

7.0 ENVIRONMENTAL IMPACT IDENTIFICATION & MITIGATION

An environmental impact is defined as any change to an existing condition of the environment. The nature of the impacts may be categorised in terms of:

- Direction - positive or negative
- Duration - long or short term
- Location - direct or indirect
- Magnitude - large or small
- Extent - wide or local
- Significance - large or small

To systematically identify the impacts associated with the proposed hotel development, an impact matrix was constructed which arrayed the main project activities against the relevant environmental factors. This matrix is shown in Tables 7.1 and 7.2.

Table 7.1: Impact Matrix for Site Preparation and Construction

ACTIVITY/IMPACT	DIRECTION		DURATION		LOCATION		MAGNITUDE		EXTENT		SIGNIFICANCE	
	Pos	Neg	Long	Short	Direct	Indirect	Major	Minor	Wide	Local	Large	Small
1. Site Preparation												
Retain Veg. Corr. (Hotel Site)	x		x		x		x		x		x	
Veg. Remov. – Hotel Site		x	x		x		x			x		x
Veg. Remov. – Parking Lot		x	x		x		x		x		x	
Habitat Remov. – Hotel Site		x		x		x		x		x		x
Habitat Remov. – Parking Lot		x	x			x	x			x	x	
Increased infiltration/runoff		x		x		x		x		x		x
Increased flood potential		x		x	x			x		x		x
Increased soil erosion		x		x		x		x		x		x
Noise		x		x	x			x		x		x
2. Cut, Fill & Levelling												
Generated solid waste		x		x	x		x			x		x
Dust		x		x	x		x			x		x
3. Material Transport												
Dusting & spillage		x		x	x			x	x			x
Traffic congestion, road wear		x		x	x			x	x			x
Routing through Negril		x		x	x			x		x		x
4. Improper Material Storage												
Dusting		x		x	x		x			x		x
Suspended solid runoff		x		x	x			x		x		x
5. Construction Works												
Noise		x		x	x			x		x		x
Dust		x		x	x			x	x			x
Beach enhancement/ damage/modification		x	x		x	x	x			x	x	
Mangrove/seagrass removal		x	x		x		x		x		x	
Visual intrusion		x	x		x		x			x		x
Refuelling of vehicles and fuel storage onsite		x		x	x			x		x		x
Repair of vehicles onsite		x		x	x			x		x		x
6. Construction Crew												
Sewage generation		x		x	x			x		x		x
Solid waste generation		x		x	x			x		x		x
Emergency response		x		x	x			x		x		x
Food Hygiene		x		x		x		x		x		x
7. Landscape & Replanting												
Vegetation/habitat reintroduction	x		x		x		x		x		x	
8. Employment												
Job creation	x			x	x		x			x	x	

Table 7.2: Impact Matrix for Operational Phase

ACTIVITY/IMPACT	DIRECTION		DURATION		LOCATION		MAGNITUDE		EXTENT		SIGNIFICANCE	
	Pos	Neg	Long	Short	Direct	Indirect	Major	Minor	Wide	Local	Large	Small
1. Water supply/Consumption												
Sustainable supply	x		x			x		x	x			x
Water conservation methods	x		x		x		x			x	x	
2. Wastewater generation/Disposal												
Sewage		x	x			x	x			x		x
Laundry		x	x			x		x		x		x
3. Transportation/Traffic												
Traffic congestion		x	x			x		x		x		x
4. Beach Use/Carrying Capacity												
Water Pollution		x	x		x			x	x		x	
Erosion		x	x		x			x		x		x
Overcrowding		x	x		x			x		x		x
Access		x	x		x		x			x	x	
Solid waste generation & disposal		x	x		x			x		x		x
Water sports		x	x		x		x			x	x	
5. Emergency Response												
Emergency response		x	x		x			x		x		x
6. Landscaping												
Vegetation/habitat removal		x	x		x			x		x		x
Local veg./habitat intro. (Hotel Site)	x		x		x			x	x		x	
Retain Veg. Corr. (Hotel Site)	x		x		x		x		x		x	
Retain tree canopy/habitat (P. Lot)	x		x		x		x		x		x	
Improved aesthetics	x		x		x		x		x		x	
7. Site Access Road												
Increased surface runoff		x	x		x			x		x		x
8. Security Lights												
Disturbance of nocturnal fauna		x	x			x		x		x		x
Visual intrusion		x	x		x		x			x		x
9. Employment												
Job creation	x		x		x		x			x	x	

