
SECTION SIX

ENVIRONMENTAL MANAGEMENT

6.1 Synoptic Approach

The Cayes Development Policy is the best-articulated document available to guide coastal development in Belize having the environmental interest at heart while recognizing that some development is necessary and even desirable in the interest of maintaining a vibrant local economy. The developers would do well to adhere closely to its recommendations.

This is especially so in view of the relatively location of the development vis a vis other comparable development in the area. Like many small scale tourism developments, this project does require the construction of buildings (nodes), amenities, boardwalk and related infrastructure. There is also dredging involved and the enterprise itself will put some pressure on coastal resources in the context of increased water users, and the demand for water based recreational services.

Notwithstanding this, there are many important areas of synergy between the policy recommendations and the plans of the developer some of which have been mentioned already. Other important parallels are:

- Developer has produced a detailed development plan with full conceptual framework, accompanied by detailed maps for the siting of the facilities and full description of the required technologies to be installed to support the population of the project site.
- Development will build on a minimal footprint only with minimal filling required to improve drainage and not to reclaim land for other uses.
- Existing natural vegetation on the project site will be preserved to the extent possible with minimal removal for buildings and support infrastructure. Vegetation ringing the coastal shorelines in particular will be respected.
- The developer plans to cooperate closely with existing and draft coastal and offshore planning guidelines as well as with the SWCMR zonation scheme which is now available and is intended to guide development in this area.
- The monitoring program submitted with this report, will ensure that long term impacts are taken into account,
- Buildings following organic architectural styles, will be constructed mainly from natural materials, and are designed to blend in with the local environment,
- Buildings are being designed to withstand minimal hurricane force winds,
- No sea walls, groynes or other coastal obstruction will be built other than the piers,

- Wide use of rainfall catchments as recommended in the policy, no use of fresh water lens.

It is important from the outset that an acceptable limit of change be established before any development takes place and proper indicators established to determine whether those limits have been breached. Acceptable limits will depend a lot on the location of the site, sensitivity of identified habitats, and the views of the local stakeholders. These indicators should be cost effective and easy to measure as long as they are verifiable. The developer should seek to form collaborative partnership with other institutions involved in similar work in the area such as the management of SWCMR and relevant NGOs.

6.2 Environmental Management System

An **Environmental Management System (EMS)** is a set of processes and practices that organizations or companies use to reduce their environmental impact. It involves a continual cycle of planning, implementing, reviewing, and improving processes and actions to meet both its business and environmental goals. The Environmental Management System (EMS) also reflects the Company's emphasis on continuous improvement in operations by measuring and evaluating its environmental performance by means of indicators.

In considering the proposed development, the proponents will implement an Environmental Management System plan to further aid the company in achieving the aforementioned synoptic benefits.

6.2.1 Benefits of Implementing an EMS

There are a range of benefits associated with operating an effective Environmental Management Systems (EMS):

Financial

- ▶ Cost savings through the reduction of waste and more efficient use of natural resources (electricity, water, gas, and fuels).
- ▶ Avoiding fines and penalties from not meeting environmental legislation by identifying environmental risks and addressing weaknesses.
- ▶ Reduction in insurance costs by demonstrating better risk management

Operational and Internal

- ▶ Improved overall performance and efficiency.
- ▶ More efficient, less hazardous production processes
- ▶ Improved consistency by reducing waste and disruption of production.
- ▶ More clearly defined staff responsibilities

- ▶ Improved internal communications and morale, often leading to sound environmental solutions suggested by staff, proves seriousness of the company

External

- ▶ Better public perception of the organization, leading to improved sales
- ▶ Reduction of the impact (e.g. noises, smells, dust) of activities on the local residents, leading to more community support

Benefits of third party verification

- ▶ Ensures that the EMS is consistent according to set protocols.
- ▶ Provides credibility and integrity in reporting and publishing environmental information.
- ▶ Demonstrates commitment to environmental transparency and accountability.

6.2.2 EMS Processes

Within the scope of the EMS, there are several environmental components that require addressing. These include the mitigation measures for the proposed possible impacts as well as establishing the monitoring plan for the proposed impacts. In addition to these components, the EMS will also focus on the implementation of a Disaster and Contingency Framework aimed at establishing the response mechanism to elements which may affect the integrity and image of the development.

6.3 Impact Mitigation Measures

Impact mitigation is a critical component of the EIA process as it aims to prevent adverse impacts from happening and to keep those that do occur within an acceptable level. The following section provides a summary of the key potential residual impacts of the preferred option and recommended standard mitigation measures intended to reduce the potential negative impacts resulting from actions of the construction period and post construction period. This key is by no means limited and other issues may be added as the EMS is being implemented.

6.3.1 Mitigation Measures In Relation To Dredging and Land Reclamation Activities

The proposed development will carry out dredging activities which include the dredging of an old silted up access channel that was once used by the local fishermen (See Fig. 2.13). The issues of concern related to the dredging operation are the sedimentation (turbidity) impacts to the aquatic environment along with the navigational and berthing hazards that may occur. This is especially relevant to boat traffic in the area. The mitigative responses to this are in large part in relation to the placement of navigational aids such as buoys and lights to alert and ward off mariners.

The primary impacts relating to the dredging activities will be the sedimentation and turbidity impacts to the marine environment which are anticipated to be high to moderate without

mitigation and considering the environment (See Table 5.1). This has been as a function of the modest scale of the dredging operations, the consistency of the seafloor material to be dredged (calcareous/corallgal sand) and consequently the mobility of the sediments, as well as the location of the proposed dredging operations. The mitigative response to these impacts is to mechanically contain or enclose the sediment plume produced from the excavation process through the deployment of sediment curtains. Other related responses include activities designed to ameliorate the re-suspension of sediments, as well as measures that would reduce the physiological stress on sessile and slow moving benthic organisms.

Additional mitigational measures include the rapid undertaking of the overall dredging operation in addition to the vacuuming of the re-suspended sediments ashore to decrease the potential of the expansive dispersal of sediments, nutrients, possible toxics and adjusting the overall mechanics of the dredging operation to allow for the re-colonization of the area by benthic organisms. The impacts from the dredging operations are expected to be localized and should be confined to the areas immediately associated with the dredged site in the near shore environment. The following table summarizes the proposed mitigation measures that will be implemented by the proposed project for all approved dredging operations.

Table 6.1 Dredging Mitigation Measures for Chrysalis

Development Activity	Primary Impacts or Environmental Disturbance	Secondary and Tertiary Level Environmental Impacts	Mitigation Measures
1. Dredging Operations and the use of the ‘Cutter Head’	1a. Disturbance of seafloor and suspension of fine sediments and re-deposition of coarse fraction.	1a1. Direct physical destruction of benthic habitat, and attenuation of light impeding photosynthesis of sea-grass, macro-algae and other autotrophs	1a1a. Use of ‘Silt Curtains’ at burrow pit, ensuring that lower end of ‘skirt’ is resting upon or is at least 1 meter of seafloor, and ensuring that top of ‘skirt’ is always above surface of water.
			1a1b. Monitoring and repairing and/or replacing leaky pipes and faulty couplings off ‘spoil’ discharge pipes.
			1a1c. Applying velocity reduction measures where spoils are deposited such as baffles to precipitate solids and curtail turbid influences in effluent stream.

