECT DESCRIPTION AND LAYOUT PLAN

Maps at appropriate scales must be provided and with proper labels and legends to illustrate the general settings of project related development sites as well as surrounding areas likely to be

affected. These maps shall include topographic contours, where available, as well as location of major surface waters, roads, parks or reserves, political boundaries and existing adjacent land uses (tourism, agricultural, industrial). Additionally the following should be provided:

1.01 Give the exact location of the project and provide proof of ownership of the parcel of land comprising the project site. Include a copy of a lease document or land title.

1.02 Describe the following characteristics of the proposed development:

a. The layout plan for the overall development, including siting of all facilities such as utilities, water treatment facilities, sewage treatment facilities, storage facilities, drainage facilities, Beach side town houses, marina town houses, villas, power generation/fuel storage facilities, marina/docking facilities, feeder roads, carriageway, administrative buildings/complexes, garbage storage/treatment facilities,

b. The physical plan for development, including the siting and rationale of all facilities and infrastructure.

1.03 Describe briefly the facilities provided in the plans above (1.02 a and 1.02 b)

1.04 Provide specifications and detailed designs for the following:
a. Collection and disposal systems for solid waste;
b. Sewage collection, disposal and treatment systems;
c. Water source, treatment and distribution systems;
d. Marinas, piers, docking facilities and related infrastructure;
e. Canal network; and
f. Carriageway.

1.05 Give detailed information on any water sport activities that will be carried out in the area (if applicable).

1.06 Give detailed information about the proposed marina (i.e. fueling for boats, mechanic services).

1.07 Provide an outline of the overall management structure anticipated for the proposed development.

1.08 Describe the implementation of the project in phases (if applicable)

2.0 THE PHYSICAL ENVIRONMENT

2.01 Provide details of the basic physical environment of the project site and zone of influence. This should include:

- Location of the project with respect to other land masses and any protected areas/marine reserves.

- Topography: Include the flood hazard and drainage patterns around the project site;

- Climate, hydrology and meteorology: Include the rainfall average per year, prevailing wind patterns and susceptibility to natural disasters (i.e. hurricanes, tropical storms and flooding);

- Geology:

    - Geomorphology – Give a detailed description of the characteristics of landforms, including a detailed description of the land surface which should include exposed rock types, types of unconsolidated materials exposed (sediments), ridges, valleys, and geological structures – faults and folds, (if they can be determined by field mapping).

    - Subsurface geology – Give a detailed description of the stratigraphy of rocks or unconsolidated materials within the project site, including depths for the protection of the water table. This must be done using core sampling, (mechanical or manual), by means of a pre-determined borehole grid. Cross sections of the rock types or unconsolidated materials should also be presented. The physical properties of the rocks and/or unconsolidated materials must be tested (particularly the permeability and percolation rates) to determine the suitability for the proposed development

- Soils: Give the fertility, permeability, agricultural value and classification, and the potential for erosion of the soils on the project site;

- Current land use of the project site and adjacent properties;

- Physical, biological and ecological description of surrounding receiving water bodies including lagoon and sea front and their relation to any protected areas or marine reserves within the zone of influence;

- Vegetation type (s).

3.0 POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

Describe the pertinent regulations, standards and policies, at the local and national levels, governing environmental quality, health and safety and protection of sensitive areas. These could include cultural resources, protection of endangered or threatened species, siting, infrastructure development, land use control and tourism that may have an impact on the proposed development.

3.01 Provide any policy, legal or administrative issues that may have an impact on the proposed development.

B. ENVIRONMENTAL ISSUES

This section of the document primarily targets the environmental issues of critical concerns based on information provided in section A.

The following are the critical issues a high quality EIA will need to address in evaluating the Placencia Resort development.

The EIA will need to address:

1.0 FLORA AND FAUNA

For the project site and the zone of influence:

1.01 Collect base line data (field study) on the terrestrial and aquatic fauna and flora; rare or endangered species or commercially valuable species within or in areas adjacent to the project site; sensitive habitats within or adjacent to project site and effluent receiving water bodies (if any). This should provide a baseline from which to detect any changes in the abundance and vigor of the species due to this development.

1.02 Provide a general description of the methodology used to collect baseline data this is to include the date, time, area surveyed and methodology used.

1.03 Estimate the acreage and type of vegetation within the development site designated for removal as well as the percent of vegetation, to be removed, taking into consideration the establishment of appropriate buffer zones along all permanent water bodies on site.

1.04 Identify any species of conservation significance (threatened and endangered species), such as manatees, crocodiles, turtles, etc., and specify detailed measures for their protection, which may include the establishment of reserves within the project site.

1.05 Highlight, where appropriate, measures that could be taken to enhance the habitat value of the project area.

1.06 Map terrestrial habitats at 1:15,000, including mangrove and vegetation cover, natural drains, etc. This should incorporate clear indicators of percent cover and habitat composition and health.

2.0 WATER RESOURCES

2.01 Determine the projected water needs for the entire development (including drinking water supply, domestic/household supply, irrigation of landscape, pool/spa, etc.).

