

ENVIRONMENTAL IMPACT ASSESSMENT

FOR

PALM HARBOUR

A PROPOSED RESIDENTIAL SUBDIVISION PROJECT

FOR HANEY FARMS



October, 2007

TABLE OF CONTENTS

<i>List of Annexes</i>	<i>vii</i>
<i>List of Tables</i>	<i>viii</i>
<i>List of Figures</i>	<i>x</i>
<i>List of Plates</i>	<i>xi</i>
<i>Glossary of Terms</i>	<i>xii</i>
<i>Glossary of Acronyms</i>	<i>xvi</i>
<i>Preface</i>	<i>xviii</i>
<i>Executive Summary</i>	<i>xix</i>
1.0: Project Description	1-1
1.1: Project Location	1-1
1.2: Access to the Site	1-2
1.3: Existing Development	1-6
1.4: Project Rationale	1-6
1.5: Developmental Options	1-6
1.6: Selection of the Preferred Option	1-10
1.6.1: Residential Component	1-10
1.6.2: Marina Component	1-10
1.6.3: Other Components	1-11
1.7: Project Construction	1-15
1.8: Project Implementation	1-15
1.9: Specifications for the Facilities and Forecast of Activities	1-16
1.10: Overall Management Structure	1-16
2.0: Physical Environment	2-1
2.1: Project Site and Zone of Influence	2-1
2.2: Physical Description	2-1
2.2.1: General Topography	2-1
2.2.2: Hydrology	2-2
2.2.3: Regional Geology of the Area	2-6
2.2.4: Climatology	2-14
2.2.5: Vegetation and Ecosystem Profile	2-16
2.3: Marine description	2-21
2.4: Natural Hazards	2-23
3.0: Legal and Administrative Framework	3-1
3.1: Introduction	3-1
3.1.1: The Environmental Protection Act SI 22/1992 and 328/2003	3-1
3.1.2: Environmental Impact Assessment Regulations SI 107/1995	3-2
3.1.3: Coastal Zone Management Strategy Chap. 329 2000 Revised Edition	3-3
3.1.4: Effluent Limitation Regulations SI 94/1995	3-3
3.1.5: Pollution Regulations SI 56/1996	3-3
3.1.6: Solid Waste Management Authority Act SI 224 of 2000	3-3
3.1.7: National Institute of Culture History Act Chapter 331 Revised 2000	3-4
3.1.8: National Institute of Culture and History (Amendment) Act SI No. 20 of 2003	3-4
3.1.9: Belize Water Industry Act No. 1 of 2001	3-4
3.1.10: Belize Port Authority Act SI 233 of 2000/2003	3-4
3.1.11: Belize Public Health Act Revised Edition SI 40/2000	3-5
3.1.12: National Lands Act (No. 6 of 1992) and SI 191 of 2000	3-5

3.1.13:	Crown Land Rules SI 60 of 1939	3-5
3.1.14:	Mines and Minerals Act Chap. 226 of 2000	3-6
3.1.15:	Forests (Mangrove Protection) Regulations, SI No. 52 of 1989	3-6
3.1.16:	The Forest Act SI 213/2000	3-6
3.1.17:	Fisheries Act SI 210/2000	3-6
3.1.18:	The Wildlife Protection Act SI 220/2000	3-7
3.1.19:	Housing and Town Planning Act SI 182/2000	3-7
3.1.20:	Belize Tourist Board Act	3-8
3.1.21:	International Conventions and Agreements	3-8
4.0:	Flora & Fauna	4-1
4.1:	Scope	4-1
4.1.1:	Importance of the Survey Area	4-1
4.1.2:	Acreage and Type of Vegetation to be cleared	4-2
4.1.3:	Methodology	4-2
4.2:	Flora Survey	4-2
4.3:	Fauna Survey	4-8
4.3.1:	Measures for Protection of Species of Conservation Significance	4-9
4.3.2:	Avifaunal Survey	4-10
4.4:	Measures to Enhance the Habitat Value of the Project Area.	4-13
4.5:	Impacts and Mitigation Measures	4-15
5.0:	Water Resources	5-1
5.1:	Overview	5-1
5.2:	Projected Occupancy	5-1
5.3:	Water Resources	5-2
5.4:	Proposed Project Water Demand	5-2
5.5:	Water Source Selection	5-3
5.6:	Selection of the Preferred Source	5-4
5.7:	Ground Water Distribution, Storage and Treatment Options	5-8
5.8:	Zone of Influence	5-10
5.9:	Water Conservation	5-10
5.10:	Surface Water Analysis	5-11
5.10.1:	Water Analysis Summary	5-11
5.10.2:	Marine Water Quality Monitoring Program	5-11
6.0:	Waste Water Management	6-1
6.1:	Overview	6-1
6.2:	Projected Wastewater Composition	6-1
6.3:	Wastewater Production	6-2
6.3.1:	Domestic Wastewater Production	6-2
6.3.2:	Marine Vessel (boat) Wastewater Production	6-3
6.3.3:	Projected Total Wastewater Volume	6-3
6.4:	Environmental Wastewater Load	6-3
6.5:	National Effluent Standards	6-4
6.6:	Wastewater Collection and Treatment Alternatives	6-5
6.6.1:	Selection of the Preferred Option	6-7
6.6.2:	Typical BESST Treatment Plan Efficiency	6-7
6.7:	Domestic Wastewater Management	6-7
6.7.1:	Legislation	6-8
6.7.2:	Wastewater Piping	6-8
6.8:	Marina Wastewater Management	6-8
6.8.1:	Proposed Vessel Wastewater Piping	6-8
6.8.2:	Bilge Water Contingency	6-10
6.9:	Wastewater Disposal	6-10
6.9.1:	Wastewater Recycling	6-10
6.9.2:	Mangrove/Wetland Disposal	6-10