7.1 Site Preparation and Construction

Impact: Effect on ecosystems and tree conservation

Vegetation clearance and construction associated with the proposed development, will inevitably mean the removal of some of the existing vegetation at both the hotel and parking lot sites. The issue, therefore, is which species can be removed, how many individuals would be lost and which sections of the sites they would be removed from. The environmental NGOs and NEPA are specifically interested and concerned about the impacts that this vegetation removal would have on the existing environment and the overall woodland habitat of the site, and its corresponding terrestrial fauna.

Several flora and fauna species were identified during the 4 - 5 days of terrestrial surveys conducted at the proposed sites (see Section 4.2). These include avifauna (birds), crabs, amphibians, reptiles and insects, which are not only independent entities and classes but together make up a complex ecosystem. This system is dependent on the interactions, food chains, food webs and relationships that exist between the various floral and faunal classes found on the project site. Therefore, changes made to the diversity or abundance of any given organism, has a potential impact (either positive or negative) on other seemingly non-related organisms residing on and frequenting the project sites. The proposed alterations to the existing environment at the proposed sites should therefore be carefully considered before implementation.

Critical ecosystem and habitat preservation species include onsite vegetation, the amphibians, the reptiles, and the insect populations identified under Section 4.2.4. Avifauna (inclusive of many of the resident and endemic species) rely directly and indirectly on the existence, diversity and the numbers of amphibians, reptiles and insects present at the site. These amphibians, reptiles and insects in turn rely on the diverse floral habitat and species found at the sites. Any large-scale removal and clearance of

vegetation from either the proposed hotel site or the proposed parking lot site is unacceptable. Mitigation methods are discussed below.

Mitigation

The main issue and goal in this development is to retain and maintain adequately-sized, representative sections of the main onsite terrestrial floral and faunal habitats. These habitats are required for the retention of the amphibian, reptile and insect species at the site which themselves support the crab and avifauna populations residing and utilising the site as a living and foraging habitat. In this regard, the implementation of the following mitigation measures are suggested:

- (i) **Minimal removal of trees throughout all phases of the project life cycle** (i.e. site preparation and the construction and operational phases of the project). The proposed final landscape plan should seek to incorporate tree species and individuals already present on the site as much as is practicable. This will also enhance the aesthetic quality of the hotel.
- (ii) **No conversion of existing onsite habitat in favour of a lower density monoculture** of coconut/other introduced ornamental species; and/or reduction in the species and number of floral individuals at the site, in favour of extensive wide open, cleared, bare or grassed spaces unless absolutely necessary.
- (iii) A **Tree Preservation Plan** is recommended before construction work begins. RIU's design architect and suitable representatives from the national regulatory agency, NEPA, must arrange a meeting at the project site to agree on and approve a final layout plan for the hotel that best suits the interests of the developer, yet seeks to retain as many of the onsite trees.

The plan will address the following recommendations:

- The designation, retention and maintenance of a closed-canopy (or partially closed-canopy) vegetation/tree corridor comprising existing site vegetation is ideal. A width of 30m is recommended in the proposed design and supported by the consultant.
- Trees/vegetation that fall within the building footprints of the approved layout plan should be preserved.
- Trees and vegetation stands throughout the remainder of the site that have a Diameter at Breast Height (DBH) of 18 cm.

The selection of these trees should be agreed upon by BOTH the developer and NEPA representatives and should be physically and clearly marked for

protection. Some trees were already marked during the fieldwork for this study (section 4.2.1.2). Selected trees should also be clearly marked and surveyed onto RIU's final layout and "existing vegetation" topographic (CAD) drawings. These drawings must be subsequently passed on to the building contractor, with specific instructions with regards to implementing and adhering to the vegetation preservation plans and drawings.

