SECTION FIVE

ENVIRONMENTAL IMPACT ANALYSIS

5.1 Introduction

An environmental impact analysis or assessment (EIA) is an assessment of the possible impact—positive or negative—that a proposed project may have on the natural environment. The purpose of the assessment is to ensure that decision makers consider the ensuing environmental impacts to decide whether to proceed with the project. The International Association for Impact Assessment (IAIA) defines an environmental impact assessment as "the process of identifying, predicting, evaluating and mitigating the biophysical, social, and other relevant effects of development proposals prior to major decisions being taken and commitments made." After an EIA, the “precautionary” and “polluter” pays principles may be applied to prevent, limit, or require strict liability or insurance coverage to a project, based on its likely harms. Environmental impact assessments are sometimes controversial but necessary for development.

5.1.1 Conceptual Approach

The impacts of this development will be felt mainly in the areas of physical alterations to the coastal and inland ecosystem, solid and liquid waste disposal, water supply and distribution, energy generation, effects on the native wildlife species of the area from a combination of factors, extraction of materials and transportation. The point has been made that no project of this size can be successfully implemented without some negative environmental impacts, however it is incumbent on the developer to reduce these to their lowest possible level, or negate them entirely if the situation allows.

The developer will be aided in this undertaking by the impacts and mitigation discussion in the relevant sections of this report and summarized in the tables below. These cover the aspects of project activities which have been identified by the DOE as liable to produce significant environmental impacts among others.

5.1.2 Environmental Principles in Impact Analysis

In principle the need to address some requirement(s) of the human species gives rise to the definition and implementation of some specific development project(s) or program(s). In the context of the proposed development, the human requirement to be addressed is the need for recreation and knowledge of the ecosystem. In the case of the latter this relates to the research and educational components of the project.

Inherent in development projects and programs are activities which alter the environment, or cause some “environmental disturbance”. These environmental disturbances have a number of “effects” which in turn leads to “environmental impacts”, which are categorized as being either negative or positive.

Environmental impacts are in principle hierarchal and in this regard are described as being sequentially 'primary', 'secondary', 'tertiary', etc., in orientation. An example of this impact sequence which specifically relates to the currently proposed project is shown in Table 5.1. Primary impacts are those impacts arising immediately from particular development activities such as land clearing and affect basic ecosystem functions such as primary productivity, metabolic rate, mechanical damage to anatomical structures and the physical destruction of habitats.

The 'primary impact' parameters in turn have another level of impacts on various ecosystem components, which are qualified by both magnitude and direction. This is unlike the 'primary impacts', which within the context of the current EIA varies in magnitude only (See EIA Rating Matrix outlined in Table 5.1). In the case of primary impacts, this may be explained by the fact that variations in the magnitude of these parameters in and of themselves are neither deleterious nor beneficial. Conversely, under the current analytical process outlined in the EIA Impact Rating Matrix (See Table 5.1), although a relationship may exist, the magnitude of change of the particular parameter may be so small or insignificant, that no discernible impact is identified.

5.2 Overview of Proposed Cumulative Impacts

In considering the proposed project, the importance of identifying the anticipated cumulative environmental impacts is of great value. This approach is designed in such a way as to preserve and conserve the environment as much as possible while undertaking the required activities necessary to bring life to the project.

In addition, a monitoring plan must also be visualized in order to quantify the potential adverse impact that may result as part for a developmental activity. These plans must be carefully designed, planned, and implemented using techniques designed to reduce and possibly eliminate the severity of the effects.

Such circumstances have been extensively studied by the Council for Environmental Quality (CEQ) and they have defined the measures as those that include:

1. *Avoiding* the impact
2. *Minimizing* the impact by limiting the degree or magnitude of the action
3. *Rectifying the* impact by repairing, rehabilitating, or restoring the affected environment.
4. *Reducing* or eliminating the impact over time
5. *Compensating* for the impact by replacing or providing substitute resources or environments.

These measures applied by the Council, can be adapted to suit the proposed project and assist the decision makers in the course of action. Figure 5.1 illustrates the generic impacts and its related influences in regards to the measures implemented by CEQ.

Fig. 5.1 CEQ's Impact Structure

5.2.1 Impact Rating Matrix

Figure 5.2 summarizes the potential impacts that can be encountered during construction and operation of the project. These impacts can be view as affecting both marina and land environments and its associated cumulative impacts.