2.02 Assess all sources of water supply, quality and quantity, paying special attention to determining the safe maximum sustainable yield it can provide. If surface or ground water sources are intended for potable use, water quality assessments of the intended sources should be conducted, as follows:

2.02. Collect a minimum of three (3) different water quality data sets (preferably three separate months) on the water sources identified above. This data should include the following parameters:

i. Temperature,
ii. Dissolved Oxygen
iii. Salinity
iv. Total Coliform Count
v. *Escherichia coli* Count
vi. Chemical Oxygen Demand
vii. pH
viii. Alkalinity
ix. Ammonia
x. Phosphorus
xi. Turbidity
xii. Total Nitrogen

(Assays I, ii & iii, to be conducted in the field and the remainder to be conducted preferably by an independent water quality consultant. The water quality analyses should contain the official stamp of the laboratory (if any) and the signature of the technician).

2.03 Identify the preferred option for water supply needs, based on environmental grounds. Specify any residual impacts of meeting water needs through this option, the significance, and any mitigatory measures to be undertaken. Provide detailed information for any water treatment processes that may be employed to obtain the required volumes of potable water for the entire development.

2.04 Given the results from above, evaluate a minimum of three (3) alternative options for the provision of water supply for the entire development.

2.05 Provide an inventory of other users in the zone of influence with respect to the chosen water source.

3.0 LIQUID WASTE / SURFACE RUN-OFF

3.01 Determine the nature, composition, source(s) and volumes of liquid waste, including sewage and grey water, pool water and spa water to be generated by the entire project.

3.02 Evaluate a minimum of three (3) options for the collection, treatment, recycling of the liquid wastes (if appropriate), and disposal of these effluents, identifying any chemicals planned for use in the treatment or management of these wastes.

3.03 Identify the preferred option(s) for liquid waste management, based on environmental grounds, including necessary infrastructure, designs, locations and land requirements. Specify any residual impacts of liquid waste management, their significance and any mitigation measures to be undertaken.

3.04 Estimate volumes of surface run off at project location.

3.05 Identify preferred option for surface drainage system for project area including drains, bridges, and sedimentation structures and run off ponds.

3.06 Identify and develop a water quality monitoring programme able to detect any change in ground water or surface water quality, or the water quality of the proposed effluent receiving water body (if any) that could impact:

- o Public health
- o Forest, wetland and adjacent aquatic habitats; and
- o Endangered or threatened species in project area and zone of influence

4.0 SOLID WASTE GENERATION

4.01 Determine the projected types and volumes of solid waste to be produced by the entire development. This should examine oil, tyres, plastics, metals, putrescible wastes, batteries/hazardous materials and construction wastes, at minimum. It will also need to include solid wastes from boats and other transportation vehicles. If composting of organic wastes is to be conducted, provide specifications on the location of the site and procedures to be followed for the composting.

4.02 Evaluate at least two (2) alternative options for the collection, treatment, storage and final disposal of these wastes, including the disposal of hazardous wastes.

4.03 Select the preferred option(s) for the disposal of these materials. This should be based on environmental grounds and public health grounds, and should specify residual impacts and their significance. If the EIA suggests the use of an existing landfill, assess the ability of the community or local government to provide the necessary infrastructure, resources and management for the collection, storage, treatment and final disposal of solid waste generated by the project and provide appropriate recommendations for these, in the event that they are inadequate.

4.04 Should the EIA determine that the construction of an on site land fill is the preferred option, the EIA should include a study to determine the most suitable site for the construction of the landfill. This study must including detailed soil analyses (profile, topographic surveys, permeability tests, etc.), designs of the proposed landfill, layout plan showing the landfill in relation to the project site, appropriate mitigation

measures and management plans for the collection, transportation and disposal of the wastes.

5.0 GEOLOGY AND EXTRACTION OF MATERIALS

5.01 Provide information on the specific soil type and submit results of analysis carried out to determine soil permeability/profile in the proposed project area.

5.02 Provide the soil profile of at least three bores of a diagonal transect of the property.

5.03 Conduct a geotechnical study/assessment to determine the load bearing capacity of the project site.

5.04 Determine the type and volume of construction materials required for the entire development, including road construction, infrastructure needs, and marina construction.

5.05 Determine the following for the dredging/excavation requirements for the project.

5.05.1 Disposal/use of dredged materials;
5.05.2 Physical character of materials to be dredged;
5.05.3 Type of dredging equipment/method of dredging;
5.05.4 Need for shoreline protection;

5.06 Determine the need for mining and impacts associated with the construction of the docking facility (if any).

5.04 Evaluate options for meeting the requirements of the Geology and Petroleum Department with respect to mining/quarry licenses/permits including reviewing the sources, volume, extraction methods and transportation as well as identifying:

5.04.1 Direct and indirect biological impacts on flora and fauna, marine and terrestrial with emphasis on the sea grass beds, and mangroves.
5.04.2 Direct and indirect physical impacts (eg. forest processes);
5.04.3 Impact on receiving water bodies, Caribbean Sea, lagoon, and mangrove wetlands.
5.04.4 Specific mitigation measures for the above mentioned.

5.05 Identify the preferred option for the extraction methods, source and transportation of materials, specifying the necessary mitigation measures, their residual impacts and significance.