Development Activity	Primary Impacts or Environmental Disturbance	Secondary and Tertiary Level Environmental Impacts	Mitigation Measures
Dredging...			1a1d. Decrease time frame over which dredging operation is to take place to avoid re-suspension of sediments over long time frame.
			1a1e. Ameliorate impacts of daily re-suspension of sediments by suctioning sediments that have resettled or re-deposited in the area.
			1a1f. Ameliorate re-suspension of sediments by confining dredging operations to calmer sea states.
			1a1g. Assist re-colonization of seafloor by benthic plants and invertebrates by ensuring that walls of dredged areas are not at an angle steeper than 35 degrees.
		1a2. "Blanketing" or smothering effects on benthic habitat and sessile and slow-moving invertebrates.	1a2a. Institute monitoring program to ensure that light penetration at seafloor is at least 25% of surface irradiance 2,000 ft., if from silt curtains.
	1b. Decrease in Dissolved Oxygen and increase in BOD.	1b1. Physiological stress and lethal effects on benthic invertebrates and to a lesser extent, fin-fishes.	1b1a. Completion of dredging operation in as short a time-frame as possible.

Development Activity	Primary Impacts or Environmental Disturbance	Secondary and Tertiary Level Environmental Impacts	Mitigation Measures
	1c. Increase in temperatures brought about by the re-suspension of sediments with a 'specific heat capacity' capable of raising water temperatures by as much as 4 – 6°C.	1c1. Lethal and sub-lethal effects on sessile and slow-moving benthic invertebrates.	1c1a. Proper deployment of 'silt curtains' to ensure that suspended sediments at dredged sites are contained and that any re-deposited sediments are 'vacuumed' and rapidly deposited on land.
2. Navigation, Berthing of Dredge and Deployment of Spoil Discharge Pipes.	2a. Navigational hazard.	2a1. Threat of injury and possibly death associated with boat traffic.	2a1a. Ensure that marker buoys and navigational lights are deployed and activated on dredge, sediment curtains and spoil discharge pipes – Buoys are to be large and bright Navigational lights are to be fully operational from 6:00 p.m. to 6:00 a.m. on a daily basis.
3.0 Deployment of spoil and discharge pipes (pontoons).	3a. Same as above	3a1. Installation of discharge pipes can be a navigational hazard.	3a1a. Placement of spoils in a geotextile containment.

6.3.2 Mitigation Measures in Relation to Solid Waste Management

It is anticipated that the solid waste generated by the proposed development is typical of any tourism based venture which generally includes domestic waste. The domestic waste will consist of organic and inorganic waste that will be generated as a result of the construction phase and to a larger extent the operation phase. The organic component will be derived mainly from discarded and unconsumed food from the individual kitchens and staff cafeteria along with some 'green waste' product as a result of the landscape maintenance (clearing and pruning). The inorganic waste for the most part will include wastes that are either classified as combustible and non-combustible. These will also be generated during both phases.

The construction phase has the capacity to generate substantial volumes of solid wastes. This varies from felled trees and shrubbery in relation to land-clearing, to concrete mouldings and form boards from the erection of buildings, to styrofoam packaging, wooden planks and metal strips from shipping crates. Other significant solid waste components from the construction

phase includes PVC piping, masonry slabs and chippings, food wrappings, aluminum cans and beverage cartons, as well as plastic and glass bottles are also expected to be a substantial part of the solid waste. It is anticipated that not much construction waste will be generated due to the small scale and low density development planned by the project proponents. Discarded food is also a relevant solid waste item during the construction phase.

One of the major impacts of the wastes generated by the development would be the attraction of feral animals such as crocodiles and birds to the area to scavenge. The mitigative response to be implemented by the development is the judicious collection and separation of the wastes into organic and inorganic components - which are to be removed from the caye on a recurrent basis (See Table 6.2). The implementation of a public education campaign focused on the tourists in general is also a part of the mitigative response (See #1a1b in Table 6.2 below).

The only secondary impact of note would be in regards to the land-based ecosystems. These impacts relate to the fact that there is to be little or no discarded food lying around in a way that would be available to feral animals, given the regular collection, bagging, composting and disposal of this category of waste.

Table 6.2 Mitigation Measures in Relation to Solid Wastes

Development Activity	Primary Impacts or Environmental Disturbance	Secondary and Tertiary Level Environmental Impacts	Mitigation Measures
1. Operational processes of the proposed project including the relevant amenities.	1a. Discarding of waste food and food containers.	1a1. Attraction of feral animals such as rats and birds to the area to scavenge and in effect shift the ecological balance in a way not induced by nature.	1a1a. Collection of discards by staff and storage in impervious bins for separation and transportation of inorganic waste to the Placencia dumpsite.
			1a1b. Implementation of education and sensitization program focused on guests in the form of interactive posters and brochures posted in strategic locations.

Development Activity	Primary Impacts or Environmental Disturbance	Secondary and Tertiary Level Environmental Impacts	Mitigation Measures
	1b. General discarding of cans, bottles, and plastics in general from foods, general packing materials and other utilitarian functions.	1b1. Habitat for mosquitoes and other insect pests, as well as aesthetic pollution from odor and unsightly accumulation of solid waste.	1b1a. Separation of waste into organic and inorganic components with the organic being composed for landscaping activities and the inorganic transported in sealed containers to the Placencia dumpsite for disposal.
		1b2. Entanglement and ingestion of plastics floating in the water column by sea turtles, birds and other fauna in the area.	1b2a. Judicious collection, confinement, and disposal of solid wastes as described above.

6.3.3 Mitigation Measures for Domestic Effluent Impacts

As mentioned in the previous section, the primary impacts associated with the domestic waste are the increased nutrients, fecal coliform, and E. Coli which can be attributed to inadvertent discharge, mismanagement, and treatment plant malfunctions etc. The situation of the increased nutrients in the water column is generally referred to as eutrophication. These nutrients are referred to as phosphates and nitrates which are derived from the generation of wastewater and sewage. The greater contribution of nutrients would come from human waste and detergents that would be generated from the residential population.

In view of the associated impacts, the project proponents plan to utilize a secondary treatment plant (See Section 3.3.2) to reduce the nutrients to levels that are not considered a threat to the environment and that are well within the national standards. The system to be adopted for the proposed project is a prefabricated treatment plant or ‘Package Plant’ titled a "Purestream ES Model BESST." The acronym of the systems stands for **B** Biologically **E** Engineered **S** Single **S** Sludge **T** Treatment.

The water quality analysis did tested positive for fecal coliform (See Sect. 2.1.2.6 and Figs. 2.7). This positive result could be attributed to the migratory bird population and other vertebrates within the area. As may be seen from Annex V, the *E. coli* readings were zero. The generation of *E. coli* becomes a significant consideration with the commissioning of the development.

The primary impact from these features of the development has been characterized as low. The application of the Treatment technology combined with water conservation measures will greatly diminish the potential human health impacts from a microbiological standpoint.

Table 6.3 Summary of Impacts Associated with Human Wastes and Domestic Effluents

Development Activity	Primary Impacts or Environmental Disturbance	Secondary and Tertiary Level Environmental Impacts	Mitigation Measures
1. Wastewater and Sewage Effluents	1a. Nutrient increase from the injection of macro-nutrients into the marine environment.	1a1. Stimulus to plant growth in the water column primarily phytoplanktons, seagrass, and macroalgae including the possibility of the overgrowth of reefs by macroalgae.	1a1a. Installation of BESST Treatment technology to treat waste to 'Tertiary' Levels, where Total Nitrogen Loads are reduced to less than 10 mg/l and Phosphorus are reduced to 2-3mg/l.
			1a1b. Reduce effluents going into the environment by recycling treated post-chlorinated effluent to flush toilets.
			1a1c. Reduce further nutrients potentially going into the water column by using stored treated effluents from BESST Treatment Plant for irrigation purposes.
	1b. Human Health and Biosecurity risks	1b1. Infection of humans and mammals with pathogenic viruses and bacteria.	1b1a. Thorough disinfection of effluents potentially going into water column or otherwise making contact with humans, by use of BESST Sewer Treatment Plant which incorporates chlorination of effluents.