The consultant recommends marking the selected vegetation, and then removing them (with their root systems intact). They are then kept alive in a temporary designated onsite nursery area and replanted onsite during landscaping and the operational phase of the project.

In addition, legally binding "stop order" caveats must be written into the building contractor's work contract, with regards to any violation of the tree retention and preservation agreements made under (v), above. Evidence of violation or unauthorised deviation from the NEPA-agreed tree preservation and final hotel layout plans, must result in the "stop order" caveats being invoked by onsite monitoring representatives (see iv above), pending a detailed review of onsite site clearance/construction practices and more regular, stricter and stringent policing of these practices.

- (iv) During site preparation, site clearance and site construction, tree preservation, retention and removal must be **closely monitored and policed by an independent, qualified entity**. These onsite monitoring representatives should be selected in consultation with (a) local environmental interest groups in Negril, (b) NEPA/NRCA, and/or (c) the EIA consultants.

Impact: Preservation of Endemic Species

As reported in Section 4.2.1.3, the bromeliad *Hohenbergia sp.* was observed throughout the site. The trees *Roystonea* and *Thrinax* were also obvious. These will also be considered in the Tree Preservation Plan, but also need to be highlighted as the preservation of these plants is not only of local importance, but national significance.

Mitigation

Those trees onsite (*Roystonea* and *Thrinax*), which support the endemics *Hohenbergia* sp., must not be cut down.

- The trees may be relocated and preserved.
- The *Hohenbergia*, however, must not be removed or their host trees affected. They must be kept, along with these epiphytes, undisturbed and in place. Prior to any issue of a NEPA construction permit, and prior to any commencement of work on the site, the final set of layout plans and building footprints for the hotel must be readjusted and shifted to accommodate this mitigation measure and must reflect and clearly show the location of these trees and the intent to retain and preserve them.
- As only one specimen of the orchid, *Tropida* was encountered on the forest floor, the presence of more than one specimen of this species needs to be determined and if necessary, removed to a sanctuary and re-introduced to the site.
- *Phyllanthus acuminatus* is a small tree and further searches of the site should be made in the development of the Tree Preservation Plan to determine the numbers present and implement a protection plan.
- The tree preservation and endemic species conservation plans could also consider preservation and relocation and of these species on the site for landscaping or tourist attraction.

Impact: Proposed Parking Area in significant ecosystem

The proposed site for the parking area should not be disturbed as it is a climax community, one of the remaining swamp-margin forest in Negril and serves as a habitat for avifauna, frogs and invertebrates present on-site. This site is also the buffer zone to the swamp ecosystem, which is also a protected area. The main issue and goal, at this

site, is not so much the potential loss of tree species and individuals, but the maintenance of the closed tree canopy. In the absence of significant understorey vegetation and undergrowth, the closed tree canopy is the primary nesting and feeding habitat for insects and birds at the proposed parking lot site. Change, modification and loss of this closed canopy will result in a major significant negative impact on bird species at the site. These bird species not only need the canopy for food and nesting, but also rely on it for cover and a sense of safety. Unapproved tree felling and removal at this site is likely to have the greatest impact on the endemic bird species.

Mitigation

An alternative site, for the construction of the proposed RIU parking lot, should be seriously considered and investigated.

In the absence of an alternative site, the existing closed tree canopy habitat must be maintained and should not be opened any more. Only trees necessary to allow sufficient access into the parking lot should be removed. The lot must be constructed and contoured around the existing onsite trees.

Impact: Noise Pollution

Site clearance and construction of the proposed development necessitates the use of heavy equipment to carryout the nature of the job. These equipment include bulldozers, backhoes, etc. They posses the potential to have a direct negative impact on the environment.