6.9.3:	Wastewater Monitoring Program	6-11
7.0:	Solid Waste	7-1
7.1:	Introduction	7-1
7.2:	Waste Types	7-1
7.3:	Construction and Field Waste	7-1
7.3.1:	Field Waste	7-2
7.3.2:	Construction Waste	7-2
7.4:	Domestic Waste	7-2
7.5:	International Waste	7-4
7.5.1:	International Waste Generation	7-4
7.5.2:	International Waste Classification	7-5
7.6:	Commercial Waste	7-5
7.7:	Solid Waste Disposal Alternatives	7-5
7.7.1:	Field and Construction Waste	7-6
7.7.2:	Domestic Waste Disposal	7-6
7.7.2.1:	Disposal Alternatives	7-6
7.7.2.2:	Selection of the preferred option	7-8
7.7.3:	International Waste Disposal	7-8
7.8:	Typical Solid Waste Management Plan	7-8
7.8.1:	Waste Minimization Strategies	7-8
7.8.2:	Domestic Waste Minimization Volumes	7-9
7.8.3:	Solid Waste Collection	7-10
7.8.4:	Educational and Sensitization Program	7-10
7.9:	Reporting Requirement and Compliance Monitoring	7-10
8.0:	Energy Generation	8-1
8.1:	Energy Demand	8-1
8.2:	Energy Supply Sources	8-2
8.2.1:	Primary Source	8-2
8.2.2:	Secondary Source	8-3
8.3:	Power Transmission Lines	8-4
8.4:	Fuel Management	8-4
8.4.1:	Domestic Fuel	8-4
8.4.2:	Operational Fuel	8-5
8.5:	Impacts and Mitigative Measures	8-7
9.0:	Geology and Extraction of Materials	9-1
9.1:	Geology Background	9-1
9.2:	Geomorphology	9-1
9.3:	Sampling Methodology	9-1
9.4:	Soil Investigation	9-3
9.5:	Proposed Dredging Activities	9-7
9.5.1:	Dredging Equipment	9-7
9.5.2:	Dredging Volumes and Fill Requirements	9-8
9.5.3:	Disposal of Spoils	9-11
9.5.4:	Maintenance Dredging	9-11
9.6:	Proposed Dredging Impacts	9-12
9.7:	Mitigation	9-13
10.1:	Road Transportation	10-1
10.1.1:	Existing Road Condition	10-1
10.1.2:	Access Roads	10-1
10.1.3:	Drainage Patterns	10-3
10.1.4:	Provision of Suitable Road/Walkways	10-3
10.1.5:	Preferred Road Option	10-6
10.1.6:	Preferred Surface Drainage Option	10-6

10.2:	Water Transportation (Marina Component)	10-7
10.2.1:	Marina Construction	10-7
10.2.2:	Canal Network	10-9
10.2.3:	Shoreline Protection (Sea Defenses)	10-11
10.2.4:	Transportation of Materials	10-13
10.3:	Marina Operation	10-13

11.0:	Social Impact Assessment	11-1
11.1:	Introduction	11-1
11.2:	Regional Demographics/Population	11-1
11.2.1:	Maya Center (Including Kendal) Village	11-2
11.2.2:	Sittee River Village	11-3
11.2.3:	Hopkins Village	11-4
11.2.4:	Santa Cruz Village	11-5
11.2.5:	Santa Rosa Village	11-5
11.3:	Cultural and Historical Resources	11-6
11.3.1:	Maya Center Village	11-6
11.3.2:	Sittee River Village	11-6
11.3.3:	Hopkins Village	11-7
11.4:	Social Infrastructure and Services	11-7
11.4.1:	Education/Health Services	11-7
11.4.2:	Labor and Employment	11-9
11.4.3:	Communication and Services	11-11
11.4.4:	Roads and Transportation	11-11
11.4.5:	Planning	11-12
11.4.6:	Protected Areas Management	11-12
11.5:	Social Impact Assessment and Mitigation	11-13
11.5.1:	Introduction	11-13
11.5.2:	Potential Impacts	11-13
11.5.2.1:	Location and Size of Development	11-13
11.5.2.2:	Historical Resources	11-14
11.5.2.3:	Roads	11-14
11.5.2.4:	Traffic	11-15
11.5.2.5:	Disturbances	11-15
11.5.2.6:	Post Construction Operations and Activities	11-16
11.5.2.7:	Housing	11-17
11.5.2.8:	Population	11-17
11.5.2.9:	Culture	11-18
11.5.2.10:	Education/Health Services	11-18
11.5.2.11:	Employment	11-18
11.6:	Positive impacts	11-19