Development Activity	Primary Impacts or Environmental Disturbance	Secondary and Tertiary Level Environmental Impacts	Mitigation Measures
Wastewater and Sewage Effluents....	1c. Suspended Solids from undisclosed components of human waste and domestic effluents.	1c1. Suspended solids would impede light penetration in the water column and photosynthesis.	1c1a. Installation of solids trap prior to BESST Treatment to reduce TSS to less than 10 mg/l
	1d. Increase in BOD substances and consequent reduction in dissolved oxygen.	1d1. Induction of physiological stress and in extreme circumstances death in relation to sessile and slow moving invertebrates.	1d1a. Application of BESST Treatment technology reduces BOD to less than 10 mg/l, this in combination with effluent recycling and reuse regime reduces BOD to insignificant levels in the water column.

6.3.4 Mitigation Measures in Relation to Energy Generation

The main impacts associated with the energy generation process are petroleum and noise pollution that will arise as a result of the operation phase of the development. The latter is especially true considering that the primary source of electrical energy for the proposed project is to be from a wind turbine. This is to be complemented by standby power in the form of diesel generators. The mitigation measures that are to be put in place are mainly in relation to the running of the power lines as well as in relation to noise and petroleum pollution.

The petroleum pollution issue is of great importance considering the operation of the diesel generators (supplementary source). This method of energy generation is also interlinked with the sourcing and transportation of the required fuel for its operation. In considering the custodial chain of petroleum management, the proponent will be required to implement mitigation measures in every phase of the fuel management program.

The installation of diesel generators as a back-up source of electricity makes noise pollution a relevant issue. The scope of the proposed development and indeed the overall energy requirement of the initiative have resulted in a categorization of the ‘primary impacts’ as ‘moderate adverse’. This noise pollution can be mitigated by the ‘muffling of the generator noise and the use of sound-proof tiles at the generator station, as well as their placement in areas far removed from the recreational activities of the project site and movement of staff and guests.

Secondary impacts associated with the energy generation component include the placement of the generators and the ‘effect’ the wind turbine would have on the caye’s bird population and flight patterns. The mitigation measures for these are discussed in the following table.

Table 6.4: Mitigation Measures in relation to Energy Generation

Development Activity	Primary Impacts or Environmental Disturbance	Secondary and Tertiary Level Environmental Impacts	Mitigation Measures
1. Operation of Diesel Generators to generate electricity.	1a. Excessive noise pollution to guests and staff of the establishment	1a1. Secondary health risks associated with excessive noise.	1a1a. Attenuate noise levels by enclosing generators with sound attenuation material and by the proper use of mufflers and other sound reduction devices designed to minimize the ambient impact.
			1a1b. Examine and develop a best siting scenario for the operation of such generators at full occupancy and generator capacity.
	1b. Petroleum Pollution due to generator operation	1b1. Contamination of waterways and soil along with reduction of species in impact area.	1b1a. Contain fuel tanks in an enclosed concrete wall capable of storing 110% of the total stored volume
			1b1b. Develop a contingency plan to address spills and leaks that can occur both on land and at sea
	1c. Air pollution and combustion fumes	1c1. Impacts on human health, particularly those challenged by respiratory diseases.	1c1a. Ensure proper operation and function of generating system along with scheduled maintenance.
2. Wind Turbines	2a. Turbine unit operation	2a1. Increase in overall ambient noise, especially around the turbine areas.	2a1a. Turbine not expected to supersede the L _{MAX} 65 dB threshold. System is designed to shut off at wind speed exceeding 56 mph.

Development Activity	Primary Impacts or Environmental Disturbance	Secondary and Tertiary Level Environmental Impacts	Mitigation Measures
	2b. Physical damage to benthic habitat and attached invertebrates	2b1. Decline in fish and aquatic invertebrate life	2b1a. Choose path of underwater cable that would avoid coral formations.
	2c. 'Shadowing' effects on the receiving environment.	2c1. Disorientation of some guests and staff	2c1a. Varying wind speed and direction reduces shadowing instances. Moreover, placement of wind turbines to follow installation guidelines for health and safety reasons.
	2d. Increase mortality of birds of the area.	2d1. Loss of diversity and caye visitation as a result of wind turbine operation.	2d1a. Placement of the turbine unit in areas not identified as 'primary migration routes'.
			2d1b. Turbine tower design has changed. Turbine rotor speeds have reduced, reducing injury to birds.

6.3.5 Mitigation Measures In Relation To Socio-Economic Concerns

The social impact assessment in principle include the process of evaluating the intended and unintended consequences of the development, and identifying and articulating the mitigative measures that are to be put in place to circumvent and ameliorate these impacts. Development projects of any kind can modify or enhance the economic viability of a given area.

Relevant in this regard are the issues of the disruption and erosion of economic activities in the area. The most pertinent being fishing. Pertinent also in terms of resource use conflicts is the issue of tourism. The area is used for general marine traffic as well as a general 'sea lane' for transporting tourists to and from the atolls and surrounding cayes.

The navigational issues dealing with the relationship of these to dredging activities (See Table 6.5). In addition, the growing tourism industry has the need for both skilled and unskilled workers to cater to the industry's demands.

Table 6.5: Mitigations In Relation to Socio-Economic Concerns

Development Activity	Primary Impacts or Environmental Disturbance	Secondary and Tertiary Level Environmental Impacts	Mitigation Measures
1. Construction Activities	1a. Temporary but slight increase in amount of people moving into the area.	1a1. Increased demand on services in the area.	1a1a. Construction will be planned and strictly scheduled such that only the minimum amounts of people necessary are in the area at any given time.
			1a1b. Adequate transportation, proper housing, and other basic facilities should be available for workers in the island.
	1b. Movement of materials and supplies and heavy equipment into the area.	1b1. Human health and safety issues.	1b1a. Safe and secure mooring of boats when loading and offloading equipment and supplies.
			1b1b. Navigation of boats to and from the site observing international and national sea lane rules and navigational protocol, and ensuring that equipment and supplies are securely stored and fastened during transportation.
			1b1c. Response to construction injury includes first aid kit on-site, and in severe case the deployment of boat to ferry injured party (ies) to Placencia.