Mitigation:

- Use equipment that has low noise emissions as stated by the manufacturers.
- Use equipment that is properly fitted with noise reduction devices such as mufflers.
- Operate noise-generating equipment during regular working hours (e.g. 7 am – 7 pm) so as to reduce the potential of creating a noise nuisance during the night.
- Construction workers operating equipment that generates noise should be equipped with noise protection. A guide is workers operating equipment generating noise of ≥ 80 dBA (decibels) continuously for 8 hours or more should use ear muffs. Workers experiencing prolonged noise levels 70 - 80 dBA should wear earplugs.

Impact: Air Quality

Site preparation and construction has the potential to have a two folded direct negative impact on air quality. The first impact is air pollution generated from the construction equipment and transportation. The second is from fugitive dust from site roads, cleared areas and raw materials stored on site. Fugitive dust has the potential to affect the health of construction workers, the resident population and the vegetation.

Mitigation:

- i. Site roads should be dampened every 4-6 hours or within reason to prevent a dust nuisance and on hotter days, this frequency should be increased.
- ii. Minimize cleared areas to those that are needed to be used.
- iii. Cover or wet construction materials such as marl to prevent a dust nuisance.
- iv. Where unavoidable, construction workers working in dusty areas should be provided and fitted with N95 respirators.

Impact: Employment

During this phase, an average of six hundred (600) trade men and labourers will be utilized and at peak construction an estimated 1200 will be needed. This represents a significant level of employment within the study area. This has the potential to be a significant positive impact.

Mitigation

Not required

Impact: Solid Waste Generation

During this construction phase of the proposed project, solid waste generation may occur mainly from two points:

- i. From the construction campsite.
- ii. From construction activities such as site clearance and excavation.

Mitigation:

- i. Skips and bins should be strategically placed within the campsite and construction site.
- ii. The skips and bins at the construction campsite should be adequately designed and covered to prevent access by vermin and minimise odour.
- iii. The skips and bins at the construction site should be adequately covered to prevent a dust nuisance.

- iv. The skips and bins at both the construction campsite and construction site should be emptied regularly to prevent overflowing.
- v. Disposal of the contents of the skips and bins should be done at an approved disposal site. The Retirement dump in St. James is recommended. Appropriate permission should be sought.

Impact: Wastewater Generation and Disposal

With every construction campsite comes the need to provide construction workers with showers and sanitary conveniences. The disposal of the wastewater generated at the construction campsite has the potential to have a minor negative impact on groundwater. No significant environmental impacts were identified from this activity.

Mitigation:

- i. Provide portable sanitary conveniences for the construction workers for control of sewage waste. A ratio of approximately 25 workers per chemical toilet should be used.
- ii. Connect to the NWC sewer main.

Impact: Storage of Raw Material and Equipment

Raw materials, for example sand and marl, used in the construction of the proposed development will be stored onsite. There will be a potential for them to become air or waterborne. Stored fuels and the repair of construction equipment has the potential to leak hydraulic fuels, oils etc.

Mitigation:

- i. Raw materials that generate dust should be covered or wet frequently to prevent them from becoming air or waterborne.
- ii. Raw material should be placed on hardstands surrounded by berms.
- iii. Equipment should be stored on impermeable hard stands surrounded by berms to contain any accidental surface runoff.
- iv. Bulk storage of fuels and oils should be in clearly marked containers (tanks/drums etc.) indicating the type and quantity being stored. In addition, these containers should be surrounded by berms to contain the volume being stored in case of accidental spillage.

Impact: Transportation of Raw Material and Equipment

The transportation and use of heavy equipment and trucks is required during construction. Trucks will transport raw materials and heavy equipment. This has the potential to directly impact traffic flow along the Norman Manley Boulevard especially at the entrance to the construction site.

Mitigation:

- i. Adequate and appropriate road signs should be erected to warn road users of the construction activities. For example reduced speed near the construction site access road. This should be done in conjunction with the Ministry of Transport and Works.
- ii. Raw materials such as marl and sand should be adequately covered within the trucks to prevent any escaping into the air and along the roadway.