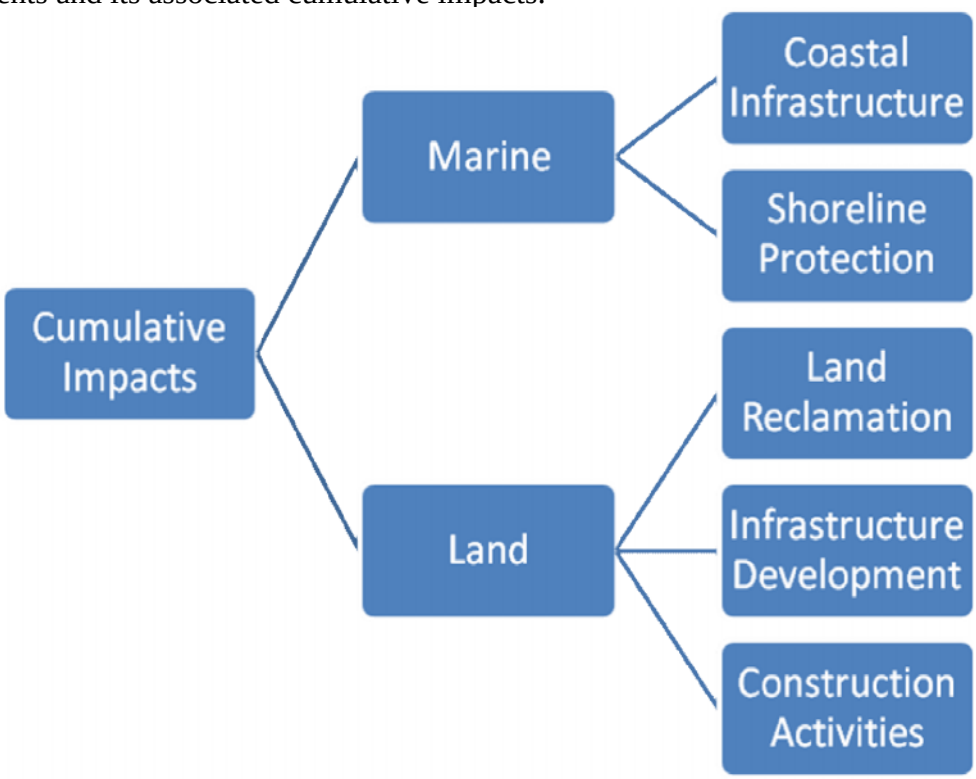

Fig. 5.2 Cumulative Potential Impacts

Table 5.1 Impact Rating Matrix for Bellcan Luxury Eco Resort

Potential impact			Magnitude	Direction	Duration	Scope	Significance
Marine Activities	Coastal Infrastructure	Sediment Re-suspension	L,M	-	I,S	S	L,M
		Benthic Fauna	M	-	M	S,M	L
		Toxic Bioaccumulation	M	-	S	I,S	L
		Water Quality	L,M	-/+	I,S	I,S	L,M
		Nutrient Availability	L	+	S	I,S	L
		Marine Organisms	L	-	I	S,M	M
		Near Shore Ecosystem	M	-	L,M	M	M,H
	Shoreline Protection	Sediment Re-suspension	L,M	-	I,S	S	L,M
		Benthic Fauna	L	-	S,M	S,M	M
		Toxic Bioaccumulation	L	-	S	I,S	L,M
		Water Quality	L	-/+	I,S	I,S	L,M
		Nutrient Enhancement	L,M	+	I,S	S	M
		Marine Organisms	L,M	-	S	S	L
		Socio-economic influence	M	+	M,L	S,M	M
Land Based Activities	Excavation	Land Clearing	L	-	S	S	L
		Habitat Removal	L,M	-	L	S	L
		Soil Alteration	L	-	S	S	L
		Water Quality	L	-	I	S	L
		Nutrient Availability	L	-	I	S	L
	Building Construction	Soil Alteration	L,M	-	S,M	I,S	L,M
		Land Alteration	L,M	-	S,M	L	L,M
		Surface Water Alteration	L,M	-	S	S	L
		Noise Generation	L	-	I,S	I,S	NS,L
		Fugitive Emissions	L	-	I,S	S	NS
		Solid Waste Generation	L	-	I,S/L	S/L	L,M
		Socio-economic Influence	M	+	M,L	S,M	M
	Infrastructural Develop. & Oper.	Soil Alteration/Pollution	L,M	-	S,M	I,S	L
		Water Contamination	L	-	S,M	S	L
		Spills and Leaks/Services	L	-	I,S	I,S	NS,L
		Drainage Alteration	L	-	L	S	L
		Fugitive Emissions	L	-	I,S	I,S	NS,L
		Noise Generation	L	-	I,S/L	S,M	L
		Aesthetic Enhancement	H	+	M,L	L	H
		Socio-economic Influence	M	+	M,L	S	M
	Land/Beach Reclamation	Habitat Alteration	L,M	-	S,M	I,S	L
		Soil Alteration	L,M	-	S,M	I,S	L
		Land Alteration	L	-	S,M	L	L
		Surface Water Alteration	L	-	M,L	S	L
		Drainage Alteration	L	-	L	S	L
		Aesthetic Appeal	M	+	L	L	H
		Fugitive Emissions	L	-	I,S	I,S	NS,L
		Socio-economic Attraction	M	+	M,L	L	H

The impact matrix was designed as a tool to understand the level of adverse, or alternatively, beneficial impacts on the ecosystem and in general of any given area in question. It is a function of the scope of the development, the ecological fragility or sensitivity of the receiving environment, and the conceptual value assigned to the integrity of the natural resources of the area by the wider community.

The connectivity or hierarchal nature of the impacts of the proposed project has been reinforced by the integration of a residual impact rating matrix outlined in Table 5.1. This matrix evaluates the mitigation measures options in the following terms:

- **Magnitude**: High (H), Medium (M), or Low (L);
- **Direction**: Beneficial (+) or Adverse (-);
- **Duration**: Instantaneous (I), Short term (S), Medium (M) or Long term (L);
- **Scope**: Instantaneous (I), Short term (S) , Medium (M) or Long term (L);
- **Significance**: Not Significant (NS), Low (L), Medium (M) or High (H) significance

The primary activities that are likely to result in some environmental impacts of note are the construction and operation of the marina, services provided as well as the construction of the buildings. The potential for pollution from air, noise, solid waste and a shift in the increase of land property are also of relevance.

5.3 Details of Potential Environmental Impacts

Various potential cumulative impacts were identified as part of the Impact Rate Matrix (See Table 5.1). The level of adverse, or alternatively, beneficial impacts is a function of the magnitude of the development activity, the nature of the impact in question, the capacity of the environment to assimilate these influences and the methodology to be applied in relation to the particular project activity.

The primary activities that are likely to give rise to the environmental impacts of note are the limited excavation/reclamation activities, infrastructure development (supporting services installation and amenities), and residential/housing construction (See Fig. 5.2 and Table 5.1). These impacts are expected to minor in scope but nevertheless important when considering the project site.

Another impact of note is the deposition of the spoils that will be used for land reclamation activities. The anticipated project plans to utilize the natural contouring of the development site. The deposition of excavated spoils, although immediately related to excavation, is conceptually separate and has been technically qualified as the physical excavation aspect of the operation.

Other primary impacts related to the excavation activities include habitat alteration. These impacts have been classified as ‘ecological/physical’ impacts In considering the project location, the most notable primary aquatic impacts associated with the proposed undertaking are an increase in macro-nutrients and turbidity. These impacts can arise especially when operating the

wastewater treatment plants. Apart from the water quality issues and aquatic impacts, the engagement of the land based facilities is also relevant in terms of the environmental impacts. This includes related impacts such as residential/building and infrastructure development, walkways and the land reclamation.

The following sections summarize the potential cumulative impacts that can be experienced by the proposed undertaking during construction and operation. It is important to note that some of the contents of this document is generalized for its simplicity. Many of the proposed potential impacts are generic and can be applied to other assessments where appropriate.

5.3.1 Excavation Impacts

It is anticipated that the excavation activities that will be carried out by the proposed development will have both physical and biological effects on the impact site and its immediate areas. The main issue of concern for this type of action is land clearing, removal of habitat and ground water contamination. The latter specifically relates to the excessive excavation of fill material adequate enough to impact the natural drainage and change in topography.