12.0:	Contingency Plan	12-1
12.1:	Introduction	12-1
12.2:	Disaster Management Structure	12-2
12.3:	Hurricane Preparedness Plan (Evacuation Plan)	12-2
12.3.1:	Purpose of Plan	12-2

12.3.2:	Information System	12-3
12.3.3:	Pre-Season Preparation	12-3
12.3.4:	Implementation Plan during Threats	12-4
12.3.5:	Safety Precautions	12-5
12.4:	Fire Prevention and Response Plan	12-6
12.4.1:	Purpose of Plan	12-6
12.4.2:	Fire Protection Equipment/Systems	12-7
12.4.3:	Fire Prevention	12-7
12.4.4:	Fire Response	12-8

12.5:	Spill Contingency Plan	12-8
12.5.1:	Purpose of Plan	12-8
12.5.2:	Mechanism	12-9
12.5.3:	Fuel Management	12-9
12.5.4:	Waste Oil Management	12-9
12.5.5:	Contingency Equipment	12-10
12.5.6:	Safety and Response Priorities	12-10
12.6:	Tidal Rise Contingency Plan	12-10
12.7:	Medical Emergency Plan	12-11
12.7.1:	Transportation (Evacuation) of Patient	12-11
12.7.2:	Contact Information	12-12
12.8:	Environmental Safety	12-12
12.9:	Conclusion	12-14
13.0:	Archaeological Resources	13-1
13.1:	Introduction	13-1
13.2:	Description of the Area	13-1
13.3:	Purpose of the Study	13-3
13.4:	Methodology	13-3
13.5:	Result of Survey	13-5
13.6:	Recommendation	13-5
14.0:	NGO and Public Interest	14-1
14.1:	Views and Concerns	14-1
14.2:	Questions/Answers at Interviews and list of Interviewees	14-2
15.0:	Subdivision Component	15-1
15.1:	Proposed Subdivision Plan	15-1
15.2:	Overall Potable Water Requirements	15-1
15.3:	Waste Management Plan	15-2
15.4:	Energy Consumption	15-4
15.5:	Restrictive Code Of Covenants	15-4
16.0:	Alternatives for Development	16-1
16.1:	Introduction	16-1
16.2:	The 'No Action Alternative'	16-1
16.3:	Technical and Economic Analysis	16-2
16.4:	Conceptual Strategy	16-2
16.5:	Conclusion	16-8
17.0:	Mitigation and Monitoring Plan	17-1
17.1:	Overview of Proposed Impacts	17-1
17.2:	Implementation Plans	17-2
17.3:	Impact Rating Matrix	17-2
17.4:	Environmental Mitigation Plan	17-4
17.4.1:	Dredging (Canal and Marina) and Land Reclamation Activities	17-4
17.4.2:	Domestic Effluent Impacts	17-5
17.4.3:	Solid Waste Impacts	17-5
17.4.4:	Boating and Dockside Impacts	17-6
17.4.5:	Impacts from Energy Generation	17-6
17.4.6:	Socio-economic Impacts	17-7
17.4.7:	Other related Impacts	17-7
17.5:	Impacts and Mitigation Measures	17-7
17.6:	Typical Monitoring Plan for Palm Harbour	17-17
17.6.1:	Purpose of Environmental Monitoring	17-17
17.7:	Conclusion	17-21

LIST OF ANNEXES

- Annex I – Terms of Reference
- Annex II – Names of Consulting Team Members
- Annex III – Seismic Code Evaluation
- Annex IV – Wind Code Evaluation
- Annex V – Regional Background to Hazards
- Annex VI – Hurricane Scales
- Annex VII – BESST Plant Specifications
- Annex VIII – Water Samples Results
- Annex IX – Earth Tub Composting Technology
- Annex X – Restrictive Code of Covenants
- Annex XI – Soil Sample Results
- Annex XII – Sheet Pile Specification
- Annex XIII – Legal Documents
- Annex XIV – Cabbage Haul Creek Hydrology