- iii. Trucks transporting raw materials should be made to enter the proposed site through one access point and leave through another. The trucks should be parked on the proposed site until they are off loaded. This will prevent the build up of trucks along the Norman Manley Boulevard.
- iv. Heavy equipment should be transported early morning (12 am – 5 am) with proper pilotage.
- v. The use of flagmen should be employed to regulate when trucks have access to the construction site or to Norman Manley Boulevard.

Impact: Food Hygiene

The establishment of a construction campsite will cause a proliferation of “cook shops” (food vendors) to provide the construction workers with meals. Improper food preparation and the failure to practice proper hygiene can result in certain pathogens entering the food supply and cause food borne illness. Food borne illness often presents itself as flu like symptoms such as nausea, vomiting, diarrhoea or fever.

Mitigation:

- i. Provision of adequate supply of potable water.
- ii. The monitoring of the various ‘cook shops’ by public health authorities, and with the monitoring of the construction management team, to ensure proper hygiene is being followed.
- iii. The provision of areas to adequately wash hands and utensils.

Impact: Emergency Response

Construction of the proposed hotel will involve approximately 600-1200 construction workers. The possibility of accidental injury is high. There may be either minor or major accidents.

Mitigation:

- i. A lead person should be identified and appointed to be responsible for emergencies occurring on the site. This person should be clearly identified to the construction workers.
- ii. The RIU construction management team should have onsite first aid kits and make arrangements for the nurse and doctor at Tropical Bay to be on call for the construction site.
- iii. Make prior arrangements with health care facilities such as the Negril Health Center or the Lucea hospital to accommodate any eventualities.
- iv. Arrange with health practitioners to be on call during the construction period.
- v. Material Safety Data Sheets (MSDS) should be stored onsite.

7.2 Operations

Impact: Earthquake Hazard

From the catalogue of earthquakes impacting Jamaica over the past 300 years, most of the larger earthquakes recorded/reported were offshore. The earthquakes occurring on land tend to be of low magnitude. From a historical seismic perspective, the site is no more prone than any other area on the island.

The major earthquake source zone on land is the Wagwater Belt in the western Blue Mountain area. The proposed site is more than two hundred kilometres (200km) from this source zone and therefore earthquakes in this area are not expected to cause significant damage at the proposed site. Given the distance of the proposed development from this source zone, the impact relating to earthquakes can be considered as moderate to low

The site is underlain by saturated sand with peat lenses. A moderate to high intensity earthquake impacting the site could adversely impact the development. There is also the potential for soil liquefaction or excessive ground acceleration.

Mitigation

- i. Proposed structures to be constructed at the site are low-rise and this implies a moderate to low earthquake hazard with respect to life and property.
- iii. To minimize earthquake impact it is recommend that the buildings at the site should be designed and constructed to withstand moderate to large earthquakes.
- iv. An emergency response plan to address natural and man-made disaster and possible evacuation is required by NEPA and should be developed in close consultation with the Office of Disaster Preparedness and Emergency Management (ODPEM).

Impact: Storm Surge

Storm Surge analysis for the site indicates that water level increases of 2.56 to 3.59 can be expected to occur for storms with Return Periods between 10 to 100 Years. These levels are well above the 1.0 m contour on the existing topographic survey and no floor levels were provided for the proposed buildings.

It is therefore reasonable to conclude that depending on the mitigation strategy adopted that significant landfilling or significant elevation of the proposed buildings will have to be carried out in order to prevent total inundation of the hotel.

Mitigation:

Two mitigations options can be employed for minimizing the likelihood of loss of life and damage to property from storm surge. These are as follows:

- i. **No Loss and No Damage Option:** This option requires that all the buildings are elevated above the storm surge associated with the desired return period. The overall objective is to limit the amount of wetting of floor space. This option does however have its disadvantages. These include potentially excessive costs for landfilling and potential aesthetic issues with the landscape.
- ii. **Selective Elevation:** This option requires that infrastructure of critical importance (such as administration and expensive equipment) and selective infrastructure such as the 1st floor and higher on the hotel blocks are elevated above a certain critical storm surge level. The overall strategy being to safeguard the operation of the hotel and to provide potential shelter for visitors that may be resident at the hotel on higher levels. This strategy has the attractive advantages of providing for the disaster management need for shelter as well as minimizing the cost for landfilling.
- iii. Minimize the risk of storm surge implementing an effective disaster and emergency management and evacuation plan for the hotel.