Development Activity	Primary Impacts or Environmental Disturbance	Secondary and Tertiary Level Environmental Impacts	Mitigation Measures
1. Construction Activities Contd.			1b1d. Berthing of dredge securely with adequate lighting at nights, and buoys and warning flags marking sediment curtains and spoil discharge pipes.
2. Employment	2a. Skilled laborers from the region not employed during construction and operation phase	2a1. Lack of economic opportunities to people in the overall region.	2a1a. Hiring people from immediate area in circumstances where requisite skills and competencies are available at competitive costs.
3. Housing	3a. Potential for lack of adequate housing for staff.	3a1. Work incompetence due to inadequate housing.	3a1a. Construction of quarters will supersede those of other similar establishments.
4. Marine Traffic	4a. Increase number of users and marine vessels to the area	4a1. Impact on natural environment by increased boat usage	4a1a. A marina pier will be constructed to accommodate the projected number of boats associated with the project.
5. Culture	5a. Pressure on existing institutions and social groups; pressure on existing lifestyles	5a1. Marginalization of minority groups and locals	5a1a. Locally strengthen existing institutions and social groups or develop new ones. Strengthen regulatory systems.
6. Resource use conflicts	6a. Potential loss of spawning area for fishery products in mangroves and near-shore areas of dredging sites.	6a1. Potential decline in fishery products due to dredging, and other activity associated with the operation of the project.	6a1a. Much of the dredging will take place in a silted up channel that when cleared will attract and increase the fishery resource.

Development Activity	Primary Impacts or Environmental Disturbance	Secondary and Tertiary Level Environmental Impacts	Mitigation Measures
		6a2. Potential decline in landings and income from fishing.	6a2a. Limited dredging where most fishing areas are located, besides silt curtains will be deployed in areas of actual dredging to contain sedimentation and turbidity influences.
			6a2b. Dredging activities to be completed within the shortest possible time to limit negative impacts in both space and time.
		6a3. Difficulties in locating fishery products and the consequent decline in landings and loss of income.	6a3a. The deployment of silt curtains and confining dredging operations to calmer sea states should decrease the possibilities of losing fishery products.
	6b.Potential disruption of tourist activities.	6b1. Relates mainly to boat traffic through area.	6b1a.. Installation of buoys, beacons and other navigational aids to ward off marine traffic from the silt curtains and spoil discharge pipes: Also relevant is relatively short duration of undertaking.

6.3.6 Other related Impacts

The proposed project will also have other impacts that can be attributed to a negative outcome if not addressed or correctly mitigated. These impacts include the need for proper safety and health practices, water usage related issues, design concepts issues, marine traffic and environmental

disturbance. The mitigative responses to these impacts include the implementation of several plans to ameliorate and circumvent the negative effects associated with the development.

Table 6.6: Mitigation Measures in Relation to Other Impacts

Development Activity	Primary Impacts or Environmental Disturbance	Secondary and Tertiary Level Environmental Impacts	Mitigation Measures
1. Water misuse and loss	1a Injection of additional brine into the injection well as a result of R.O use.	1a1. Additional stress due to excess brine concentration.	1a1a. Implement a water conservation plan to address the water needs.
			1a1b. Develop a contingency plan for water shortage (s) and water contamination if so is the case.
			1a1c. Implement a water recycling plan (Section 3) aimed at utilizing wastewater for non potable uses.
2. Design Concepts	2a. Loss of additional vegetation cover and habitat area	2a1 Loss of natural habitat and biodiversity.	2a1a. Plan layout poses less environmental impact to construct and operate.
			2a1b. Conservation of the natural contouring and aesthetics of the mangrove forests, and beaches.
3. Environmental Disturbances	3a. Noise pollution from the operation of construction equipment and machinery	3a1. Disturbance of wildlife and guests/staff /construction personnel	3a1a. All installed equipment such as a power generator etc., be enclosed to minimize noise impacts
	3b. Airborne pollutants from proposed construction and operational activities	3b1. Same as above, incremental airborne pollutants to Airshed	3b1a. Operation of machinery (dredger) and equipment operated during daylight hours.

Development Activity	Primary Impacts or Environmental Disturbance	Secondary and Tertiary Level Environmental Impacts	Mitigation Measures
			3b1b. Burning of organic combustibles will be limited during the construction and operational phases.
4. Security	4a. Remote location makes it prime target for illegal activities	5a1. Induced stress and other physiological related symptoms to staff and guests considering the possibility.	5a1a. Consideration should be given to mount security systems and security personnel along with adequate communications equipment to authorities.

6.4 Environmental Monitoring Plan

The principles underlying environmental monitoring as it relates to any given development is to observe for any changes over time that may be associated with the development. These changes would in principle vary over time in both magnitude and direction. In the case of the latter it is important to understand that changes in environmental parameters and functions may be positive or negative. Thus in principle a monitoring plan does not necessarily focus on the perceived or anticipated negative changes precipitated by a given development, or indeed vice versa where the focus may be on the positive or beneficial changes only. The parameters chosen are those that have been identified in the analytical process as being affected in the most significant way by the development.

6.4.1 Benefits of Environmental Monitoring

Numerous purpose (and implied benefits) can be delineated pre- and/or post-EIA environmental monitoring. For example, Marcus (1979,) identified the following six general purposes or case of information gleaned from the conduction of post-EIA monitoring:

1. Environmental monitoring provides information that can be used for documentation of the impacts that result from a proposed action; this information enables more-accurate prediction of impacts associated with similar federal actions.
2. The monitoring system could warn agencies of unanticipated adverse impacts or sudden changes in impacts trends.
3. The monitoring system could provide an immediate warning whenever a preselected impact indicator approaches a predetermined critical level.

4. Environmental monitoring provides information which could be used by agencies to control the timing, location, and level of impacts of a project. Control measures would involve preliminary of regulation and enforcement measures.
5. Environmental monitoring provides information which could be used for evaluating the effectiveness of implemented mitigation measures.
6. Environmental monitoring provides information which could be used to verify predicted impacts and thus validate impact prediction techniques. Based on these findings, the techniques---for example, mathematical models---could be modified or adjusted, as appropriate.

6.4.2 Specific Monitoring Plan

The proposed monitoring plan for the project will entail those parameters and ecosystem components that have been identified through the mitigation matrix and other mitigation factors.

These issues include:

- Water Quality monitoring (Marine and Effluent)
- Beach Dynamics
- Waste Management
- Soil contamination (spills)
- Biodiversity
- Environmental health and safety
- Engineering aspects
- Socio economic influence
- Others

6.4.2.1 Surface Water Quality Monitoring Program

Pollution from all the different sources can pose a serious threat to the marine ecosystem and therefore considering the negative impacts, the proposed development plans to incorporate a water quality monitoring program. This program, which will further be developed by the proponent and DOE, will form part of the EMS and also of the water resources management plan previously discussed in Section 3.2.

Water samples will be collected and analyzed on a monthly basis for the following parameters using the recommended protocol required by the *Effluent Limitations Regulations* (this regulation recommends the use of the Standard Methods for the Analysis of Water and Wastewater):

a) *In situ Measurements*

- | | |
|--------------------|--------------------------|
| • Salinity | • Turbidity |
| • Temperature | • Total Dissolved Solids |
| • Dissolved Oxygen | • Conductivity |
| • Ph | |

b) Laboratory Analysis

This will include the determination of

- Total Suspended Solids
- Total Nitrate
- Total Phosphate
- Total and Fecal Coliform
- E. Coli