The primary impacts related to the actual excavation or land leveling are land clearing and removal of important habitats. Overall, it is anticipated that the excavation activities will be low with the mitigating measures relating to limiting this activity where possible and that no important habitat is within the project site (See Table 6.1). There are no known secondary effects other that the possible alteration of the movement of nutrients and water within the layers of soil, which for the most part is comprised of calcareous sand.

Possible responses to the impacts can include the rapid undertaking of the overall excavation operation to conceptually decrease the severity and range of impacts in space and time. The impacts from the dredging operations are expected to be localized and should be confined to the areas immediately associated with the excavated site.

5.3.2 Land Reclamation Impacts

The land reclamation activities slated for the proposed development will be limited in scope. This assumption is primarily based on the notion that the project will utilize the natural topography of the property as much as possible. Therefore reclamation activities will be limited to certain low lying areas as indicated by the proposed project (See Fig. 2.21 and Section 2.1.4.3). The cumulative impacts associated immediately to the reclamation process include possible Salinization of soils where these will be used as ‘fill’ material in order to elevate the terrain, increase beach erosion, increase turbidity in the water column, deposition of anoxic sediments and removal of habitat in the area where the spoils will be deposited (See Table 5.1). These impacts are both biological and physical in nature and relate to a number to other variables such as biodiversity, conservation value etc. Although there are identifiable primary impacts, these consequences mentioned are not expected to translate into significant secondary and tertiary impacts as they relate to various ecosystems and their components in the area.

5.3.3 Domestic Effluent Impacts

In relation to the domestic effluent impacts which are basically linked to the generation of liquid waste, the development will be associated with two main generic impacts which are increased nutrients and pathogens in the water column. The effects of pollutants on aquatic systems are primarily a function of the amount and nature of the contaminants introduced (Corbitt, 2005). The situation of increased nutrients in the water column is generally referred to as eutrophication. This relates to the macro-nutrients, which are 'phosphates' and 'nitrates'. These are generally derived from gray water effluents, as well as sewage effluents from the flushing of toilets.

In general a major source of macro-nutrients in gray water effluents is from detergents and human waste. These sources would be primarily generated by the residential component of the anticipated development. Another potential source of macro-nutrients is from the general decomposition of the organic substances along with some fertilizer use. The magnitude and scope of this potential sources and its impact has been assessed as 'moderate to high' without mitigation measures (See Table 5.1).

The secondary impacts of these macro-nutrients also extend to the sea off the eastern side of the project site and more importantly the shorelines of the Laguna de Cantena adjacent the project site on the leeward side of the project site. If mitigated successfully, these impacts would be considered as insignificant to minor based on the function of the sewage treatment technology applied.

The concentration of phosphates and nitrates found in the waters near the project site varies from 0.13 to 0.18 ppm and 1.0 to 5.0 ppm respectively (See Fig 2.13). These values are relatively low and not be considered as 'polluting'. The effect of increased levels of macro-nutrients in the water column is to, in general, increase 'primary production', or photosynthesis in autotrophic plant-life. This relates to micro-algae such as *Chaetocerus spp*., and *Tetraselmis spp*., sub-tidal plants such as the sea grasses *Thalassia spp.,* and *Syringodium spp.,* and macro-algae such as *Halimeda spp.,* and *Udotea spp*.

Potential increases in nutrient and pathological levels for the proposed development relates to both the construction and operational phases with the greater nutrient impacts associated with the commissioning of the development. It is noteworthy to point out that the change in nutrient profile associated with the development should not impact any coral reef ecosystem. This is a function of distance or more appropriately 'dilution effect' of the sea, as well as the use of proper mitigating measures such as the use of a tertiary treatment plant (See Section 3.3). It is important to note that the coral reef east of the project site is considered important as recently stated in several documents produced by the different stakeholders of the country.

The issue of fecal coliform associated with the development is an important one. As may be seen from Fig. 2.5 (See Section 2.1.2.6), there were no detectable levels of fecal coliform or *E. coli*. The generation of *E. coli* becomes a significant consideration with the commissioning of the development and the project site. The primary impact from these features of the development has been characterized as 'major' without proper mitigating measures. For that reason and others

related to liquid waste treatment, the proposed project plans on using a tertiary treatment plant to dampen and greatly diminish this potential human health impact from fecal coliform. Thus the 'Tertiary Impact' for the potential of 'Pathogenic Diseases' has been assessed as minor adverse.

Although in principle there should be no fecal coliform or other associated pathogen in the 'tertiary' treated effluents from the treatment plants to be installed, the adoption of a 'precautionary approach' leaves room for a situation that is less than perfect. The use of tertiary treated effluents to flush toilets and water the lawn is a good conservation strategy. However the latter scenario brings with it the possibility for the presence of pathogens, albeit at low levels. This has been taken into account as being short and of low significance (See Table 5.1).

5.3.4 Potable Water Impacts

There are no extractive processes associated with the primary sourcing of potable water for the proposed development. The main source of potable water for direct human consumption is from rain-fed cisterns supplemented by supplies obtained from water desalinization. In relation to the rainwater source, the roofs of the various buildings are to be fitted with gutters to 'harvest' the water. The plumbing associated with the water delivery system, is detailed in Fig. 3.1. There are, in effect, no deleterious impacts associated with the potable water infrastructure and/or use.

In terms of the secondary source, the potential threat of sourcing of potable water through Water Desalinization (Reverse Osmosis) is the threat of salinization of soils. The primary impacts of this activity are the deployment and operation of the RO Plant (See Table 5.1). The primary impacts have been marked as minor given the volume of water to be used and the volume of hypersaline brine to be derived as a corollary to the process.

The secondary impacts associated with the secondary source of potable water has also been assessed as minor since the strategy for this source is to supplement the rainwater catchment. The 'deep well' injection of the hypersaline brine from the RO Process is the main strategy to reduce the ecological impacts from this source.

The main tertiary impacts are in relation to 'odor pollution' and 'muds and sight pollution'. These have been assessed as 'minor' deleterious given the limited scope of the excavation and consequent deposition of spoils and the above-mentioned strategy to use the R.O. technology to supplement the sourcing of potable water.

5.3.5 Solid Waste Impacts

The proposed project will generate solid waste as it relates to the construction and operational phases. It is anticipated that the solid waste generated during the construction phase will be viewed as instantaneous and short term (substantial volumes over a short period of time) as opposed to the operational phase which can be viewed as long term (steady continuum).