6.0 TRANSPORTATION AND RELATED INFRASTRUCTURE

6.1 Roads/Walkways

6.11 Provide a layout of the existing access road(s) and/or walkways (if any), drainage and culverts to the development site. Identify whether any new roads/walkways will be required for the development.

6.12 Evaluate options for the provision of suitable roads/walkways for the development, taking into account proper access and egress to the project site, buffers, etc.

6.13 Select the preferred option for the provision of suitable roads/walkways for the development. This will need to examine construction materials (types, sources, volumes, transportation) and methods in relation to their environmental impacts.

6.14 Recommend precise mitigation measures, based on the specific option selected, for the proper management of the vehicular traffic close to and within the project area. These mitigation measures must include recommendations for protection features against siltation, erosion and other potential pollution to the environment.

6.15 Identify any changes in drainage patterns, if applicable.

6.2 Boat Related Activities and Infrastructure

6.21 Determine the projected number and types of boats likely to be associated with the entire development.

6.22 Evaluate options for boat storage, i.e docking/marina facilities and the size of such a facility. This will require examination of:

i. Design and siting of marina facility (with dimensions), including access channel;
ii. Wind conditions;
iii. Wave conditions;
iv. Transportation of construction materials;
v. Construction methods
vi. Near shore and off shore sedimentation patterns;
vii. Benthic substrate;
viii. Methods of controlling sedimentation of marina;
ix. Requirement for maintenance dredging (frequency and volume)
x. Estimated flushing rate for the proposed marina. Near shore and off shore current;

6.23 Evaluate options for the supply of fuel to boats and identify the best method for eliminating potential oil spillages and maximizing health and safety (if applicable). This should include options for the proper storage of the fuels.

7.0 ENERGY GENERATION

7.01 Determine the projected energy requirements for the entire development.

7.02 Evaluate a minimum of three (3) alternative options for meeting these needs, using fossil fuel, solar, wind resources (and others if appropriate). For each of these options, it will be necessary to investigate:

7.02.1 Fuel storage (where relevant);
7.02.2 Transportation (where relevant);
7.02.3 Health and safety;
7.02.4 Pollution sources, volumes, and types;
7.02.5 Significance of any pollution that may result from energy generation; and
7.02.6 Mitigatory measures to be implemented.

7.03 Select the preferred option(s) for energy generation. This should be based on environmental grounds and should specify the residual impacts of generation of the preferred option, its significance and the mitigation measures to be undertaken.

8.0 SOCIAL FACTORS

8.01 Conduct a study to determine the potential social impacts of the proposed development taking into account factors such as:

i. Regional and national economic impact of the project;
ii. Traditional resource users within the project area;
iii. Labor – employment opportunities (present and projected);
iv. Regional and local population (present and projected, resident & seasonal)
v. Integration;
vi. Customs & culture;
vii. Displacement and resettlement (if any);
viii. Police/Security services;
ix. Public Health Services, including pest and vector control;
x. The ability of the community or local government to provide emergency response services for any accidents, fire protection, and the availability of medical facilities and trained personnel to respond to medical emergencies.

9.0 ARCHAEOLOGY

9.01 In consultation with the Department of Archaeology, assess the area for archaeological interest and make provision for the protection of any such features.

9.02 The Archaeological Assessment Report is to be properly incorporated and integrated into the overall development plan. Recommendations for the protection of any features must be identified and properly addressed.

10.0 CARRYING CAPACITY

10.01 Provide technical justification for the number of buildings, number of persons residing and visiting the project site/resort. This should be described in such a way as to determine the carrying capacity of the area.

10.02 Determine the projected number of buildings to be constructed including dwellings, cabañas, offices or other similar complexes. A layout of all complexes and other infrastructure to be built and the proximity to each other should be shown.

10.03 Identify possible spin-off developments anticipated as a result of this project.

11.0 CODE OF RESTRICTIVE COVENANTS

11.01 In the EIA, a "code of restrictive covenants" should be developed to assist in ensuring compliance by future lot/home owners with the intended development plan for the area. This code should focus on various issues, especially on environmental protection and enhancement.

12.0 NGO AND PUBLIC INTEREST

12.01 The EIA team will report on the views and concerns of local NGOs, public interest groups and relevant government departments/agencies regarding the development of the project.

12.02 Provide a copy of the questions/answers used for the report including the name and organization of all the interviewees and the date of the interview.

13.0 DISASTER MANAGEMENT AND CLIMATE CHANGE ISSUES

13.01 Identify emergency preparation, response and applicable management measures for the proposed development (e.g. hurricane, floods, fires etc.). This should include evacuation and hazard management plans inclusive of climate change adaptation measures (such as sea level rise and structural/building design conducive with the climatic conditions of project site).

C. POTENTIAL CUMULATIVE IMPACTS

1.0 Identify all potential cumulative impacts and significant changes that may result from the implementation of this overall project. This should include, but not be limited to, changes in the following:

(a) Water Quality of the area;
(b) Current patterns and hydrographic characteristics;
(c) Land Use pattern;
(d) Boat Traffic;
(e) Infrastructure;
(f) Employment opportunities;
(g) Socio-cultural environment; and
(h) Abundance of flora and fauna.