Table 6.7 Monitoring Plan for Surface Waters

Parameter	Frequency	Critical Level	Geographic Area	Priority	Agency Responsible
Nutrients (Phosphate and Nitrates)	Monthly	10 mg/l	Incorporate previous monitoring sites (See Fig. 2.5, 2.6 and 2.7).	High Priority	DOE, CZAMAI
TSS/TDS	Monthly	100 mg/l	Incorporate previous monitoring sites (See Fig. 2.5, 2.6 and 2.7).	High Priority	DOE, CZMAI
Turbidity	Monthly	Observing disappearance of secchi disc and comparing this over time at different locations.	Incorporate previous monitoring sites (See Fig. 2.5, 2.6 and 2.7).	High Priority	DOE, CZMAI
BOD	Monthly	200 mg/l (EPA/WHO)	Incorporate previous monitoring sites (See Fig. 2.5, 2.6 and 2.7).	High Priority	DOE, CZMAI
Dissolved Oxygen	Monthly	< 4.0 mg/l (DOE)	Incorporate previous monitoring sites (See Fig. 2.5, 2.6 and 2.7).	High Priority	DOE /Fisheries, CZMAI
- Total Coliform - E. coli - Fecal Coliform	Monthly	0/100 ml of sample	Incorporate previous monitoring sites (See Fig. 2.5, 2.6 and 2.7).	High Priority	Public Health

6.4.2.2 Wastewater Monitoring Program

As with water resources monitoring, a wastewater monitoring program will be implemented to complement the previously described monitoring plan. It is anticipated that this section will focus primarily on the functions of the wastewater treatment plant and the quality of the treated wastewater (effluent). In addition, the program will also develop a maintenance plan encompassing structural failures, inspections, monitoring of equipment (treatment plant, grease traps, oil/water separators, etc.) short and long term repairs as well as training for new employees in charge of supervising the plant. Also, notice and warning signs will be posted throughout the

project site and especially the marina on proper wastewater practices. At the marina, this will include the prohibition of bilge and sewage disposal near the adjacent areas.

Samples of the treated wastewater will be collected and sent to an approved DoE laboratory for monthly testing or in default tested in-house (DoE permission required). Table 6.8 shows a proposed monitoring template that will be reviewed by the project and DoE.

Table 6.8: Wastewater Monitoring Template

Date (day/month/year)	Dissolved Oxygen (mg/l)	Ph (Units)	Total Phosphate (mg/l)	Total Nitrate (mg/l)	TSS (mg/l)	BOD (mg/l)	F. Coliform (count)	E. Coli (count)
____/01/____								
____/02/____								
____/03/____								
____/04/____								
____/05/____								
____/06/____								
____/07/____								
____/08/____								
____/09/____								
____/10/____								
____/11/____								
____/12/____								
Annual Average								

6.4.2.3 Solid Waste Monitoring Plan

The proposed project plans to undertake an intensive solid waste monitoring plan in order to address all the relevant issues that can arise from the collection, storage, and disposal of garbage. Indicators will be developed to keep track of this activity and report any major incident/accident to the Solid Waste Management Authority and other relevant agencies as required.

Such examples include inadvertent spillage during transportation, flying, or ‘blowing’ away of uncontained garbage etc. It is anticipated that due to the development density, the ‘impacts’ associated with this section will be minimal, but nevertheless, it does require monitoring. Especially considering that any waste debris can travel along the waters and accentuate the present volume of garbage that litters Belize’s cays coastline.

Table 6.9 Parameters for Solid Waste Monitoring

Parameters	Frequency	Critical Levels	Area/ Locale	Priority	Agency Responsible
Solid Waste Management					
Collection	Daily	Same as above	Anywhere where available trash receptacles are located.	High	SWMA, DOE , Public Health
Disposal	Weekly	Clean environment	Collected waste will be transported to Placencia pier and then taken to the Placencia dump site	High	SWMA, DOE , Public Health
Storage	Daily	Same as above	At WTS on the project site	High	SWMA, DOE , Public Health
Management	Daily	Development, implementation and documentation	All aspects of the management plan	High	SWMA, DOE , Public Health

6.4.2.4 Biodiversity Monitoring Program

The objectives of the monitoring programs are to minimize and reduce the environmental impacts on wildlife and their habitats, and to minimize detrimental effects on protected or endangered species. The use of the caye for recreational activity should be carried out with caution.

Recommended Monitoring Measures for flora and fauna are as follows:

- A checklist will be developed in order to ensure data collection in terms of the abundance of local species. In the event of an important sighting, the sighting will be recorded.
- Assist in any way possible by relocating animals if found within the construction sites, if necessary.
- Restrict land clearing only to areas required in order to minimize habitat destruction or reduce buffer zone area.
- Posting of warning signs throughout the property about wildlife, especially the crocodiles.
- Minimize effects on the receiving environment by minimizing the negative impacts that may hamper potential navigational interests.
- Confinement of the construction activities to as small an area as possible.
- Establish monitoring program for biological communities for a period of three years. This should focus on features of mangrove habitats, which are likely to reflect changes in

environmental conditions (such as specie composition and distribution, changes in number of individuals, girth, height and litter, birds, fish and other animals).

Table 6.10 Proposed Biodiversity Monitoring Plan

Parameters	Frequency	Critical Levels	Area/Locale	Priority	Agency Responsible
Biodiversity					
Bird Abundance	Twice per year, during December and in June (i.e. winter and summer)	Population changes and diversity profile to be noted and compared with existing data	To be done on project sites (Channel Cayes).	Moderate	Forest Dept.
Feral Animal Population (Crocodiles, birds, others)	Twice per year during June and December	Population changes to be observed over time.	To be done on project sites (Channel Cayes).	Moderate	Forest Dept., Public Health
Finfish Populations	Twice per year during June and December, and coincident with coral reef survey	Population changes and shifts in diversity to be observed over time and compared with pre-development situation.	Dredged areas/wind turbine placement site and interaction with fishermen and tour guides of the area	High	Fish. Dept.
Sea-grass biomass and density	Twice per year during June and December.	Sea-grass biomass and density to be observed over time for any discernible trend that may be associated with the proposed development.	Dredged sites, mangrove reserve areas and others as determined by the authorities.	High	Fish. Dept.

Parameters	Frequency	Critical Levels	Area/ Locale	Priority	Agency Responsible
Coral Cover	Twice per year, during June and December	Population changes and diversity profiles to be compared over time with pre-development situation.	Dredged sites, wind turbine, and near shore development areas – beaches, piers, decks etc.	High	Fish. Dept., DOE

6.4.2.5 Social Monitoring

Due to the increase in the demand for permanent employment in the country, this project will result in positive benefits for the already booming Stann Creek District. The social component is wide and varied and will include a number of issues mainly employment, accommodations and safety. A number of new jobs (temporary and permanent) will be created with the workers required to live on the project site. With this notion, adequate accommodations will be made available for the workers.

It is anticipated that employment will come mainly from the Stann Creek District with a minor fraction from the other districts. The proposed project will also design an Emergency Management System (See Section 6.6). Staff will be identified for first aid training. This training is offered free of cost by the Red Cross Society. It is also recommended that an emergency evacuation plan be set in the event that any emergency takes place.

Table 6.11 Social Monitoring Issues

Parameter	Frequency	Critical Level	Geographic Area	Priority	Agency Responsible
Employment	Annually	Ratio of locals to foreigners as well as migrant workers	Construction site and administration of proposed project	High	Labor Department
Accommodations	Monthly	Adequate housing and infrastructure	Project site	High	Labor Department
Services	Annually	Acceptable/non acceptable	Marina and residential component	High	BTB, BTIA

6.4.2.6 Other Monitoring Plans

The proposed project will also implement other monitoring plans as part of their EMS program. These plans will be further expanded as the project develops and gradually comes to light.