The proposed solid waste management scheme for the anticipated project site will involve the collection and separation of garbage into organic and inorganic components. The organic components as is customary, will be composed on site using an 'Earth Tub composter or its

equivalent. This action will reduce the waste to semi-dry mulch that can be used as organic fertilizers for gardens, hedgerows, and general landscaping. During the construction phase, the vegetation accruing from the minimal land clearing will be collected and composted as well.

The inorganic component will be assimilated at the project site and transported to the San Pedro Municipal dump site two to three times per week as required or until enough has been accumulated to justify its transportation. There is also a possibility of collecting the inorganic waste from several developments southwards of the project site. This issue would have to be agreed upon and sorted out.

In relating to the solid waste impacts, the development anticipated that there will be two main generic environmental impacts related to the generation and management of the solid waste. These impacts include the potential attraction of feral animals to the site and the potential for increasing the incidence of pestilence and pathogenic diseases. In addition the wanton disregard of solid waste can be aesthetically unpleasing.

The attraction of feral animals to the project site would be as a consequence of the increased availability of food in the form of discards from the restaurant and domestic activities. The animals relevant in this regard would be predatory and omnivorous mammalian fauna such as raccoons, rats and opossums, as well as predatory reptiles such as the crocodile and opportunistic bird species such as the Grackle (*Quiscalus mexicanus*), the Herring Gull (*Larus argentatus*) and the Frigate Bird ((*Fregata magnificens*).

The impacts of feral animals in regards to the proposed development have been assessed as ‘minimal’ impact in regards to seabird and migrant bird populations. There are also some adverse impacts however and these relate to general species diversity and the possibility of injury from animals such as crocodiles. These impacts however have been all categorized as ‘low’.

The only secondary impact would be in regards to the land based ecosystem as described earlier and has been classified as ‘minor’. This impact related to the little or no food discard lying around in a way that would be available to attract the feral animals. The impacts to wildlife relates to the availability of food from a non-natural sources and the consequent ‘bioavailability’ and proliferation of wild stocks.

As to the incidence to pestilence and pathogenic diseases, these impacts are considered minor to insignificant given the judicious nature of the management scheme. The most important issue is the possible proliferation of mosquitoes and sand flies.

5.3.6 Energy Generation Impacts

As mentioned earlier in the document, the anticipated development will source their energy from alternative energy sources primarily solar and wind. In view of this there are no potential impacts related to the generation of energy via solar. Wind turbine on the other hand has several potential primary impacts which are classified as minor given proper mitigating measures. These potential impacts include noise generation, ‘shadowing’ effect on the residents and its influence on the

migratory bird population. There are no secondary or tertiary impacts related to the wind turbine operation other than the localized impact due to the footprint of the turbine foundation.

In terms of the secondary sources of energy, the anticipated project plans to utilize generators to supplement their energy demands. There are two (2) main impacts associated with the secondary source generation which are petroleum and noise pollution. The containment structure to house the bulk fuel tanks on the project site and the non-spillage protocol in dispensing fuel greatly reduces the probability of any environmental impact from this source.

The noise pollution issue is of greater relevance than the petroleum pollution issue, in regard to energy generation due to the 'standby' mode. The installation of diesel generators as the secondary source of electricity makes noise pollution an important issue. The scope of the proposed development and the overall energy requirement has resulted in a categorization of the most significant 'primary impact' (See Table 5.1).

There are no secondary impacts of note in relation to noise pollution. The 'tertiary impacts' have been assessed as 'minor adverse', given the 'muffling' of the generators and the use of sound-proof tiles on the walls of the generator house (See Section 3.5). The placement of the generators in the 'Utility Zone' away from the hub of the recreational activities and residential zone is expected to drastically ameliorate the potential noise impacts.

5.3.7 Boating and Dockside Impacts

The boating impacts are related to the possibility of physical harm and injury to boat passengers and bathers due to boat collision. These impacts are classified as high and require proper mitigating measures which include rapid response mechanisms. In relation to the dockside impacts, these are largely related to the refueling of the project's and owner's boats. Another potential source of petroleum pollution would be from the unauthorized and inappropriate discharge of 'bilges' of boats tied up at the dock for extended periods by clientele of the facility.

The primary impacts of petroleum pollution have been categorized as 'minor' in scope given the non-spillage protocol to be adopted by management and the relatively small volumes of fuel involved. The secondary and tertiary impacts from petroleum are expected to be largely indiscernible in scope given the non-spillage protocol mentioned above, and the limited volumes involved. Pier impacts are related to both sedimentation and petroleum pollution impacts. The sedimentation impacts are related to the construction phase of the operation (See Table 5.1).

5.3.8 Impacts from the Building Construction

The associated impacts related to the eventual construction of the different residential and support buildings will be wide and varied. It is anticipated that this event will be minor deleterious in nature and the main impact relates to the clearing of land required for the placement of construction material along with the actual construction itself which can generate solid and liquid waste as secondary impacts.

Considering that only some of the low lying areas of the project site will be reclaimed, it is anticipated that the impacts due to this activity will be low (See Table 5.1). Therefore the only plausible impacts with this issue include that actual reclamation and the construction noise and other related pollution. It is anticipated that these impact will be 'short and low' considering the overall development (See Table 5.1).

The impacts on nesting turtles is expected to be minimal considering that the area, especially the project site. That is to say that the turtles rarely visit the area to nest. Nesting sites are further southwards where the sand dunes are more pronounced (See Section 2.3.1).

In any event, the associated building construction impacts are anticipated to be 'low and short' thereby 'limiting' the cumulative impacts brought on by the proposed development. This is especially important considering the location and the immediate environment of the project site.

5.3.9 Walkway Impacts

It is anticipated that the walkway impacts for the most part will be 'low and short' similar to the building construction impacts (See Section 5.3.8). The designing and routing of the walkway would result in some short-term sedimentation impacts and to a lesser extent sight pollution impact (See Table 5.1). This is primarily due to the 'limited' reclamation of the project site and the need to conserve as much vegetation as possible.

The construction of the walkway will entail the construction of a wooden platform supported by wooden stilts or stakes (See 'wooden walkway' in Fig. 1.3, and 3.6.1). This elevated wooden walkway will be used by guests, residents, visitors and staff to access the elevated casitas (See Fig. 1.3 and 3.6.1). It is anticipated that the impacts related to the construction of this walkway will be minimal as little or no littoral and mangrove forest will be removed.