2.0 The above analysis should distinguish between significant positive and negative impacts; direct and indirect impacts; immediate, medium and long-term impacts, irreversible or unavoidable impacts and identify impacts that may result from accidental events (i.e. oil/fuel spills, accidental release of untreated wastewater/ effluent, etc.). This analysis should be divided into construction, operational and maintenance activities / phases.

3.0 Characterize the extent and quality of available data, explaining significant information deficiencies (gaps) and uncertainties associated with the prediction of such potential impacts.

D. CONCLUSION/RECOMMENDATIONS

This section discusses the potential impacts (both positive and negative) and proposes alternatives to the execution of the project based on the information generated by Section B.

1.0 DETERMINATION OF POTENTIAL IMPACTS

1.01 Identify all significant changes that may result from the implementation of the project. This should include, but not be limited to, changes in the quality of any permanent water body on or near the project site, land use, noise, potential land use conflicts, traffic, infrastructure, employment opportunities, socio-cultural behaviour, abundance and vigor of flora and fauna, changes in abundance of pests and vectors, effects of the development on aesthetics and visual quality.

1.02 Review and compare the baseline data collected from the previous EIA submission and with the data collected for this submission to determine if any environmental characteristics have changed due to the development.

1.03 The analysis should distinguish between significant positive and negative impacts; direct and indirect impacts; immediate, medium and long-term impacts; irreversible or unavoidable impacts including the magnitude of these impacts (low medium, high); identify impacts that may result from accidental events (i.e. spills of hazardous waste, accidental release of untreated effluent discharges, etc.). The analysis should be divided into construction, operational and maintenance activities.

1.04 Characterize the extent and quality of available data, explaining significant information deficiencies and any uncertainties associated with the prediction of impacts. This section proposes alternatives to the execution of the project based on the information generated by Section B.

2.0 ALTERNATIVES FOR DEVELOPMENT

2.01.1 Present all reasonable alternatives for development in comparative form, exploring each alternative. Include the 'no-action' alternative and the reason why certain alternatives were recommended or eliminated. These alternatives should look at the following components:

2.01.2 Siting of the necessary support infrastructure and all facilities;

2.01.3 Earth Movement Activities (evaluate the different extraction/dredging methodologies, extraction/dredging points (burrow sites), extraction/dredging volumes, material fill sites etc.)

2.01.4 Liquid and solid waste treatment and disposal options (evaluate the different treatment technologies and methodologies).

2.01.5 Boat Storage and marina/docking facilities (siting, design, etc.)

.02 MITIGATION AND MONITORING PLANS

2.02.1 Based on the investigations, develop a mitigation matrix outlining mitigation measures for all potential negative environmental impacts including, but not limited to, construction activities, waste treatment and disposal, habitat alteration and erosion control, and management of pests and vectors (rodents, mosquitoes, flies, etc.),.

2.02.2 Provide a detailed monitoring plan to be implemented for the entire operation, identifying any agency/body responsible for its implementation and any training that may be necessary for the implementation of the plan. The plan should include monitoring of wastewater discharge characteristics (if any), changes in ecological species (including endangered species), contingency measures to emergency response to accidental events (fire, flood, hurricane, leakages, spillages, etc.).

2.02.3 Provide a detailed plan for the decommissioning and rehabilitation of the site to other uses in the event that the project is discontinued.

ANNEX II

EIA PREPARERS

Consulting Team Members

Tunich-Nah Consultants & Engineering (TNCE)

Jose Garcia, P. Eng.	Team Leader & Engineering
Hugo Rancharan	Environmental Engineering Technician
David McCulloch	Engineering Technician
Gerald McCulloch	Engineering Technician
Kareem Myvett	Engineering Technician
Richard Ayuso	Field Technician

In association with:

Allan Moore, PhD.	**Archaeology**
Lenny Gentle	**Field Ecologist**
Alberto Rosado	**Civil Engineer**

Nb. All CV's are available on request

ANNEX III

DEED OF CONVEYANCE

BELIZE

25 8 0

THIS **DEED OF CONVEYANCE** is made the 9th day of August 2004

BETWEEN **SYDNEY J. TURTON** of 152 Barrack Road in Belize City (hereinafter referred to as 'the Vendor') of the one part and **HUGH PARKEY FOUNDATION FOR MARINE AWARENESS AND RESEARCH** a company incorporated in Belize with its registered office situate at No. 1876 Hutson Street in Belize City (hereinafter referred to as 'the Purchaser') of the other part.

WHEREAS:

(1) The Vendor is under and by virtue of Minister's Fiat (Grant) No. 95 of 1993 and Minister's Fiat (Grant) No. 344 of 1995, seised of the properties described in the Schedule hereto for an estate in fee simple absolute free from encumbrances;

(2) The Purchaser is desirous of purchasing the said property and the Vendor has agreed to sell the same to the Purchaser for the sum of One Million Five Hundred and Thirty Thousand Dollars in the currency of the United States of America.