Table 6.12: Associated Monitoring Plans

Parameter	Frequency	Critical Level	Geographic Area	Priority	Agency Responsible
Beach Dynamics					
Beach erosion	Quarterly	Observable loss of beach material.	- beach areas of project site	Moderate Priority	CZMAI, Fish. Dept.
Engineering Aspects					
Safety considerations in relation to navigational lights, marker buoy for the dredge.	Construction phase activities to be done on a weekly basis.	All lights aboard the dredge as well as beacons marking the path of the spoil delivery pipes and sediment must be functional, and all marker buoys must be deployed appropriately.	- Associated with the dredge, spoil delivery pipes and sediment curtains.	High Priority	Port Authority
Technical integrity of dredging operation.	Construction phase activity to be done on a daily basis.	Inspection of sediment curtains and spoil delivery pipe for overflows and leakages respectively.	- Done along the entire path of the sediment curtains and spoil delivery pipes.	High Priority	CZMAI, Fish. Dept.
		Inspection of shore-based spoil deposition pit or de-watering 'bund' for leakages and collapse of walls.	- Done along perimeter of bund.	High Priority	DOE, CZMAI, Fish. Dept.

6.5 Disaster and Contingency Management Framework

The proposed project will develop and implement a disaster management and contingency framework (DMCP) to address all the emergency incidents and accidents that could occur on the project site. With this in mind, the project will focus on five types of disasters that could affect the project in one way or the other. In considering this possibility, the proposed project plans to incorporate the following table of potential disasters and their respective plans

Table 6.13 DMCP for Chrysalis

Disaster	Description	Response Plan	Stages
Hurricanes and tropical storms	This natural phenomenon can drastically affect Chrysalis's infrastructure and operation should a hurricane strike the cay.	Hurricane Preparedness Plan	Alert, Response, Recovery
Fire	This anthropogenic and to some extent natural event poses a serious problem to the infrastructure and occupants of Chrysalis.	Fire Prevention and Response Plan	Response
Fuel/oil Spills and leaks	This incident affects the soil and water on a whole if not properly addressed.	Spill Contingency Plan (Tier levels)	Response, Recovery
Climate Change	This slow occurring natural occurrence can pose serious risks to the project if not adapted and monitored over time.	Tidal Rise Contingency Plan	Alert, Response
Medical	Medical emergencies can occur at any moment without giving notice and therefore requires a quick and coordinated effort to respond to this need. This is especially important considering the project location.	Medical Emergency Plan (Transportation and Evacuation)	Response, Recovery
Environmental Health and Safety	Required training in the different disaster and contingency field.	Environmental Safety	Alert, Response, Recovery

It is anticipated that once in operation, the development will develop a more detailed plan of action for the proposed DMCP scenarios in order to mitigate and ameliorate any potential negative impact these could have on the environment.

6.5.1 Administrative Framework

It will be the responsibility of the project to formulate an Emergency Committee to address the potential disasters outline in Table 6.13. This committee will elect an Emergency Coordinator or

his/her designate who will chair and oversee the preparation activities in relation to the potential disasters described (See Table 6.13). Considering that the development density is so small, the proposed project will utilize every available human resources to implement this committee.

The emergency committee must conduct periodic meetings to address and update important issues relating to the disaster management plans. Such important issues should be the objectives of the committee, their roles and responsibilities, updates as well as their terms of reference (TOR) which they will abide by.

The Emergency Committee will also decide on the election policies for the assistants and coordinators. Furthermore, the committee must submit any disaster reports to upper management and authorities if required.

6.5.2 Hurricane Preparedness Plan

The proposed hurricane preparedness plan will be comprised of the following sections:

6.5.2.1 Purpose of Plan

This hurricane preparedness plan is to:

- (i) To establish the coordinating mechanisms necessary for Chrysalis to prepare and implement measures to safeguard property and lives of all concerned during the threat of a storm or hurricane.
- (ii) To ensure that the coordinating mechanism that will ensure maximum safety of property or lives during an incoming storm, is put in place, and to make sure the developer and residents/guests are familiar with the mechanism.

6.5.2.2 Storm Information System

The “official alert” system for hurricane entails the coordination between the management and the National Emergency Management Organization (NEMO) in conjunction with the Belize National Meteorological Service (NMS). The proposed project will follow the official alert and hurricane categories put in place by NEMO described in the following tables:

Table 6.14 NEMO Warning Flag System

Flags	Phases
One Red Flag	Preliminary Alert Phase (Storm/Hurricane Watch)
One Red flag with Black Center	RED I Phase (storm or hurricane watch)
Two Red Flags with Black Centers	RED II (Warning Phase)
One Green Flag	Green Phase (ALL CLEAR)

Table 6.15 NEMO Hurricane Categories

Tropical Depression	29 mph – 38 mph
Tropical Storm	39 mph – 73 mph
Hurricane Category 1	74 mph – 95 mph
Hurricane Category 2	96 mph – 110 mph
Hurricane Category 3	111 mph – 130 mph
Hurricane Category 4	131 mph – 155 mph
Hurricane Category 5	Above 155 mph

6.5.2.3 Action Plan

The following is a generic implementation plan as outlined by the National Emergency Management Organization. The implementation plan has been modified to fit this project.

Preliminary Alert - Hurricane Watch

This is the First Phase, and means that a storm or hurricane may threaten within 72 hours. A storm or hurricane is within 21° N 80° W of Belize.

Actions to be taken:

- (i) The Emergency Committee should be prepared to convene and take action if the NEMO issues a warning.
- (ii) Stay informed by radio and television of the storm progress.
- (iii) Obtain hurricane tracking charts for Committee members and interested parties,
- (iv) Obtain the contact number etc. from the management, including residents and guests with marine vessels, and inform vessel owners of the alert phase,
- (v) Ensure that contact is made with all guests and captains of vessels, whether by direct or indirect means to alert them of the phase and to make initial contact.
- (vi) Prepare a checklist (electronically) of items required in the event of a strike
- (vii) The Emergency Coordinator will identify and categorize items or equipment to be removed as follows: list of equipment to stay, and list of those to be removed to an approved shelter.
- (viii) Prepare a tentative list of all the guests and management staff on the island.

Hurricane Warning – Red 1 Phase (Watch)

During this phase, a hurricane may threaten within (36) thirty-six hours. A hurricane or storm is located within 20° N 87° W.

Actions to be taken:

- (i) Advise all vessel Captains to leave the project site immediately and take their vessel to safe harbor.

- (ii) The Emergency Coordinator will advise all employees and available human resources to install the hurricane shutters on the buildings and other related infrastructures.
- (iii) Advise all occupants of the caye including guests and employees to be prepared to evacuate the caye upon the recommendations of management/NEMO.
- (iv) Identify official shelter for guests, visitors and any other employee in need of such shelters on mainland.
- (v) Update NEMO on all actions taken and be prepared to leave.

Hurricane Warning – RED 2 Phase

Whenever Phase 2 (Red) is given, this means that a hurricane is likely to strike Belize within (24) twenty-four hours.

Actions to be taken:

- (i) The checklist of items required will then be printed and each head of department will be provided with a checklist,
- (ii) The precautionary list will be printed and provided to each head of department,
- (iii) Final hurricane preparations should be concluded,
- (iv) Evacuation of employees, guests and residents should be completed.

Fourth Phase – Green (All Clear)

This is the ALL CLEAR, which will be declared by NEMO after the hurricane has passed and it is safe to return to review the effects of the hurricane.