In general the proposed elevated wooden walkway far outweighs the alternative of road/pathway construction in terms of impacts. Essentially, the proposed walkway will not interfere with the natural drainage patterns of the impact area as well as with the loss of any vegetation. For this reason also, the construction of the walkway is not expected to cause any discernible ecological impact and has therefore been assessed as low given the nature of the activity and its relative distance to the sea and lagoon. This is as a result of the miniscule scale of the operation relative to the size of the project site and caye and the abundant extent of the natural resources.

5.3.10 Roadway Impacts

The impacts of the roadway will primarily consist of sedimentation, air pollution and sight pollution. In considering the length of roadway to be constructed, the anticipated impacts are perceived to be short and low. In other words, the associated construction works for the road will result in the suspension of fine particulate matter as a result of the grading of the 'road'. It is important to remember that this road will actually be a 'road reserve' and that it will not be fully developed until there is actually a 'road' linking the north with San Pedro Town. In any event, it is anticipated that the potential impacts associated with the proposed activity will be localized and confined to the 'road reserve'.

5.3.11 Heliport

The proposed project plans to construct a heliport for the eventual landing of helicopters. The anticipated impacts related to the operation of the heliport involves the generation of noise on approach and departure as well as the loss of vegetation for the placement of the heliport. It is anticipated that these impacts are considered as minor or low relative to the operation timeframe and small impact radius (localized).

This component must be identified as an important impact considering the overall combined effect (noise and turbulence) it might have in relation to the operation of the wind turbine. Noise levels are low considering the nature of the area and its undeveloped state. It is anticipated that as development progress in and around the project site, the noise levels will eventually increase as is customary in any developing area. This holds true for the neighbors who are to the north of the heliport. Presently, the area is not developed nor is it considered to be developed any time soon. Therefore the noise impact related to the placement of the heliport has been assessed as low and instantaneous.

Other impacts include the possibility of physical harm and injury as a result of accidents and incidents involving the helicopter. The impact related to this scenario has been assessed as high considering the probable outcome.

5.3.12 Overview of Social Impacts

The proposed development site is located just north of Rocky Point and is situated in the middle of two protected areas: the Bacalcar Bacalar Chico National Park and Marine Reserve. The boundary of the marine reserve at or near the proposed development site is stated as the high water mark. The Bacalar Chico Management Plan delineates the area in front of the site as General Use Zone 1; however the site also borders Conservation Zone 2.

The *General Use Zone 1* allows for the sustainable management of existing traditional uses within the marine reserve prior to declaration. This zone runs from in front of the development site north to the Bacalar Chico Canal and is accessible to local fisher folks who utilize the area for commercial fishing. The key objective of this zone is to provide the opportunity for established uses and activities to be continued in a sustainable manner under a stringent monitoring scheme.

The adjacent *Conservation Zone 2* which borders the property is designated as a controlled extraction zone designed to accommodate subsistence fishing, recreation and tourism. The zone accommodates all of the different types of recreational activities permitted in the reserve, in affording beach areas for swimming, corals for diving and snorkeling, areas for canoeing and good areas for fishing. The key objectives of this zone are to prevent fishery stocks from overexploitation by commercial fishing and to enhance the value of the area for recreational and tourism activities.

It is important to note that the Bacalar Chico Management Plan shows a proposed surveillance route at Rocky Point; and two new ranger stations at Rocky Point and Robles. Since the 1990s,

the terrestrial and marine area between Robles Point and Rocky Point was recognized as an important area for marine turtles nesting, breeding area for the Queen Conch, seasonal spawning bank for Nassau Grouper the and Yellow-fin Grouper, as well as a variety of other species. It is also important to note that specific regulations also govern the BC National Park where hunting of wild animals etc. is prohibited.

Currently, the only access to the site is by boat through an access channel near two cut. Marine access to the site from the town of San Pedro is outside the reef. There is no existing real road access to the site; however, there is a registered road reserve which commences west of the municipal pier near NOVA. Because the area of the coast between Robles and Rocky Point is very sensitive in terms of both overland road access and marine traffic, potential impacts on the existing environments will need to be analyzed both in terms of construction and completion activities of the project.

To determine those unintended impacts of the proposed development, the social impact assessment (SIA) examined those issues related to proposed development activities without intending to change or modify social groups, values, or activities in the area and the region (Table 5.2). In general, the SIA will attempt to provide essential and valuable input for higher and more strategic levels of decision making during all phases of development and will incorporate data collected and assessed during the social assessment review. The social impact assessment is not intended as a scientific evaluation, but merely as guide to assessing those main issues of concern. For consideration, other associated direct impacts include increased sea traffic and safety to and through the area during and at completion of project, and indirect impacts such as basic needs for workers and emergency services.

The SIA conducted will build on reported information and activities within the existing local and regional environments and will identify and analyze those impacts (if any) of the proposed development during all phases of construction. In general terms, the impact assessment will include analyzing, monitoring and managing the social consequences of proposed development activities.

5.3.12.1 Details of Social Impacts

The social impact assessment will cover both the social and cultural impacts as well as the economic impacts of the project. This assessment will also include the overall value and changes of the resources taking into account the future value of the natural resources by users and impacts of the proposed development on these areas; the general role of traditional users in response to both the fishery and tourism value, and future value of the fishery resource, as well as other impacts on increased usage of the area during post construction and development and completion phases.

Development projects of any kind can modify or enhance the economic viability of a given area. The main purpose of the social impact assessment is to analyze those potential social, cultural, economic and transportation impacts, the proposed development may have on the immediate area and the region on a whole. Associated impacts will be analyzed for both positive and/or negative factors based on the proposal for resort development at its current site.

In view of proposed development activities, conditions relating to the construction and operation of the resort development at its current site were completed by examining those components that could potentially affect proposed activities:

- Likelihood and/or probability of impacts to occur
- Magnitude or degree of the impacts and significance
- Mitigating measures
- How the impacts can be reduced (mitigated) or prevented

In assessing the overall social environment as it relates to the socio-economic, cultural, tourism and transportation conditions the potential impacts of the proposed development may have on the area and the region, the following components were assessed:

- Existing and Proposed Activities
- Marine Traffic
- Road Access
- Disturbances (noise, air quality)
- Population/Housing
- Socio - Cultural
- Education/Health Services
- Employment/Safety
- Emergency Services
- Tourism Activities
- Economic Impact

5.3.12.2 Existing and Proposed Activities

The proposed development site is situated in the northern portion of the Bacalar Chico National Park and Marine Reserve. Land tenure in the immediate area and along this eastern coast is private holdings. The National Park is Government or national lands. Except for a recently constructed wooden structure on the beachfront of the northern adjacent property, there is no other nearby developments in the immediate vicinity of the development site.