LIST OF TABLES

Table 2.1:	Land Systems Found in the Geographic Region of the Project.	2-6
Table 2.2:	Soil Classification of the Southern Coastal Plain	2-7
Table 2.3:	Agricultural Suitability of Soil Sub-Suite	2-10
Table 2.4:	Hazard Mapping in Belize	2-26
Table 2.5:	Vulnerability Studies for Belize	2-27
Table 3.1:	Licenses and Permits required by the Development	3-9
Table 4.1:	Mangrove Forest Cover	4-4
Table 4.2:	Savanna Lowland shrub with Pine Forest	4-5
Table 4.3:	Tropical Seasonal Broadleaf Forests	4-5
Table 4.4:	List of Species Observed/Recorded at the Project Site	4-8
Table 4.5:	List of birds identified on the site	4-11
Table 4.6:	Potential Ecological Impacts (Residual Impact Rating) to Vegetation and Wildlife	4-16
Table 5.1:	Projected Occupancy Rate for the Intended Development	5-1
Table 5.2:	Projected Water Demand for Palm Harbour Development	5-2
Table 5.3:	Projected Palm Harbour demand according to zones	5-3
Table 5.4:	Summary of Water Sources	5-3
Table 5.5:	Microbiological Disinfection Devices	5-9
Table 6.1:	Typical Composition of Untreated Domestic Sewage*	6-1
Table 6.2:	Projected Wastewater Productions for Palm Harbour Development	6-2
Table 6.2b:	Wastewater generated by marine vessels	6-3
Table 6.3:	Environmental Wastewater Profile	6-4
Table 6.4:	Effluent Limitation Standard for Commercial Activities	6-4
Table 6.5:	Evaluation of Wastewater Disposal Alternatives	6-6
Table 6.6:	Projected Performance of BESST Treatment Plant and its equivalent	6-7
Table 6.7:	Wastewater Alternative Uses	6-10
Table 6.8:	Wastewater Monitoring Template for Palm Harbour	6-11
Table 7.1:	Estimated Solid Waste Generation for Belize Municipalities	7-3
Table 7.2:	Projected Solid Waste Production volumes for Palm Harbour	7-4
Table 7.3:	International waste generated by marine vessels	7-5
Table 7.4:	Domestic Waste Disposal Options	7-7
Table 7.5:	Waste Reduction Yield for Palm Harbour Development	7-9
Table 8.1:	Projected Energy Demand for Palm Harbour	8-1
Table 8.2:	Selection of Secondary Sources for Palm Harbour	8-3
Table 8.3:	Matrix of potential environmental impacts as a result of power generation	8-7
Table 9.1:	Anticipated Dredging volumes for the proposed project	9-10
Table 11.1:	Current and Projected Population Figures of Five Villages to be Directly Impacted by the Development (CSO Census 2000).	11-2
Table 11.2:	National Population Figures by District of Belize, 2000.	11-2
Table 11.3:	Social Infrastructure of the Villages to be Impacted by Proposed Development	11-9
Table 11.4:	Employment Data in the Stann Creek District during 2003-2006	11-9
Table 11.5:	Labour Requirements by Proposed Development During Phases of Development	11-10
Table 11.6:	Proposed Activities, Potential Impacts & Residual Impact Rating.	11-20
Table 12.1:	Summary of the Disaster Preparedness Plans for Palm Harbour Development	12-1
Table 12.2:	Palm Harbour Emergency Services	12-12

Table 15.1:	Proposed Acreage Plan	15-1
Table 15.2:	Projected Water Demand for the Residential Subdivision	15-2
Table 15.3:	Estimated Wastewater Productions for Subdivision Component	15-2
Table 15.4:	Projected Solid Waste Productions for Residential Component	15-3
Table 15.5:	Projected Energy Consumption for Residents	15-4
Table 16.1:	Summary of Development Alternatives	16-3
Table 17.1:	Impact Rating Matrix for Palm Harbour	17-3
Table 17.2:	Summary of Mitigation Measures	17-8
Table 17.3:	Proposed Monitoring Scheme	17-18

LIST OF FIGURES

Fig.1.1:	General Project Location	1-1
Fig. 1.2:	Existing and Proposed Development Sites	1-5
Fig. 1.3:	Options 1 - Subdivision Development and Marina Plan	1-7
Fig. 1.4:	Option 2 - Subdivision Development and Marina Plan	1-8
Fig. 1.5:	Option 3 for the Proposed Development	1-9
Fig. 2.1:	Topography of Project Site	2-3
Fig. 2.2:	Watershed Map of the Development Site	2-5
Fig. 2.3:	Geological Map of Belize	2-8
Fig. 2.4:	Geological Fault Map of Belize	2-12
Fig. 2.5:	Seismic Intensity Map of Belize	2-13
Fig. 2.6:	Mean Monthly Rainfall minus Evaporation	2-14
Fig. 2.7:	Rainfall Isopleth Map	2-15
Fig. 2.8:	Vegetation Map of the Project Site	2-17
Fig. 2.9:	Fire Risk Map of the Project Site	2-18
Fig. 2.10:	Protected Areas Map showing Project Outline	2-19
Fig. 2.11:	Agriculture Land Use, Stann Creek District (courtesy LIC)	2-20
Fig. 2.12:	Sapodilla Lagoon Bathymetry	2-22
Fig. 4.1:	Vegetation Map of the Project Site –Note project Boundary	4-3
Fig. 5.1:	Typical Cross Section of the Proposed wells on site.	5-6
Fig. 5.2:	Well Location and Potable Water Supply Plan	5-7
Fig 5.3:	Potable Water Treatment Plan	5-10
Fig 5.4:	Water Sample Location Map	5-12
Fig. 6.1:	Wastewater Collection and Pumping Plan	6-9
Fig. 7.1:	Solid Waste Transition Site	7-11
Fig. 8.1:	Typical Above ground storage tanks	8-6
Fig. 9.1:	Soil profile locations taken at Palm Harbour	9-4
Fig. 9.2:	Hydrometer Results for Soil Samples	9-5
Fig. 9.3:	Probe Locations in the Sapodilla Lagoon	9-6
Fig. 9.4:	Proposed Excavation/Dredging Volume for Palm Harbour	9-9
Fig. 10.1:	Proposed Road Project Outline for Palm Harbour	10-4
Fig. 10.2:	Proposed Road Project Cross Sections	10-5
Fig. 10.3:	Typical Main Pier Cross Section	10-8
Fig. 10.4:	Marina Pier Detail for Palm Harbour	10-10
Fig. 10.5:	Lagoon Sheet Pile and Residential Bulkhead Installation	10-12
Fig. 10.6:	Marina Maintenance Yard	10-14
Fig. 13.1	Archaeological Transect Map	13-4
Fig. 17.1:	CEQ's Impact Structure	17-1