Actions to be taken:

- (i) The Emergency Committee will attempt to return and survey the project site as soon as possible,
- (ii) The Emergency Committee will immediately make a brief report on all damages (supported with photographs), and prepare an estimate of damages, and submit the same to NEMO and Management for their perusal.
- (ii) Employees of the project will report as previously advised.
- (iii) Clean-up phase will commence with the assistance of project employees, and all available human resources, where possible.

6.5.3 Fire Prevention and Response Plan

Fire outbreaks are considered both life threatening and disastrous to any development. In considering this possibility and the remoteness of the project site, the proposed project will employ fire protection equipment along with a fire prevention plan and engineering controls.

6.5.3.1 Purpose of Plan

The primary objective of the project is to ensure that the coordinating mechanism that will ensure maximum safety of property or lives during a blaze, is put in place, and to make sure the staff or guests are familiar with the mechanism and will include:

- (i) increase awareness to residents/guests, management and others of the need for a fire prevention and response plan,
- (ii) establish the coordinating mechanisms necessary for the project to prepare and implement measures to safeguard property and lives of all concerned should a fire occur in a building
- (iii) Indicate all possible evacuation routes for each building on the project site.

6.5.3.2 Fire Prevention

It is important to remember that prevention is better than cure in medicine; well that same principle applies to fire. While water may be plentiful, it's immediately availability may not be a possibility. Therefore the proposed project plans to implement the following:

I. Use of fire retardant material - The use of nonflammable building material will be encouraged for the proposed project. This will include also the use of fire rated doors and fire resistant barriers.

II. Qualified personnel to install electrical system - Only certified wiring Technicians will be allowed to carry out any electrical work on the premises. This will need to be approved by the Belize Electricity Limited.

III. Building Codes - The project will call for the construction of villas and other buildings, with heights up to one storey high. A set of building codes will be developed by the engineers of the project.

6.5.3.3 Fire Protection Equipment/Systems

The proposed project intends to install fire protection equipment and systems in order to protect their buildings and related infrastructure. The following are fire detection, notification and suppression systems that can control a fire.

1) *Fire alarm detection and notification systems.*

- *Smoke and heat detectors:* The project will install fire detection equipment in the form of smoke and heat detectors in each of the residential units and in the administrative and supporting building. These detectors can activate a smoke alarm possibly signaling a fire or something burning.

2) *Fire Suppression Systems.*

- *Hydrants:* Fire hydrants will also be used on the project. Water for these hydrants will be gotten from either the recycled wastewater or from the sea. In both instances a portable

water pump with hoses will be used to extinguish the fire.

- *Fire Extinguishers:* The proposed project will install multi-purpose dry chemical (Class ABC) fire extinguishers at all the key areas. Dry chemical extinguishers will range in sizes of 7 lbs to 10 lbs.

6.5.4 Spill Contingency Plan

The proposed project will require a Spill Contingency Plan for the handling of fuel for the generators. Therefore, the plan will provide an organizational structure and procedures for preparing and responding to hydrocarbon spills and leaks both on land and at sea.

6.5.4.1 Purpose of Plan

The purpose of the plan is to outline the procedures necessary to reduce and contain the effect of a spill by means of a well-coordinated response in conjunction with the different governmental tier response levels

6.5.4.2 Response Policy

The response policy will call for a timely and effective response to incidents which requires basic training in the response policies as well as the use of contingency equipments to contain and clean up a spill after it occurs. The following tables are DOE Tier levels as described by the National Emergency Preparedness Plan for Oil Spills (NEPPOS).

Table 6.16 Marine Spills Levels

Tier	Quantity (gals)	Location	Response
I	1,000-10,000	Coastal/ Marine	To be managed by polluter
II	10,000-100,000	Coastal/ Marine	Requires Government assistance for management
III	>100,000	Coastal/ Marine	Requires Government and/or external assistance

Table 6.17 Inland Spill Level

Level	Quantity	Location	Response
A	<1,000	On land or Inland	To be managed by polluter
B	>1,000 or poses significant health hazard and requires evacuation	On land or Inland	Responsible party requires GoB assistance to manage the discharge.

For the purpose of this project both Tier I and Level A will be considered. This is especially so because of the fuel transportation from the mainland to the caye.

6.5.4.3 Fuel and Waste Oil Management

Fuel management is a very critical safety issue considering the remoteness of the project site. It is however, not a difficult task to do considering the small volumes that will be handled by the project during construction and operation. Fuel will be managed to prevent spills and leaks via the following:

- *Storage:* Fuel will be stored inside a reinforced concrete containment wall. This will be designed to contain 110% of the maximum tank volume. To protect against any accidental fire the tank will be sited away from all electrical installations.
- *Maintenance:* It is necessary to inspect all containment walls and fuel containers. Improper functioning of these can lead to unnecessary spills and leaks. Another important issue is fuel lines. The less there are, the better. It is with that reason that the fuel tanks must be as close as possible to the generators.

In terms of the waste oil, although not required to be developed fully considering the volumes produced, it is important however, to reiterate that the project is in an ecologically fragile environment. Small waste oil spills for this matter, do fall under the Spill Contingency Plan and therefore:

- *Storage:* All waste oil will be stored in properly sealed containers and inside a containment wall.
- *Handling:* Used oils are a legal responsibility of Chrysalis and thus should be handled adequately and with care.
- *Disposal:* Although the volume may be very small, it is important to properly discard the accumulated waste oil. Once stored, the waste oil should be disposed by an approved or certified contractor.

6.5.4.4 Contingency Equipment

Spill response equipment is the most important component in the Spill Contingency Plan. This equipment can vary depending on the size and type of the activity. For the interest of the proposed project, the following equipment will be required:

- Spill response Kits – these will be made available to the maintenance staff and installed at key locations such as generators, boats, etc.
- Containment Booms – these are mostly for marine spills and will be deployed if required.

6.5.5 Tidal Rise Contingency Plan

Global warming is predicted to cause significant rises in sea level over the course of the twenty-first century. The natural phenomenon is an extremely slow process taking several years to decades to materialize. Nevertheless, sea level rise can impact the project's shoreline. Therefore it is anticipated that land reclamation activities would increase this level to approximately 3 feet in some development areas. Considering its importance from an economic long term investment, the following sections summarize the contingency plan for sea level rise at the project site.

6.5.5.1 Purpose of the Plan

The overall objective of the project is to mitigate the effects of this long term phenomenon by:

- Preventing erosion and protecting vulnerable areas prone to such activity
- Prepare a comprehensive plan to remediate the problem by formulating tidal charts, sea level maps and the other necessary tools.

6.5.5.2 Adapting to Sea Level Rise

Adaptive responses focus on protection of shores or allowing them to retreat, with subsequent loss of existing shoreline systems and structures. The following points describe the importance of undertaking such a task.

- **Elevating land surfaces and beaches** - The effects of rising sea level can be offset by elevating beaches, land surfaces, and structures as sea level rises. A key benefit of this approach is that the character of the shore is not altered.
- **Protecting natural shorelines by allowing shores to retreat** - Several planning measures have been proposed to enable some shorelines to remain in roughly their natural state as sea level rises, rather than be replaced with structures. For the most part, these measures apply to areas that are not yet developed.
- **National assessments of adaptive responses** – There has been no documentation on the effects of sea level rise in Belize. Nevertheless, these adaptive responses should be carried out in order to estimate the economies of scale in considering the responses.