The current development site and adjacent properties are for the most part still under vegetation. Information gathered indicated that there is a proposal for a tourist resort and condominium development 'ABR' southwards of the project site. This development is still to be seen. With the advent of the proposed development, and a proposed access road to the site, land values and the

potential for additional private developments will increase. Existing users to and through the area, are the traditional fisherfolk and local tour operators mostly from the town of San Pedro.

During the post-construction and other phases of development, marine traffic to the area and the region will increase. Seemingly, there will also transportation of workers and materials to and from the site regularly.

5.3.12.3 Marine Traffic

- Impact on traditional users to the area
- Increase number of users and vessels to the area
- Impact on natural environment by increased boat usage
- Safety for traditional and other users

The region in front of the development site has been zoned General Use Zone 1 by the Bacalar Chico management plan which allows for sustainable management of existing traditional uses within the marine reserve prior to declaration. The key objective of the zone is to provide the opportunity for established uses and activities to be continued in a sustainable manner under a stringent monitoring scheme. Information gathered indicates that the area of the proposed development is generally utilized by local tour operators from San Pedro for marine tourism activities.

It is expected that there will be a marked increase in the movement of marine vessels to and through the area of the development site during development. Marine traffic includes transporting staff, tourists and other marine traffic to and from the development. Increase of marine traffic will require that safety measures be installed for users to and through the area of the proposed development.

5.3.12.4 Road Access

- Impacts from road construction on adjacent properties and the existing environment
- Transportation of construction materials and equipment during development
- Noise pollution from equipment and machinery transporting materials and supplies to the site

Currently there is no road access to the development site, and very limited access for the development of properties on Northern Ambergris Caye. It is noted that there is an existing road or track that leads from the San Pedro River to near Journey's end. This road however, cannot support heavy equipment and machinery. Because of the topography of the area, choices regarding road construction standards will be influenced by site characteristics and the value of the resources to be utilized.

Recent planning for the area indicates that there has been a proposal for a road reserve on northern Ambergris since the early 1990s. With the GOB acquiring the Pinkerton estate in 1990, and the approval of huge parcels of lands on Northern Ambergris, property owners have increasingly been lobbying for a road to access northern properties. The construction of an all weather road on northern Ambergris will not only complement the developer but will also pave the way for many undeveloped properties which have been abandoned due to limited access.

Because of the limitations and hazards for the transportation of equipment and materials to the site by marine vessels, road access to the site is the most feasible and eco-sensible recommendation. The description for the road reserve to the site is described within "road access" within the social assessment. This road access has been envisioned by the San Pedro Town Council for over a decade. The road access recommended is along western property boundaries to include road reserves within existing subdivisions along the coast from near the municipal pier to the other development site northwards.

At completion of a road to the property, and during all phases of construction and development, it is expected that materials and equipment will be transported overland from near the NOVA shrimp facility to the proposed development site. It is also expected that unfamiliar noise pollution will be one of the main concerns of the residents. A walkway along the western edge of the development along lagoon will also be constructed. This is not expected to have any major impacts, as the walkway will not be constructed in the national park.

5.3.12.5 Disturbances (Noise, Air Quality)

- Noise pollution from the operation of construction equipment and machinery
- Disturbance from airborne pollutants, contaminants, from proposed activities
- Noise and disturbance from heliport activities and wind turbine

During the construction phase and completion phase, noise and air pollution will be one of the main impacts from equipment and machinery. Impacts on road construction works on the environment include noise, dust and air pollution. Similarly, noise from the operation of the heliport and energy generation (wind turbine) will also be an issue.

5.3.12.6 Population Housing

- Temporary/permanent worker population increases
- Voluntary populations from elsewhere in the region
- Unplanned communities
- Pressure on existing resources
- Demand for services
- Impacts on areas of ecological importance

Because of the demographic location of the proposed development, the area and the region of the proposed development site will see increases in worker populations during all phases of construction. It is expected that voluntary populations from San Pedro and elsewhere in the region will be seeking employment within the new development.

The area and region of the development site along the Ambergris Caye eastern coast consists entirely of private properties, of which there is no available public land for spontaneous or unplanned communities. Also, because of the topography, the area and the site can only support general low density land use.

The demand for unavailable services not found at the site will put pressures on existing resources. Increased populations in the area and the region will also see impacts by users in areas of ecological importance.

5.3.12.7 Socio-Cultural

- Cultural displacement
- Pressure on existing customs and lifestyles
- Locals become marginalized
- Pressure on existing institutions and social groups

The town of San Pedro is where the core of the population of the island resides. Over the past two decades, because of the growth of tourism activities, the Town has experienced increases in population growth from different cultural and ethnic groups, be it local Belizeans, Central American Immigrants or North Americans, etc. This growth in and of itself has had great impact on the lifestyle, culture and social institutions in the Town of San Pedro.

In the area of the development site, there are no nearby resident population or nearby local residential housing. Any additional or new immigrants to the island will place extra pressure on existing institutions and social groups.

5.3.12.8 Education/Health Services

- Pressure on educational institutions by migrant worker populations
- Pressure on health and sanitary facilities by migrant worker populations
- Locals become marginalized by migrant worker population

The town of San Pedro is the nearest town from the development with educational and limited health services facilities. Because of the demographic location of the project, the relocation of additional immigrant populations to the island will place a high demand for housing, schools and other ancillary services. The improvement or addition of health facilities will not only

complement growing needs of the population of San Pedro, but will also afford additional available services and facilities for this tourist destination.

In considering the level of health and infrastructural services on the island, it is recommended that the developer include in the project development on site basic first aid for personnel, guests and visitors during and after project completion.

5.3.12.9 Employment/Safety

- Skilled laborers not employed during construction phases; unskilled laborers not trained
- Safety measures not installed for all laborers and employment types
- Security and safety of users and visitors to the area
- Endangerment of pier and docking facilities to life and properties

Employments of locally available employable workers as well as their safety are two main social issues of concerns within any new development projects. Unskilled and untrained laborers can also prove very expensive to project development. Also of importance, are safety of new infrastructure development and the area of the proposed development, for employees, tourist, and traditional users to and through the area of the terrestrial and marine environment.

5.3.12.10 Emergency Services

- Staff not trained in basic emergency procedures.
- Emergency service not available on site during and at completion of project development.
- Emergency facilities not available on the island for employees, visitors and unrelated actions.