NOW THIS DEED WITNESSETH that in consideration of the said sum of One Million Five Hundred and Thirty Thousand Dollars in the currency of the United States of America (US$1,530,000.00) paid by the Purchaser to the Vendor (the receipt whereof is hereby acknowledged by the Vendor), the Vendor doth grant and convey unto the Purchaser ALL THOSE pieces or parcels of land described in the

Schedule hereto TO HOLD the same unto the Purchaser for an estate in fee simple free from incumbrances.

IN WITNESS WHEREOF the Vendor has hereunto set his hand and seal on the day and the year first abovewritten.

THE SCHEDULE ABOVE REFERRED TO

ALL THOSE pieces or parcels of land more particularly described in Plan No. 95 of 1993 attached to Minister's Fiat Grant No. 95 of 1993 AND Plan No. 344 of 1995 attached to Minister's Fiat (Grant) No. 344 of 1995 and comprising a total area of approximately 186 acres situate at and being Spanish Lookout Caye, approximately 10 miles southeast of Belize City, Belize District.

SIGNED SEALED AND DELIVERED)
by the said SYDNEY J. TURTON)
in the presence of:)

I, SYDNEY J. TURTON of 152 Barrack Road in Belize City hereby acknowledge that I did sign seal and deliver the above written Deed as my act and deed.

ACKNOWLEDGED at)
Belize City)
)
this 9th day of)
August 2004)

Before me,

Justice of the Peace

BE IT REMEMBERED that on the 9th day of August 2004 personally appeared before me the above-named Sydney J. Turton and acknowledged before me that he did sign seal and deliver the within-written Deed as his act and deed and that the signature " " is in his own handwriting.

Justice of the Peace

I HEREBY CERTIFY that I have counted the above written document and that it contains 9 Folios of 72 words and — words over and no more.

WITNESS my hand this 9th day of August 2004.

Tibanks

The above written document was prepared and drawn by W.H. Courtenay & Co. in their offices as Attorneys for one of the parties concerned therein.

DATED the 9th day of August 2004.

W. H. Courtenay & Co.

DATED 9th. August 2004.

SYDNEY J. TURTON

AND

THE HUGH PARKEY FOUNDATION FOR
MARINE AWARENESS AND EDUCATION

DEED OF CONVEYANCE

Lodge for record by W. H. Courtenay & Co.
this 25 day of Aug. 2004
at 3:30 p.m.
for Registrar of Lands

...given and registered in Book ...
...onformity with the provision...
...f the General Registry Ac...
Chapter 258 of the Law of Belize
Revised Editions 1980 in Deeds
Book Volume 26 153-162
of 2004 at Folios this
25 day of August 2004