Impact: Beach Erosion

The erosion analysis indicates that the site could experience an erosion loss of up to 25m of shoreline on the western end of the property. Fortunately, there are no plans for

placing significant infrastructure in this zone. This erosion loss could hinder the operations of the hotel as far as guest satisfaction is concerned given the lack of beach space alternatives on this site.

Mitigation:

Storm event erosion can be mitigated or minimized by;

- i. Should beach nourishment be desirable, then similar sized or coarser sand should be used for beach nourishment.
- ii. Should the owner decide that the potential erosion losses are unacceptable, as far as operational risks are concerned, then coastal engineering options (such as submerged breakwaters and artificial sand dunes) could be considered. Such options, if carefully thought out, could provide the required protection against erosion while blending with the natural surroundings.
- iii. Preservation of sea grass beds that help to anchor the seabed.
- iv. Minimizing the risk of storm surge relates primarily to instituting an effective disaster and emergency management and evacuation plan for the hotel.

It should be noted that further detailed design conditions will be required to employ any of the aforementioned options.

Impact: Flooding

Flooding impacts relates to; a) flooding of the site by adjacent properties and b) flooding of adjacent property by the proposed development at the site.

The construction of the proposed hotel at the site will result in increase storm water runoff from the site. This is primarily due to the construction of buildings and paving of

the green areas. Present stormwater from the main road will also be prevented from entering the site. The pre and post development storm water runoff from the site is shown in Table 7.3. With the proposed development at the site, there will be an increase in runoff of approximately 46 to 56 percent. It is assumed that only approximately 50 percent of the site will be made impervious.

Table 7.3 Storm Water Runoff - Development Site

Return Period (yrs)	5	10	25	50
Pre Dev Runoff (ft ³ /s)	20.6	28.1	37.9	48.5
Post Dev Runoff (ft ³ /s)	42.1	54.6	71.5	86.6

Storm Water Runoff Estimate Calculation:

Storm water runoff to and from the site was estimate using the Rational Method:

$$Q = CIA$$

- Q = Peak Runoff (cusecs)
- A = Drainage area (acres)
- I = Average Rainfall Intensity lasting a critical duration (t) and corresponding to a return period (T) used in the design.
- C = Dimensionless runoff coefficient based on the degree of imperviousness and Infiltration capacity of the drainage surface.

Mitigation

Drains and absorption pits will be constructed at the site to accommodate the increased stormwater that should be generated from the site. Consequently the increased stormwater runoff from the site will not impact negatively on coastal waters or adjacent properties. The increased stormwater should not be directed to the coastline.

Stormwater that is presently generated on the main road will be prevented from entering the site. This water will be diverted into a drain paralleling the main road to discharge ultimately into a drain north of the site.

The runoff coefficients for the project site were obtained from published tables of runoff coefficients after a field survey of the physical characteristics of the site. The pre-development runoff coefficients range from 0.25 to 0.35, while the post-development runoff coefficient range from 0.77 to 0.90. The rainfall intensities for the maximum 24-hour rainfall for the rainfall station at Negril were used in the computation.

- i. Storm water generated on the site should not be diverted onto the main road, as this will exasperate the flooding problem along this road. The adsorption pits must be designed to accommodate the increased runoff from the site.
- ii. There should be no subsurface disposal of effluent at the site. Stormwater disposal system should not be used to dispose hazardous or other toxic substances either directly or indirectly.

Impact: Employment

During this phase, an average of four hundred (400) staff will be needed for the proper operation of the hotel. This represents an increase in the level of employment within the study area. This has the potential to be a significant positive impact.

Persons engaged in this phase will require training, which will result in an increase of persons with training in the hospitality sector.