In most developments, emergency services are not necessarily built into project design as it is one of the least requirements of any development. In most cases, employees and visitors alike are seldom aware of dangers relating to project development activities. In any event, the anticipated development will secure the relevant Disaster Preparedness Plan.

5.3.12.11 Tourism Activities

- Impact of inland and marine attractions
- Carrying capacities of marine and inland sites
- Impact on fishery resources
- Disruption of tourist activities relating to marine traffic through the area

The proposed development site is within the BCNP and MR. The main concerns within the national park and marine reserves are impacts of development activities by both construction operations and related tourism activities within these areas. Another main concern is impact on turtle nesting sites and the no hunting regulations. Increased boating activities in and through the area may also have some impact on fishery resource and on traditional tourist activities in the area.

5.3.12.12 Economic Impact

- Increased employment
- Increased economic benefits generated by direct expenditure
- Increased revenue for the marine reserve

Impact on fishery resources by traditional users

The proposed development will bring increased economic benefits to the area and the region. In respect to the marine reserve, areas have been zoned for specific areas for activities by traditional users. It will generate both on-site direct employment and indirect supply-industry jobs and spin off for many other individuals and businesses. Jobs will be created at both local and national levels.

Local workers, especially in the town of San Pedro and the region will be needed throughout all phases of the project, and the income generated will boost economic growth and development. In addition, some of the construction materials like sand, marl, and gravels are available nearby. These sources can supply a huge quantity of material for road construction.

Table 5.2 Social Impact Summary for Belcan Eco Resort

Category of Project Activity	Potential Impacts	Recommended Mitigation Measures	Residual Impacts Magnitude Direction/Duration/Scope
Existing and Proposed Activities	- Location and size of project and existing uses	- All development activities scheduled so as not to obstruct existing uses and future activities of the area	- High/positive/decade/local/ long
	- Access to the area by traditional users	- traditional users continue to have access to areas of traditional uses	- High/positive/decade/local/ long
	- Ability of traditional users to adopt to change	- traditional users flexible to new owner proposed activities during and after completion of project development	- High/positive/decade/local/ long - High/positive/decade/local/ long
	- Increase usage of the area of development by new comers	- development planned so as not to impact on traditional user areas and activities - machinery and equipment be maintained	- High/medium/months/local - High/positive/decade/local/ long
Marine Traffic	- Impact on traditional users to the area	- the Developer and staff should be advised of areas of traditional uses	- High/positive/decade/local/ long
	- Increase number of users and marine vessels to the area	- the movement of marine vessels to the area should be scheduled	- High/positive/decade/local/ long
		- all watercraft activities be regulated and designated markers placed in special impact areas	- High/positive/decade/local/ long
		- workers be transported to and from the site to their respective areas during all phases of construction	- High/positive/decade/local/ long
	- Impact on natural environment by increased boat usage	- safe and secure mooring of craft, when off-loading materials and equipment at docking facility	- High/positive/decade/local/ long
		- all watercraft activities be monitored and regulated	- High/positive/decade/local/ long
	- safety for traditional users and other users	- Marine traffic through and near the area be regulated; buoys and markers should be fitted to facilitate day and night vessels in the area	- High/positive/decade/local/ long
		- Hazardous areas and areas of specific importance be demarcated	- High/positive/decade/local/ long
		- [lighted] buoys and markers should be installed to facilitate day and night users in and through the area	- High/positive/decade/local/ long

Category of Project Activity	Potential Impacts	Recommended Mitigation Measures	Residual Impacts Magnitude Direction/Duration/Scope
Road Access	- Impacts from road construction on adjacent properties and the existing environment - Transportation of construction materials and equipment during all phases of development - Noise pollution from equipment and machinery transporting materials and supplies to the site - Opening up access road could increase demand pressure on sensitive areas	- road construction be completed so as not to cause or create undue impacts on property and environment - All materials transported should be covered and properly secured - Equipment and machinery be maintained in quality condition - All on site materials should be properly stored and unused materials disposed of – offsite - Carrying capacity studies should be conducted to determine acceptable limits of change due to increased access and use.	- High/positive/decade/local/ long - High/medium/years/local/ long High/medium/years/local/ long
Disturbances (noise, air quality)	- Noise pollution from the operation of construction equipment and machinery - Disturbance from airborne pollutants from proposed activities	- All installed equipment such as a power generator etc., be enclosed to minimize noise impacts during day and night time uses - operation of heavy machinery and equipment operated during daylight hours - Equipment and machinery maintained in quality condition - No burning of debris allowed	High/medium/years/local/ long - High/medium/months/local/ long - High/negative/months/local
Population/Housing	-Temporary/permanent worker population increases - Voluntary populations from else-where in the region - Unplanned communities - Pressure on existing resources - Demand for services - Impacts on areas of eco-importance	- Developer provides for all on site needs of the workers and visitors (i.e. housing, food, water, etc.) - Additional staff quarters be constructed at the site - the area and region of the proposed development is private land tenure - All adjacent lands are private lands except for adjacent protected area - Construction workers, personnel, visitors be educated as to existing plan and uses of the area - Developer provide for all on site needs of the workers and visitors - Construction workers, personnel, visitors, etc., be educated as to existing plan and uses of the area	- High/positive/decade/local/ long - High/positive/decade/local/ long - High/no change/decade/local/ long - High/no change/decade/long - High/positive/decade/local/ long - High/positive/decade/local/ long - High/positive/decade/local/ long

Category of Project Activity	Potential Impacts	Recommended Mitigation Measures	Residual Impacts Magnitude Direction/Duration/Scope
Socio - Cultural	- Cultural displacement - Pressure on existing customs and lifestyles - Locals become marginalized - Pressure on existing institutions and social groups	- Locally strengthen existing institutions and social groups or develop new ones - Strengthen existing institutions, and regulatory systems	- High/negative/decade/local/ long - High/medium/decade/long - High/medium/decade/long/
Education/Health Services	- Pressure on educational institutions by migrant worker populations - Pressure on health and sanitary facilities by increased migrant worker populations - Locals become marginalized by new influx of migrant worker population	- the local authorities will need to develop an institutional plan to meet the needs of the growing population and visitors alike	High/negative/decade/local/ long
Employment/Safety	- Skilled laborers not employed during construction phases; unskilled laborers not trained - Safety measures not installed for all laborers and employment types - Security and safety of users and visitors to the area - Endangerment of pier and docking facilities to life and properties	- Employ skilled and unskilled laborers from the greater Belize - Train locals from San Pedro and the region with the potential for long term employment - All operators be trained and involved in development plans, safety procedures and use of safety equipment - Proper gear be utilized for all labor types - Warning signs, buoys, lights etc, be installed in the terrestrial and marine environments of the development	- High/positive/decade/local/ long - High/positive/decade/local/ long - High/positive/decade/local/ long - High/positive/decade/local/ long - High/positive/decade/local/ long
Emergency Services	Staff not trained in basic emergency procedures - Emergency service not available on site during and at completion of project development - Emergency facilities not available on the island	- Staff trained in basic emergency procedures, and all operational machinery and equipment - Install emergency equipment and facilities on site - The development should have a sound emergency plan and emergency first aid in place on site for employees, resident population and visitors - Emergency plan for accessing facilities on the mainland as needed	- High/positive/years/local - High/positive/years/local - High/positive/years/local - High/positive/years/local