for Registrar of Lands

W. H. COURTENAY & CO.
Barristers & Attorneys-at-Law
1876 Hutson Street
Belize City
Belize, Central America

ANNEX IV

ATTN: MR. Jose Garcia

BELIZE BREWING COMPANY LIMITED

WATER and WASTEWATER LABORATORY

Sample ID: Spanish Caye **DATE: 1 October, 2007**

INORGANIC CHEMISTRY

PHYSICAL	UNIT	METHOD	RESULTS					
			A	B	C	D	E	F
COLOUR, TRUE	units	Platinum - Cobalt Standard/ UV VIS Spectro						
COLOUR, APPARENT	units	Platinum - Cobalt Standard/ UV VIS Spectro						
CONDUCTIVITY	µs/cm	CONDUCTIVITY (probe)	54,500	52,600	52,200	53,200	53,400	53,000
VOLATILE WEIGHT	mg/l	Furnace						
OIL IN WATER	ppm							
pH	unit	pH/ISE meter (probe)	6.47	7.79	7.65	7.78	7.32	7.7
SALINITY	ppt	Mercuric Nitrate titration	36.1	34.4	34.1	33.8	34.5	34.6
FIXED WEIGHT	mg/l	Furnace						
SUSPENDED SOLIDS (SS)	ppm	Colorimeter	3	5	2	4	3	6
TEMPERATURE (IN LAB)	°C	Probe/Termometer						
TOTAL DISSOLVED SOLIDS (TDS)	ppm	CONDUCTIVITY (probe)	27,200	26,300	26,100	26,600	26,700	26,500
TURBIDITY	ntu	Nephelometric -Tungsten						
METALS	**UNIT**	**METHOD**						
ALUMINUM (Al)	ppm	Aluminon/UV VIS Spectro						
BARIUM (Ba)	ppm	Turbidimetric/ UV VIS Spectro						
CALCIUM (Ca)	ppm	UV VIS Spectro/ Titration						
CHROMIUM (Cr)	ppm	1,5-Diphenylcarbohydrazide/UV VIS Spectro						
COPPER (Cu)	ppm	Bicinchoninate/ UV VIS Spectro						
IRON, TOTAL (Fe)	ppm	UV VIS Spectro						
LEAD (Pb)	ppm	Dithizone/ UV VIS Spectro						
MANGANESE (Mn)	ppm	Periodate Oxidation/UV VIS Spectro						
MAGNESIUM (Mg)	ppm	UV VIS Spectro / Titration						
MERCURY (Hg)	ppm	Cold Vapor						
SELENIUM (Se)	ppm	Diaminobenzidine/ UV VIS Spectro						
SILVER (Ag)	ppm	Colorimetric/ UV VIS Spectro						
SODIUM (Na)	ppm	Probe						
ZINC (Zn)	ppm	Zincon/ UV VIS Spectro						
NON-METALS	**UNIT**	**METHOD**			**RESULTS**			
CHLORINE, FREE (Cl)	ppm	UV VIS Spectro /DPD						
CHLORINE, TOTAL (Cl)	ppm	UV VIS Spectro/DPD						
FLUORIDE (F)	ppm	SPADNS/UV VIS Spectro						
NITROGEN, TOTAL (N)	ppm	Cadmium Reduction/ UV VIS Spectro						
DISSOLVED OXYGEN (DO)	ppm	PROBE						
PHOSPHATE, TOTAL (PO_4)	ppm	PhosVer / Orthophosphate/ UV VIS Spectro	0.8	0.7	2	0.9	0.8	0.8
INORGANIC COMPOUNDS	**UNIT**	**METHOD**			**RESULTS**			
ACIDITY (as $CaCO_3$)	ppm	Titration						
AMMONIA (NH_3)	ppm	Salicylate / Probe						
BICARBONATE (HCO_3)	ppm	Titration						
CARBON DIOIXIDE (CO_2)	ppm	Titration						
CARBONATE (CO_3)	ppt	Titration						
CHLORIDE (Cl)	ppm	Mercuric Nitrate						
CHROMATE (CrO_4)	ppm	Titration						
CYANIDE (CN)	ppm	Pyridine-Pyrazalone/ UV VIS Spectro						
TOTAL HARDNESS (as $CaCO_3$)	ppm	EDTA Titration/ UV VIS Spectro	6,172	6,010	5,970	6,060	6,110	6,100
HYDROGEN SULFIDE (H_2S)	ppm	Titration / UV VIS Spectro						
HYPOCHLORITE (BLEACH)	ppm	Titration						
M ALKALINITY(TOTAL), (as $CaCO_3$)	ppm	Sulfuric acid titration						
TOTAL NITRATE (NO_3)	ppm	Cadmium Reduction/ UV VIS Spectro	3	2.6	4.8	2.2	5.5	1.6
NITRATE NITROGEN (NO_3-N)	ppm	Cadmium Reduction/ UV VIS Spectro						
NITRITE (NO_2)	ppm	Diazotization/ UV VIS Spectro						
HYDROXIDE ALKALINITY (OH)	ppm	Titration						
OZONE (O_3)	ppm	Indigo Trisulfonate/ UV VIS Spectro						
PHENOLPHTHALEIN ALKALINITY (as CaCO	ppm	Sulfuric acid titration						
PHOSPHATE (PO_4)	ppm	PhosVer / Orthophosphate/ UV VIS Spectro						
SILICA (SiO_2)	ppm	Smcomolybdate/Colometric						
SODIUM CHLORIDE (NaCl)	ppm	UV VIS Spectro / Titration						
SULFIDE (S^-)	ppm	Methylene Blue Titration						
SULFITE (SO_3)	ppm	Titration						
SULPHATE (SO_4)	ppm	Sulfa Ver 4/ UV VIS Spectro	1,200	1,600	1,400	1,400	1,100	2,100

ORGANIC CHEMISTRY

OXYGEN DEMAND, BIOCHEMICAL (BOD_5)	mg/l	BODTRAK / 5 days Digestion	16	14	15	14	17	19
OXYGEN DEMAND, CHEMICAL (COD)	mg/l	Reactor Digestion						
ORGANIC	1/cm	Direct method/ UV VIS Spectro						
ORGANIC CARBON, TOTAL (TOC)	ppm	Direct method/UV VIS Spectro						
TRIHALOMETHANES (THMs)	ppb	Chloroform/UV VIS Spectro						

MICROBIOLOGICAL ANALYSIS

	UNIT	METHOD			RESULTS			
HETEROTROPHIC BACTERIA	count	R2A Agar (MF)						
TOTAL COLIFORM	count	m-ENDO Broth (MF)						
ESCHERICHIA COLI (E.coli)	count	m-ENDO Broth (MF)			0/100ml	0/100ml	0/100ml	0/100ml	0/100ml	0/100ml
FECAL COLIFORM	count	m-FC/ROSOLIC Broth (MF)			0/100ml	0/100ml	0/100ml	0/100ml	0/100ml	0/100ml
ENTEROCCOCCI	count	m-EL Broth (MF)						
YEAST	count	R. B. Agar (MF)						
MOLD	count	R. B. Agar (MF)						

Analyst: Damian Espat

ANNEX V

SEISMIC CODE EVALUATION

SEISMIC CODE EVALUATION

Caribbean Islands (CARICOM)
Evaluation conducted by Myron Chin

NAME OF DOCUMENT: **Caribbean Uniform Building Code(CUBiC)** Part 2 Section 3

YEAR: 1985

GENERAL REMARKS: This was developed by a firm of Short Term Consultants called Principia Mechanica of London, UK as part of the USAID/CDB funded CUBiC project in November 1983 and the seismic code provisions of CUBiC are based essentially on SEAOC but with appropriate sections from UBC, ATC and New Zealand codes.