LIST OF PLATES

Plate 1.1:	Aerial Views of Project Site including Sapodilla Lagoon	1-3
Plate 1.2:	Overhead View of Project Site	1-4
Plate 1.3:	Western View of Shrimp Farm and Greater Sapodilla Lagoon	1-4
Plate 1.4:	Proposed Management Structure for Palm Harbour	1-16
Plate 2.1	Seismicity of Central America: 1990-2000	2-11
Plate 2.2:	Flood Risk Areas	2-25
Plate 4.1:	Vegetation Types of Project Site	4-6
Plate 4.2:	More Examples of Vegetation found on site	4-7
Plate 4.3:	Locations indicating bird habitats surveyed	4-12
Plate 5.1:	Present Farm Well Location	5-5
Plate 8.1:	Typical diesel generator	8-3
Plate 8.2:	Generator sound attenuation house	8-3
Plate 8.3:	Fuel Tanks in Containment Structure	8-6
Plate 9.1:	Excavated Soil Profile	9-2
Plate 10.1:	Present Access Road system	10-2
Plate 13.1:	Palmetto Vegetation along Transect Line	13-2
Plate 13.2:	Southern Transect A-C	13-2

GLOSSARY OF TERMS

Algae: one celled or many celled plants that have no root, stem, or leaf system.

Avifaunal: Pertaining or relating to birds

Bathymetry: depth profile of the ocean bottom or seafloor.

Beach: sediment seaward of the coastline through the surf zone that is in transport along the shore and within the surf zone.

Bedrock: the solid rock that underlies loose material, such as soil, sand, clay, or gravel.

Benthic: pertaining to the ocean bottom or seafloor.

Benthos: the forms of marine life that live on the ocean bottom or seafloor.

Biogenic Sediments: sediments containing materials produced by plants or animals such as corals, shell fragments and tests housing diatoms and radiolarians.

Biomass: total weight of the organisms in a particular habitat, species, or group of species.

Canal: a strip of watercourse that is used by the residents to access their lots via a marine vessel

Coast: a strip of land that extends inland from the coastline as far as marine influence is evidenced in the landforms.

Coastline: landward limit of the highest storm waves' effect on the shore.

Coliform: type of bacterial found in faeces

Construction: excavation, movement of earth, erection of forms or structures, or similar activities at a development or project site.

Developer: see Proponent

Disposal: the discharge, deposit, injection, dumping, spilling, leaking, or placing of any waste into or on any land, water so that it may enter the wider environment, including ground water sources.

Effluent: water discharged from a development into receiving water body or the environment otherwise.

Estuary: the mouth of a river valley, or a bay or lagoon receiving freshwater, where marine influence is manifested as tidal effects and increased salinity of the freshwater.

Euryhaline: pertaining to the ability of a marine organism to tolerate a wide range of salinity.

Eutrophication: elevation of nutrient content of water through input of fertilizers, fecal materials and domestic effluents

Fauna: animals.

Fecal: of or related to faeces.

Fetch: area of the open ocean over which the wind blows with constant speed and direction thereby creating a wave system.

Flora: Pertaining or relating plants.

Geogenic Sediments: sediments derived from non-living or inorganic sources such as silicate sand.

Geology: The scientific study of the origin, history, and structure of the earth.

Groundwater: water below the land surface in a zone of saturation.

Habitat: a place where a particular plant or animal lives generally refers to a smaller area than environment.

Inlet Canal: a series of canals linked to a primary canal. These are often used for residential and recreation purposes.

Intertidal Zone: lies between the high and low tide extremes and can be divided into a *high tide zone* which is mostly dry and covered by the highest high tide but not the lowest high tide, the *middle tide zone* exposed and covered equally by all high tides and exposed during all low tides, and the *low tide zone* which is mostly wet and covered during the highest low tides and exposed during the lowest low tides.

Lagoon: a body of water separated from the sea by a bank or coral reef: Also the region between a shore and a barrier reef or inside a ring of islands composing an atoll.

Land reclamation: dredging to mine sand, clay or rock from the seabed and using it to construct new land elsewhere. This is typically performed by a cutter-suction dredge or trailing suction hopper dredge. The material may also be used for flood or erosion control

Littoral Forest: low-lying coastal forest impacted by tidal influence.

Littoral Zone: also known as the foreshore or intertidal zone, lies between the high and low tide extremes.

Macroalgae: algae that project more than 1 cm above the substrate, such as *Dictyota spp.*, and *Halimeda spp.*

Mangal: a swamp dominated by mangroves.