Category of Project Activity	Potential Impacts	Recommended Mitigation Measures	Residual Impacts Magnitude Direction/Duration/Scope
Tourism Activities	- Impact on turtle nesting beach by tourist activity - impact on turtle nesting beach by newcomers to the site - Impact on national park (i.e. no hunting etc.)	- visitors and employees be educated as to the importance of the site - Turtle and other nesting and spawning areas should be demarcated as no access zones. - planned activity to avoid disrupting nesting site - no hunting, fishing, setting of traps etc on protected area - licenses and permits required for various activities	- High/negative/decades/local/ long - High/negative/decades/local/ long - High/negative/decades/local/ long
Economic Impact	- Increased employment - Increased economic benefits generated by direct expenditure - Increased revenue for the marine reserve - Impact on fishery resources by traditional users	- increased revenue to area and region and lifestyle - increased domino effects and spin offs on the island and the mainland - additional income for the marine reserve	- High/positive/decades/local/ long - High/positive/decades/local/ long - High/positive/decades/local/ long

5.4 Indirect Impacts

It is anticipated that the proposed project will also have indirect cumulative impacts on the receiving environment as summarized below.

5.4.1 Impact on Fishing Activities

There is little difference in comparing the relative impact data in terms of the fishing activities of the BCNP and MR. It is important to note that the project site falls within a productive area under conservation. The species primarily targeted are lobster and conch, followed by a number of finfish species such as Grey Snapper, Barracuda, Yellowtail, Snook, Mullet and Groupers. Since no dredging is to take place, then the relative impacts due to sedimentation and turbidity will be nil.

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5.4.2 Impacts on Tourism Activities

In analyzing the tourism related impacts, it has been determined that there are virtually no existing impacts on the pre-existing tourism activities in the area. The major clientele for the proposed development is expected to be foreign supported by local staff and supplies. The encounter with local staff and stakeholders in the area in general has social impacts. These impacts have been considered as 'moderate' and include – 'culture conflicts', tourism related activities (reef visits, kayaking, parasailing etc.), injury and pollution (noise, soil and water) etc..

The 'culture conflicts' in principle arises from the encounter of two (2) different cultures with different languages, ethnicity, race, religion and value systems. Most of the guests that are to be the clientele of the proposed resort are expected to be foreigners from the United States, Europe and to lesser extent Asia. Their encounter with local stakeholders in the area, as well as the local staff could be an issue of some significance. This 'moderate' categorization of impact signals the need for some mitigative intervention.

The issue of 'pathogenic disease' relates to those associated with insect pests such as mosquitoes and roaches and nuisance pests such as botflies and sand flies. The development, if allowed to proceed in an environmentally irresponsible way that would for example result in an increase in 'standing water', would provide a habitat of mosquitoes, which would increase the risk of malaria. The increased contact of tourists/residents/guests with certain activities increases the potential for insect borne pathogenic diseases. The focus on handling solid wastes in a responsible way should leave no additional breeding habitat for mosquitoes.

The issue of 'sand-flies' are relevant in the context of nuisance pests. They are generally discomfiting to humans in modest numbers and are intolerable to many when in abundance. The plying of tourists in unspoiled environments brings with it insect pests. The limited reclamation activities should reduce the number of pests as inundated areas are reclaimed.

The issue of noise pollution would be primarily associated with the helipad usage along with the wind turbine operation. Other notable sources can be attributed to the occasional operation of the standby generation. Construction noise are expected to be short term and localized. Similarly,

boat traffic and the occasional chatter are classified as minimal. It is anticipated that these impacts will be minimal to the overall setting of the project site, especially considering the decibel levels generated by the reef surrounding environment (birds, whistling of wind etc.).

The issue of 'reef visitation' relates to the impacts of tourists and guest in general on the health and well-being of the nearby Mesoamerican Barrier Reef. This is limited almost exclusively to scuba diving and snorkeling since this is almost the only circumstance under which these guests are likely to encounter corals in any marked assemblages. The potential for holding onto coral, or standing on corals, or other physical modes of contact, exists.

This could lead to breakages, or the physical crushing of coral polyps and skeleton, and subsequently diseases. The likelihood of this happening on a significant basis is low. This is related to the general environmental ethic incorporated into the pre-dive briefing of scuba divers and snorkelers in Belize in general and is a cornerstone of the Bellcan Eco Resort operations.

5.5 Conclusion

It must be a basic premise that all developments will produce some environmental impacts and therefore the basic question is how much is acceptable under the circumstances? The obvious consensus is that the country needs development but only of the kind that is sustainable and in conformity to national development priorities. The challenge throughout is to find an acceptable level that will strike the necessary balance between the need to develop and the need to protect vital environmental processes. Also important is the planned scale of the infrastructural development and their potential to unravel the social fabric and lifestyles of the people in the area within which they are based.

Therefore in considering the overall development and its conceptual approach to sustainable development, the related impacts are not that different from most other projects of the area. What sets the project apart from others is the size and magnitude of the anticipated development within the BCMR and NP. This can be viewed from the extent and quality of the available data collected during field visits as well as from published literature, especially those of the BCNP/MR and Fisheries Department. In order to get a perspective of the potential impacts data was cross-referenced with known authors in order to corroborate the 'prediction' and 'sequence of environmental impacts' if any. This action can only be ascertained if a scaled model was generated and the impacts recorded, but that notion is up to speculation especially considering that the data reflects only a 'snap shot' of the existing conditions. It is therefore anticipated that the proposed project is within the appropriate confines of sustainable development.