SPECIFIC ITEMS:

NOTE: Bracketed numbers refer to Code specific chapters or articles: [4.1.b]
Parenthesis numbers refer to Items of this document: (see 2.2)

1. GENERAL PHILOSOPHY

1.1 Explicit concepts. [2.300]

Scope of Code is for new Buildings and does not cover requirements for Design and Construction of special structures including, but not limited to, bridges, transmission towers, industrial towers and equipment,piers, wharves, hydraulic structures, off-shore structures and nuclear reactors These special structures require special consideration of their response characteristics and environment which is beyond the scope of the CUBiC provisions..

Seismic design is a design controlled by displacements and deformations. Inelastic deformations are accepted, adequate ductility is essential.

Masonry or concrete shall be reinforced so as to qualify as reinforced masonry or concrete for seismic loads.

1.2 Performance Objectives.

No performance objectives are given but the main objective is to protect human life and reduce economic loss caused by earthquakes. In [2.307.2]

DUCTILITY- The building as a whole, and all of its elements that resist seismic forces or moments, or that in case of failure are a risk to life, shall be designed to possess ductility.

2. SEISMIC ZONING AND SITE CHARACTERIZATION

2.1 Seismic Zoning. [2.305.4 and Table 2.305.1]

THE VARIOUS ISLANDS OF THE ENGLISH SPEAKING CARIBBEAN ARE ASSIGNED ZONAL COEFFICIENTS ,Z, IN TABLE 2.305.1.

TERRITORY	Z VALUE
JAMAICA	.75
ANTIGUA	.75
ST.KITTS-NEVIS	.75
MONTSERRAT	.75
DOMINICA	.75
ST.LUCIA	.75
ST.VINCENT	.50
GRENADA	.50
BARBADOS	.375
NW TRINIDAD	.75
REST OF TRINIDAD	.50
TOBAGO	.50
GUYANA ESSEQUIBO	.25
REST OF GUYANA	.00
BELIZE –AREAS WITHIN 100KM OF SOUTHERN BORDER I.E. INCLUDING SAN ANTONIO AND PUNTA GORDA BUT EXCLUDING MIDDLESEX, POMONA AND STANN CRECIL	.75
- REST OF BELIZE	.50

2.2 Levels of Seismic Intensity.

No levels of Seismic Intensity given in the code.

2.3 Near Fault considerations.

Not considered.

2.4 Site Requirements

2.5 Site Classification. [2.305.8]

The value of the soil factor, S, shall be determined by the following formulae but shall not be less than 1.0:

For T/T_S= 1.0 or less, $S= 1.0 + T/T_S - 0.5\ T^2/T_S$
For T/T_S greater than 1.0,
$S= 1.2 + 0.6\ T/T_S - 0.3\ T^2/T_S$

T shall be established by properly substantiated analysis but T shall not be taken as less than 0.3 seconds.
The range of values of T_S may be established from properly substantiated geological data, except that T_S shall not be taken as less than 0.5 seconds nor more than 2.5 seconds. T_S shall be that value within the range of site periods as determined above that is nearest to T.
Where T has been established by a properly substantiated analysis and exceeds 2.5 seconds, the value of S may be determined by assuming a value of 2.5 seconds for T_S.

2.6 Peak Ground Accelerations.

Effective Peak Ground Accelerations are not defined.

3. PARAMETERS FOR STRUCTURAL CLASSIFICATION

3.1 Occupancy and Importance. [2.305.6]

Three Classes, with corresponding Importance Factors I are given:

Class I Buildings: I = 1.5
These are Essential Facilities required for use in the aftermath of a major earthquake, e.g. hospitals, fire stations, communication centers etc.
Class II Buildings: I = 1.2
These are public buildings and buildings which accommodate large numbers of people, e.g. cinemas, theatres, schools, defence establishments etc.
Class III Buildings: I= 1.0
All other buildings not included in Class I or class II above.

3.2 Structural Type. [Table 2.305.2]

Nine Structural Types for Steel and Concrete and Three for Timber.

Frame Type (Ductile steel, concrete, timber).
Dual Type (Frame + Wall combination. Frame with 25% of shear demand; steel, concrete, masonry, timber)
Wall Type (either concrete, masonry or plywood walls or steel or timber braced frames)
Cantilever Type (or Inverted Pendulum)
Others Type (none of the above)

3.3 Structural Regularity: Plan and Vertical. [2.304.2]

Buildings which have highly irregular shapes, large differences in lateral resistance or stiffness between adjacent storeys, or unusual features shall be analysed by dynamic methods. In particular, buildings classified in Importance Groups I and II shall be analysed by dynamic methods when:

(a) the seismic force resisting system does not have the same configuration in all storeys and in all floors.
(b) The floor masses differ by more than 30% in adjacent floors.
(c) The cross-sectional areas and moments of inertia of structural members differ by more than 30% in adjacent stories.