Mangroves: collective term used for range of salt-tolerated inter-tidal plants found throughout the tropics and within latitude of 20° north and south of the equator.

Marina: A boat basin that has docks, moorings, supplies, and other facilities for small boats, yachts and cabin cruisers.

Marina Slips: A docking place for a ship between two piers.

Neap Tide: tide of minimal range occurring when the moon in quadrature, or its 1st Quarter and 3rd Quarter Phases.

Near shore Zone: the seaward zone from the shoreline to the line of breakers.

Pelagic Environment: the open ocean environment which is divided into a neretic province with water depths 0 to 200 m and the oceanic province with depths greater than 200 m.

Pelagic Organism: free-swimming or floating biota that live exclusively in the water column, not on the sea floor or ocean bottom.

Permitting Agency: a Government Agency responsible for issuing permits to allow various aspects of a development to proceed within the context of the Laws of Belize.

Permit: authorization, license, or equivalent control document issued by an Agency of the Government of Belize to implement various aspects of a development.

Point Source of Pollution: any discernible, confined, and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, vessel or other floating craft from which pollutants are or may be discharged.

Pollutant: any dredged spoil, solid waste, incinerator residue, sewage, garbage, chemical waste, heat, industrial, domestic, municipal or agriculture waste discharged into the environment.

Primary Productivity: the amount of organic matter organisms synthesize from inorganic substances within a given volume of water or habitat in a unit of time.

Proponent: developer proposing a particular project.

Red List: Catalogue of Threatened Species compiled by IUCN.

Residents: Locals or community members of a development, housing project etc.

Riprap (also known as **rip rap, rubble, revetment, shot rock** or **rock armour**) is pieces of rock or other material used to armor shorelines or stream banks against water erosion. Riprap reduces water erosion by resisting the hydraulic attack and dissipating the energy of flowing water or waves.

Salinity: a measure of the quantity of dissolved solids in ocean water: it is expressed in part per thousand by weight after all carbonates have been converted to oxide, the bromide and iodide to chloride, and all the organic matter oxidized.

Sessile: attached to the bottom or to rocks, pilings, etc. and unable to move.

Sewage: any human body waste and the waste from toilets and other receptacles intended to receive or retain body wastes that are discharged into the environment.

Sand: particle size ranging from 1/16 to 2 mm: It pertains to particles that lie between silt and granules on the Wentworth Scale of grain size.

Sanitary Landfill Site: a facility at which municipal, industrial wastes and hazardous wastes are applied onto or incorporated into the soil surface.

Shore: the section of land seaward of the coast: This extends from the highest level of wave action during storms to the low water line.

Shoreline: the line marking the intersection of the water surface with the shore: It migrates up and down as the tide rises and falls.

Silt: a particle size ranging from 1/128 to 1/16 mm: It is intermediate between sand and clay.

Spring Tide: tide of maximum range occurring every fortnight and coincides with when the moon is new and full respectively.

Sublittoral: seabed below the low tide mark.

Suction Dredges

These operate by sucking through a long tube, like some vacuum cleaners. A plain suction dredger has no tool at the end of the suction pipe to disturb the material.

Supralittoral Zone: this is the backshore environment above the spring high tide line and is only covered by water during storms and heavy sea states.

Tide: periodic rise and fall of the ocean surface and connected bodies of water resulting from the unequal gravitational attraction of the moon and sun on different parts of the earth.

Tidal Range: the difference in height between consecutive high and low water: The comparison may also be a day, month or year.

Tidal Period: elapsed time between successive high or low water.

Topography: the physical shape of the land surface.

Transect: a line or narrow belt used to survey the distribution of organisms or substrate across a given area.

Wave: a disturbance that moves over or through a medium with a speed determined by the properties of the medium.

Wave Height: vertical distance between a crest and the preceding trough.

Wave Length: horizontal distance between two corresponding points on successive waves such as from crest to crest.

Watershed: The region draining into a river, river system, or other body of water.

GLOSSARY OF ACRONYMS

AST: Above ground Storage Tank

BAS: Belize Audubon Society.

BWSL: Belize Water Services Limited

BEL: Belize Electricity Limited

BESST: Biological Engineered Single Sludge Treatment

BSWMP: Belize Solid Waste Management Program

BOD₅: 5 days Biological Oxygen Demand test

CEQ: Council of Environmental Quality

CITES: Convention on the International Trade in Endangered Species of Wild Flora and Fauna

CSO: Central Statistical Office, See SIB

CZMAI: Coastal Zone Management Authority and Institute.

ECP: Environmental Compliance Plan

EIA: Environmental Impact Assessment.

DoE: Department of the Environment.

GoB: Government of Belize.

GPS: Global Positioning System

IMO: International Maritime Organization

IUCN: International Union for the Conservation of Nature.

NEAC: National Environmental Appraisal Committee

NEMO: National Emergency Management Organization

NFS: National Fire Service

NGO: Non-Government Organization.