Mitigation

Not required

Impact: Negril Marine Park Zonation

The Negril Environmental Protection Plan and more specifically the Negril Marine Park has zoned Bloody Bay (section 5.3.4). Of significance is the area that has been zoned as a replenishment area (fish sanctuary). Operation of the proposed hotel has the potential to impact negatively on this zone. In addition, the moratorium placed on motorized water sports within the Bay by the Tourism Product Development Company Ltd. (TPDCO) and supported by NEPA will impact on the hotel operation.

Mitigation

- i. Mandate non-motorized crafts in proximity to the proposed fish sanctuary.
- ii. Inform and educate guests about the proposed fish sanctuary and what is not allowed there.

Impact: Beach Use and Carrying Capacity

The beach at Bloody Bay is used for recreational and commercial purposes. It is used by residents and the guests of at least of eight (8) hotels. The addition of the proposed development in Bloody Bay will have a potential direct negative impact on beach use and carrying capacity. It will reduce the public beach area used by residents and tourists alike. However, the carrying capacity of the Bay will not be exceeded.

Mitigation:

- i. RIU could work in tandem with the Urban Development Corporation to improve the facilities at the relocated public beach at Long Bay.
- ii. TPDCO, NEPT or CBOs should conduct periodically surveys to determine if the carrying capacity is being exceeded.

Impact: Solid Waste Generation and Disposal

It is anticipated that approximately 2.5 tonnes (2,508 kg) of waste will be generated/day during the operation of the proposed development. The operation of the development has the potential of significantly increasing the solid waste at the site.

Mitigation:

- i. Provision of solid waste storage bins and skips.
- ii. Provision of adequately designed bins and skips to prevent access by vermin.
- iii. Monitor beach garbage.
- iv. Contracting a private contractor to collect solid waste in a timely fashion to prevent a build up.
- v. Ensure that the solid waste collected is disposal in an approved dumpsite such as the Retirement dump in St. James.

Impact: Water Supply and Consumption

The analysis of the data supplied indicates that a hotel of the size and composition of the proposed hotel can be expected to consume approximately 382,200 LPD. However, the proposed conservation measures are expected to reduce this amount to approximately 276,533 LPD or approximately 27.6% less than the customary amount. In addition, the available amount of water is 7,280,000 LPD.

The proposed conservation measures are expected to have a significant beneficial impact on the reduction of the customary water consumption of such hotels. In addition, it can be reasonably concluded that the hotel is not expected to place any operational burden on the treatment plant.

Mitigation:

In addition to design and infrastructural measures for the reduction of water consumption, hotels also have to put operational measures in place to manage the use of this resource. Summarized is a list of recommended operational strategies for the reduction of water consumption.

Recommended Operational Checklist for Water Conservation

Areas	Strategies
Housekeeping	<ul style="list-style-type: none">• Do not leave the tap running while cleaning, using buckets for holding water instead• Make sure that all faucets do not leak and are in good repair• Report immediately any leaking or dripping faucet or toilet• Give guests the option of changing linen and towels every two or three days• Use only the minimum required amount of detergent in the laundry• Reuse rinse-water in the first cycle of washing of the next load• Separate the laundry's hot-water system from the guest room hotel-water system if possible• Hotel guests can be given politely written cards as to how to conserve water in their bathrooms, for example to, shut off water during tooth brushing, shaving, and other unnecessary period• Keep utility bills to track the consumption of water• Purchase and use water-saving equipment always• Establish an effective employee training program about water conservation
Restaurant and Beverage	<ul style="list-style-type: none">• Do not leave faucets running• Wash food products in buckets, bowls or containers• Use dishwasher with sufficient loads