3.4 Structural Redundancy.

Not considered

3.5 Ductility of elements and components. [2.307.2]

Clauses 2.307.2 to 2.307.18 cover the ductility requirements of the various types of frames.

4. SEISMIC ACTIONS

4.1 Elastic Response Spectra.

Not considered.

4.2 Design Spectra

Not considered.

4.3 Representation of acceleration time histories

Not considered.

4.4 Design Ground Displacement

Not considered.

5. DESIGN FORCES, METHODS OF ANALYSIS AND DRIFT LIMITATIONS [2.305, 2.305.17, 2.306]

5.1 Load Combinations including Orthogonal Seismic Load Effects

Load Combinations not mentioned but drift provisions given in clause 2.305.17 which states as follows:

"Lateral deflections or drift of a storey relative to its adjacent stories shall not exceed 0.005 tiimes the storey height unless it can be demonstrated that greater drift can be tolerated. The displacement calculated from the application of the required lateral forces shall be multiplied by 1.0/K to obtain the drift. The ration 1.0/K shall not be less than 1.0."

5.2 Simplified Analysis and Design Procedures

None given.

5.3 Static Method Procedures. [2.305]

$$V = ZCIKS\,W$$

where

V = Total Lateral Force or Shear at the base
Z = Seismic Zonal Coefficient (see 2.1)
C = $1/15\sqrt{T}$
C need not exceed 0.12

For moment resisting structures where the frames are not enclosed or adjoined by more rigid components tending to prevent the frames from deflecting when subjected to seismic forces:

$$T = C_T h_n^{3/4}$$

Where

C_T = 0.035 for steel frames
C_T = 0.025 for concrete frames
h_n = the height in feet above the base to the highest level of the building

For all other buildings:

$$T = 0.05h_n/\sqrt{L}$$

Where

L = the overall length (in feet) of the building at the base in the direction under consideration.

W= Total Weight (100% of Permanent (Dead) Load + applicable portions of other loads.

Force distribution in proportion to each floor weight, W_i , and height, h_i .

$$F_i = V [w_i h_i^k / \Sigma W_k h_k^k]$$

Where k is an exponent related to the building period as follows:

For buildings having a period of 0.5 seconds or less, k=1

For buildings having a period of 2.5 seconds or more, k=2

For buildings having a period between 0.5 and 2.5 seconds, k may be 2.

Natural Period calculated with Rayleigh Method

5.4 Mode Superposition Methods. [2.306]

Required whenever Static Method Procedures (see 5.3) are not allowed. Combination of modes according to SRSS .

5.5 Non Linear Methods.

No Non linear methods of analysis are mentioned as alternative methods.

5.6 Torsional considerations. [2.305.14]

All structures with Plan Structural Irregularities (see 3.3) where the vertical resisting elements depend on diaphragm for shear distribution at any level, the shear resisting elements shall be capable of resisting a torsional moment assumed to be equivalent to the storey shear acting at an eccentricity of not less than five percent of the maximum dimension at that level..

5.7 Drift Limitations. [2.305.17]

See (5.1)

5.8 Soil-Structure Interaction Considerations.

Not considered

6. SAFETY VERIFICATIONS

6.1 Building Separation

Not considered

6.2 Requirements for Horizontal Diaphragms

Not considered

6.3 Requirements for Foundations [2.307.22]

Individual Pile Caps and caissons of every building shall be interconnected by ties each of which can carry by tension and compression a minimum horizontal force equal to 10 percent of the largest pile cap or caisson loading, unless it can be demonstrated that equivalent restraint can be provided by other approved methods.

6.4 P-Delta Considerations

Not considered

6.5 Non-Structural Components

Not considered

6.6 Provisions for Base Isolation

Not considered

7. SMALL RESIDENTIAL BUILDINGS

Not considered in CUBiC but the draft Small Building Code of Trinidad and Tobago (SBCTT) has a number of sections which deal with Lateral Load Design for earthquakes in Sections 3.1.7 and 3.2.6 on pages 16 to 21 and 42 to45. These pages can be viewed at URL: http://www.boett.org

In the preparation of this SBCTT, extensive use has been made of the Caribbean Uniform Building Code (CUBiC). It was noted that at this time CUBiC is being considered for revision and the management committee for the revision project has elected to make use of the International Code Council Inc. of the USA in the provision of the base documentation for this review. In like manner for this code use has been made of the ICC year 2000 International Residential Code Final Draft 1998.

The exercise was managed by the Board of Engineering of Trinidad and Tobago sponsored by the Joint Consultative Council of the Construction Industry (T&T) and the Interim National Physical Planning Commission (T&T) with support of the Trinidad and Tobago Bureau of Standards (TTBS).

8. PROVISIONS FOR EXISTING BUILDINGS

Not considered

CODE IMPROVEMENT RECOMMENDATIONS

The CUBiC Seismic Code can be considered as being a very outdated Code since no updating has taken place since it was produced in 1985. It is therefore recommended that it be replaced with a more modern seismic code such as IBC 2000 incorporating updated seismic hazard maps for the English speaking Caribbean region in a Caribbean Application Document (CAD). In respect of Chapter 7 on Small Residential Buildings it is recommended that the Small Building Code of TT be adopted.