MoH: Ministry of Health

MSL: Mean Sea Level

SIB: Statistical Institute of Belize

TSS: Total Suspended Solids

SWMA: Solid Waste Management Authority

WTS: Waste Transfer Site

TOR: Terms of Reference

PREFACE

The proposed Palm Harbour project is a residential based development aimed at attracting the foreign retired population. This EIA submission is comprised of two important components aimed at summarizing the impacts and describing the document in an expansive narrative. The narrative consists of the immediate project concerns which are supported by a number of annexes that in principle provide further details to the issues covered.

The main narrative is broken down into a number of interrelated chapters that were developed based on the project TOR outlines. The main narrative begins with the project description and the physical environment in which the project will be located. This is an important component in any EIA as it allows the reader to get an understanding of the overall project development and related infrastructural components along with a description of the environmental setting in which the project will be located. Furthermore, these two sections serve as an introduction to other linked documents such as Chapters 3, 4,5,6,7 and 8.

Chapters 9 and 10 are focused on the geology of the project site and the dredging/excavation activities that are scheduled to take place. These chapters are probably one of the most important sections of the document whereby the dredging activities and dredging volumes are discussed in detail in conjunction with the project development.

Chapters 11 and 14 are focused on the description of the social assessment and the related socio-economic impacts or spinoffs that the project would have with the surrounding communities and neighboring proposed projects including the adjacent shrimp farm operation.

The orientation of the document changes in Chapter 12, which is focused on the disaster and contingency plans that can and would be incorporated in the event of an accident, incident of natural disaster.

Chapter 13 summarizes the history and archaeological finds (if any) of the project site. This chapter also intends to set guidelines should any artifact of archaeological importance be found during the construction phase. Chapter 15 sets out the subdivision component and how the development would consume the utilities from a subdivision standpoint.

The most substantive part of the document deals with the magnitude and scope of the impacts and alternatives arising from the proposed schedule of activities for the development. This is described in Chapters 16 and 17 of the document and entails a detailed description of the potential impacts and the proposed mitigation measures designed to reduce or ameliorate the impact.

The overall document was prepared with the fundamental view of understanding the project and its anticipated impacts on the receiving environment. Care was taken in obtaining the necessary information to satisfy the project's TOR and the overall intentions of the developer to exercise his right to develop his property.

EXECUTIVE SUMMARY

Project Location

The proposed subdivision project owned by Herman Haney is to be located west of the Sapodilla Lagoon and east of Haney Shrimp Farm. This location is just south of Sittee Village and north of the Placencia Peninsula. The project site lies on some 434 acres of land and entails lagoon frontage.

The project site is dominated to the east by a mixed variant of mangrove scrubs and to the west by a stretch of lowland broadleaf forest. The property is a part of a larger area of land owned by the developer. The project site consists of 21.3 % of the total land area (2,040 acs). Presently there is no development on the project site, nor is there a history of any development that may have been pre-existing.

Access to the site will be facilitated by the construction of an internal road network that will be linked to an improved and upgraded shrimp farm road. This road access will pass through the shrimp farm and will be lined with royal palms, respective of the project name. Servicing of these roads outside the development can be accessed via the Southern Highway.

Project Background

Palm Harbour is a proposed retired residential and marina development that will be carried out in two phases with subsequent sub-phases. The marina component will include the construction of a 105.5 acre marina (area includes 37.88 acres of property to be excavated) which will provide berthing access for the residents as well as for the visiting population.

The berthing will be facilitated by 15 to 19 marina piers which will have a wide access for the small motorized/battery powered vehicles. In addition, the project will incorporate the required services and amenities such as a fuelling station, wastewater and potable water services, boat maintenance yard and a commercial zone for semi commercial businesses.

The proposed residential subdivision lots will vary in size and cost and include 306 Canal side lots, 12 Estate Lots, 42 Commercial lots and 37 large and 22 small subdivision lots. The canal side lots are expected to have canal frontage which will be constructed as part of the dredging/excavation process.

The Palm Harbour residential and marina components have been designed to accommodate 1,839 persons of whom 50 are transient visitors and 15 workers. Almost all of these workers are to be Belizeans.

Included in the project proposal will be the dredging/excavation of an access channel, lagoon frontage and boundary canals with their respective inlet canals. It is anticipated that this activity will yield about 5.5 million cubic yards of spoils which will be used to reclaim the land.

In addition, the project will attempt to facilitate recreational activities such as sport fishing, boating, kayaking, tours to the cayes and reef, etc. It is required that all the prospective land owners will abide by a Code of Covenants.

The Utility Zone will house the energy generation facilities, potable water storage, sewage treatment plants, and solid waste temporal transition site. The developer will install these required infrastructures in order to operate safely and efficiently.

The primary source of energy for the subdivision project is to be from diesel generators that will be supplemented by the future connection to the national grid. Potable water for the project will be extracted

from an existing well. Solid waste will be managed by a separation process with the organic being used as compost and the inorganic combustible waste incinerated.

Project Rationale

The proposed venture is as a result of the declining market value of the shrimp industry. This project plans to utilize prime recreational land in order to attract the retired foreign population. The project proponent plans to receive some investment return to subsidize the shrimp farm operation.

This diversification is first of its kind and if the shrimp market price decreases, other farms may follow suit in the tourism industry.