6.5.5.3 Climate Change Effects

According to Usher, (Usher 2000), the changes in the hydrological cycle in Belize as a result of climate change, would be characterized by changes in sea levels, the intensity of hurricanes and its accompanying storm surge, and changes in rainfall patterns and temperature. These changes may result in devastating impacts on the project such as:

- Exacerbated erosion of the coastline and accompanying beach loss;

- Alteration or destruction of mangrove communities due to changes in precipitation and seasonality, resulting in the alteration of the productivity of mangrove ecosystems,
- Increased inundation as a result of sea level rise, with consequences such as salt-water intrusion,
- Vulnerability to flooding and soil erosion of low lying areas within project site,
- Loss in net tourism economic activities as a result of the combined effects of climate change,

These issues are of a limited scale to the project site; nevertheless, the net effect of a national scale would be more visible. Planning will include the elevation of property by land filling, the construction of buildings to standards to withstand major hurricanes, and the establishment of building codes and guidelines that will be satisfactory to minimize damage during disasters.

6.5.6 Medical Emergency Plan

This plan is a new concept that must be implemented based on the expanding growth of the tourism industry. In considering this, the proposed project plans to implement and develop a medical emergency plan to respond to such an incident.

6.5.6.1 Purpose of the Plan

The primary objective of the plan is to respond to a medical emergency in a quick manner by:

- Establishing the coordinating mechanism necessary to respond to a medical emergency and to implement basic first aid treatment if applicable.
- Develop and implement a coordinating mechanism necessary to secure appropriate emergency transportation to a recognized health institution.

6.5.6.2 Basic First Aid

First aid treatment usually involves the use of a first aid kit, which is a collection of supplies and equipment for use in giving first aid, particularly in a medical emergency. Most first aid kits contain bandages for controlling bleeding, personal protective equipment such as gloves and a breathing barrier for performing rescue breathing and CPR (cardiopulmonary resuscitation), and sometimes instructions on how to perform first aid.

Aims

The 3 main aims of first aid, commonly referred to as the “3 Ps” are:

- Preserve life
- Prevent further injury
- Promote recovery

6.5.6.3 Transportation (Evacuation) of Patient

When conventional first aid requires additional medical attention, the patient must be transported to a recognized health institution for further treatment as quickly as possible. For this reason it is important to establish relations with the health institution and notify them on the project's plan and determine whether the institution is able to assist in emergency cases. In any event, the Emergency Committee will be required to make transportation arrangements to the health institution in the event of a medical emergency.

6.5.6.4 Contact Information

Contact information is an important factor in considering emergency situations. It can be used for any disaster emergencies. The following table lists the emergency services for the proposed project.

Table 6.18 Chrysalis Emergency Services

Institution/Department	Contact Number	Alternate Number
Southern Regional	522-3832	522-3833
Placencia Health Center	523-3326	-
Director	TBFIM	TBFIM
Other	TBFIM	TBFIM

6.5.7 Environmental Safety

Environmental safety is a growing concept that must be developed, especially considering the growing number of tourists who visit the country. Moreover, this concept must be practiced on a daily basis by those who make up the tourism industry. With this in mind, the Emergency Committee of the proposed development will develop safety training programs for the project.

Training

Training is the field concerned with workplace learning to improve performance. Such training can be generally categorized as *on-the-job* or *off-the-job*. On-the-job describes training that is given in a normal working situation, using the actual tools, equipment, documents or materials that they will use when fully trained. On-the-job training is usually most effective for vocational work. Off-the-job training takes place away from normal work situation which means that the employee is not regarded as productive worker when training is taking place. An advantage of off-the-job training is that it allows people to get away from work and totally concentrate on the training being given.

(a) Hurricane Preparedness Plan

Hurricanes and storms can cause severe property damage and flooding, especially considering the project environment. Moreover, the restoration time is virtually unknown with these types of sustained damages. With this in mind, the Emergency Committee will carry out yearly training in

the form of drills to fine tune and sort out the preparation process. These drills are important in accessing the integrity and functionality of the preparedness plan.

(b) Fire Prevention and Response Plan

Fire outbreaks are dangerous if not contained and extinguished in time. Time is of the essence when dealing with fires. The Emergency Committee will ensure that the persons assigned to fight a fire are properly trained. Training can be carried out by the National Fire Service upon request. The trainee will basically get an understanding of the concepts of a fire and how to properly operate and use a fire extinguisher to fight small fires.

The training will be enhanced to include the usage of the project's fire hydrant system to extinguish large fires that might occur. Special attention will be paid to this section as it signifies the last line of defense for the proposed project. The training will also include the maintenance of both the fire extinguishers and fire hydrant systems.

(c) Spill Contingency Plan

Training in this field will be limited to small localized spills that could occur in the marina and adjacent waters. Precedence will be given to the small spills since the probability is much higher. Trainees in this area will be required to learn the basics in spill containment and remediation process.

This will involve the deployment of spill kits to the required areas and also undertaking remediation services. Training in this field can be undertaken by the Department of the Environment, or private consultancies.

(d) Medical Emergency

Much of first aid is common sense, and people are almost certain to learn some elements as they go through their life (such as knowing to apply an adhesive bandage to a small cut on a finger). However, effective life-saving first aid requires hands-on training by experts, especially where it relates to potentially fatal illnesses and injuries, such as those that require Cardiopulmonary Resuscitation (CPR), as the procedures may be invasive, and carry a risk of further injury to the patient - which the '3 aims' of first aid above, clearly try to avoid.

Training in first aid is often available through the Red Cross or through commercial providers, who will train the staff for a fee. This commercial training is most common for training of employees to perform first aid in their workplace.

As the key skill to first aid is preserving life, the single most important training a first aider can receive is in the primary diagnosis and care of an unconscious or unresponsive patient. The most common mnemonic used to remember the procedure for this is ABC, which stands for **Airway, Breathing and Circulation**.

6.6 Conclusion

The aforementioned environmental management plan will serve to better manage the project especially considering the project location and its associated constraints. Despite the best intentions it is always wise to have a standby arrangement in the event that things do go wrong as sometimes they do. At such times it is incumbent on the developer to revisit the initial guiding principles and to evaluate the activities of the development at regular intervals. It is imperative that development be guided under the applicable laws and guidelines. For this reason the following modus operandi is suggested to guide the post operational period:

- The resort should develop an environmental and social agenda as part of a broad based strategy that guides operating policies and decisions,
- At regular intervals, coordinate with an outside independent body to analyze and evaluate the strategy,
- Conduct a thorough review of management practices as a way of finding opportunities for improvement and set priorities for action,
- Once implemented, regularly audit and evaluate the strategy to ensure its effectiveness.

In addition the developer can take the following measures to ensure the integrity of the ecosystems upon which the project will be based:

- Conduct or cause to be conducted a survey of the area prior to embarking on the proposed development with particular emphasis on sea turtles, manatees and American crocodile population (if any) and habitat quality, and reproductive patterns
- Conduct frequent sampling to detect changes in the baseline parameters to be better able to determine the impact of the development activities on the area's environment,
- Collaborate with any ongoing conservation efforts in the project area to ensure that endangered wildlife are not unduly disturbed,
- Coordinate with the local authorities and the SWCMR to mark with buoys a preferred route for the transportation of cargo and personnel,
- Support any local conservation initiatives in the area seeking to protect similar habitats, which are likely to be used by fauna displaced by the development,
- Ensure that equipment operators and site supervisors are properly sensitized to the need of protecting the flora and fauna from undue disturbances.

These approaches can therefore increase the effectiveness and efficiency of the management plan which in turn would demonstrate good environmental stewardship.