Potential Project Impacts

The environmental impacts arising from the project were both ecological and social in orientation. The aim of the project developer is to develop the Palm Harbour into an environmentally friendly development by planning around and utilizing the existing resources.

The project activities that are likely to give rise to some environmental impacts of note are the land clearing, dredging/excavation and reclamation operations, the generation of domestic effluents and solid waste as well as energy generation and marina related activities.

Land Clearing Process

Potential impacts arising from the land clearing process includes the alteration of the habitat causing possible reduction in abundance of species. The project site intends to preserve a buffer zone which includes the lowland broadleaf forest strip found on the north north-western portion of the project site.

The use of re-vegetation, landscaping and buffer zones and reserves will be done to increase habitat value of the disturbed site. The movement of residents and transient visitors will be by an improved and upgraded access road as well as by a dredged marina and access channel.

Dredging Requirements and Volume

It is anticipated that an estimated 5.5 million cubic yards of material will be dredged (See Figure 9.4). Of this volume, it is estimated that the access channel will produce 93,323 cubic yards of material whilst the marina itself will generate 1.3 million cubic yards of material (See Figure 9.4). The Sapodilla Lagoon/ Cabbage Haul Creek dredging activities will yield an additional 2.9 million cubic yards. Finally the inlet canals along with the boundary canals will generate an additional 1.2 million cubic yards of material. These dredging volumes are modest given the scale of the lagoon bed to be excavated relative to the wider Sapodilla Lagoon.

Potential impacts related to this activity are varied and a number of measures will be implemented to mitigate the issue. The primary turbidity and sedimentation impacts arising as a consequence of the dredging activities scheduled to be undertaken in conjunction with the currently proposed project are moderate in scope. The secondary impacts have been assessed as 'minor' at their most severe; this is related to the limited dredging volumes, the modest sensitivity of the area, and the dredging methods and associated protocols to be applied.

In relation to the latter, a cutter-head dredge and excavators will be applied, this is to be accompanied by sediment curtains. Additional mitigative measures will also be applied such as dredging in calm lagoon-states only, and suctioning the dredged area of mobile sediments on a daily basis to curtail re-suspension and the re-broadcasting of sediments

Water and Wastewater

It is anticipated that 86,540 gallons of water will be required daily at full operation and occupancy of the project. It is also anticipated that 70 % of the demand will be converted to wastewater or 60,578 gallons a

day. Water for the project, as mentioned previously, will be extracted from an existing well and pumped to the project site where it will be stored in ground tanks.

Wastewater and sewage derived from human activities are to be treated through the use of a secondary treatment technology in the form of a 'BESST' Treatment Plant. The technology implemented will reduce the major pollutants such as the macro-nutrients (nitrates and phosphates), ammonia, as well as Total Suspended Solids (TSS) and Biochemical Oxygen Demand (BOD) to levels where they do not pose a threat to the integrity of the environment.

The collection and treatment system is divided into smaller zones with various pumping stations. This will be able to facilitate growth without having to purchase a big treatment plant from the beginning. The post-treated effluent from the BESST Treatment Plant, is to be stored and used for irrigation and fire-fighting processes.

Solid Waste

Solid waste management will entail the regular collection and disposal of garbage generated on site. Garbage will be separated into organic (biodegradable), inorganic (non-biodegradable) and international food tainted waste. The latter two will be disposed by incineration.

Energy

The energy requirements for the proposed project are expected to be mainly for residential (domestic) and marina operation purposes. As mentioned previously, energy will be produced by generators that will work continuously. Energy will be required to power domestic appliances, project infrastructure as well as marina based infrastructure including maintenance equipment.

The environmental impacts related to the energy generation will be minimal as modern mitigation technologies can be adapted to suit the equipment. Site selection and equipment placement will, however, be an issue to consider when developing the Utility Zone.

Marina Related Activities

It is anticipated that the marina activities will be limited in scope and includes the fuelling of vessels, providing water and wastewater services, solid waste collection and disposal and vessel maintenance.

These services will be provided via a service station located in the extreme north-east corner of the project site whereas the boat maintenance area will be situated on the extreme southeast corner of the project site. These two areas along with the marina piers will provide all the marina requirements for the retired residents.

Potential impacts related to the activity include the enclosed containment structure that will be provided to carry out the boat maintenance activity. Moreover, while refuelling and boat servicing, impacts relating to fuel spills and bilge/wastewater spillage can arise. Mitigation measures include the use of a certified attendant trained in these sort of activities and the use of spill control kits at key areas.

Social Related Impacts

The proposed Palm Harbour subdivision is expected to be completed within 4 years and at its inception and throughout the life of the project, create long-term economic employment and investment opportunities for the area, the region, and the country on a whole. The proposed undertaking will result in increased population growth, increased visitation to the site, and an increase in the temporary and full time labour force.

Conclusions

The proposed residential development intends to attract the retired foreign population by offering varied sized lots at affordable rates. It is the intention of the developer to incorporate the marina and canal

component as an added attraction to facilitate the sale of the lots without jeopardizing the major components of the environment.

Overall, this residential project is a diversification undertaking by the developer aimed at subsidizing his ailing shrimp farm operation, a first of its kind for shrimp farmers.