Areas	Strategies
	<ul style="list-style-type: none"> • Make regular inspections of dishwasher pumps for water leakage • Do not use water to defrost or thaw frozen food products, defrost in refrigerator • Report immediately any leaking and dripping faucet • Install infrared-activated faucets and toilets in restaurant rest rooms • Track the consumption of water by regular monitoring utility bills • Establish an effective employee training program about water conservation
Maintenance and Recreational	<ul style="list-style-type: none"> • Recover waste pool water for reuse • Make regular inspections of circulating pumps for water leakage • Report immediately any pool or faucet leakage • Purchase and use water-saving pool equipment • Track the consumption of water by regular monitoring utility bills • Establish an effective employee-training program about pool water conservation • Consult pool specialists about effective maintenance of swimming pool

Impact: Wastewater Generation and Disposal

The operation of a hotel generates significant amounts of wastewater from guest and from the operation of laundry and kitchen facilities. Analysis of the data provided indicates that the proposed hotel wastewater can be amply treated in the existing wastewater treatment plant. The estimated flow from the hotel is 248,880 LPD, were as the treatment plant has the capacity to take an additional 6,825,000 LPD. Wastewater treatment is therefore not expected to be an issue.

Grease

There are concerns about excess grease reaching the Negril Wastewater Treatment Plant. The proposed hotel has incorporated a grease trap in their design. The grease trap has a retention time of 7.26 hours, whilst the required (according to NWC) is 5.0 hours. It can therefore be concluded that the design meets and exceeds the NWC guidelines and it is expected to provide sufficient treatment. Grease and its potential adverse effect on the performance of the waste stabilization ponds is therefore not expected to be an issue.

Solid Waste Compactor Effluent

Hotels very often employ a solid waste compactor for minimizing the volumetric requirements of the solid waste that is generated and the required pick up interval. The solid waste that is usually emptied in these compactors consists of all kitchen wastes, except cardboard (which is usually recycled), yard trimmings and office waste. The kitchen waste usually generates a significant effluent stream after the activation of the compaction action. The waste stream is known to have a very strong effluent with BOD in excess of 20,000 to 50,000 mg/l. Because of the relatively small flow, it is usually poorly handled and allowed to flow either into the sewers or into the landscape.

There are no designs for the handling of this compactor effluent. However, the need for proper consideration has been discussed with the project's architect (Ms. Isiaa Madden). The project architect has agreed in principle and has expressed her intention to forward this information to the project's engineers.

Mitigation:

- i. Recycle grey water (water from showers and sinks) for irrigation of the hotel grounds.
- ii. Ensure that the strainers within the recycling system are adequately maintained.

- iii. Ensure that the proposed hotel wastewater system is linked to the Negril Sewage System.
- iv. Clean the grease trap periodically to maintain their effectiveness.

Impact: Storm Surge

Storm Surge analysis for the site indicates that water level increases of 2.56 to 3.59 can be expected to occur for storms with Return Periods between 10 to 100 Years. These levels are well above the 1.0 m contour on the existing topographic survey and no floor levels were provided for the proposed buildings.

It is therefore reasonable to conclude that depending on the mitigation strategy adopted that significant landfilling or significant elevation of the proposed buildings will have to be carried out in order to prevent total inundation of the hotel.

Mitigation:

Two mitigations options can be employed for minimizing the likelihood of loss of life and damage to property from storm surge. These are as follows:

- i. **No Loss and No Damage Option:** This option requires that all the buildings are elevated above the storm surge associated with the desired return period. The overall objective is to limit the amount of wetting of floor space. This option does however have its disadvantages. These include potentially excessive costs for landfilling and potential aesthetic issues with the landscape.
- ii. **Selective Elevation:** This option requires that infrastructure of critical importance (such as administration and expensive equipment) and selective infrastructure such as the 1st floor and higher on the hotel blocks are elevated

above a certain critical storm surge level. The overall strategy being to safeguard the operation of the hotel and to provide potential shelter for visitors that may be resident at the hotel on higher levels. This strategy has the attractive advantages of providing for the disaster management need for shelter as well as minimizing the cost for landfilling.

Impact: Beach Erosion

The erosion analysis indicates that the site could experience an erosion loss of up to 25m of shoreline on the western end of the property. Fortunately, there are no plans for placing significant infrastructure in this zone. This erosion loss could hinder the operations of the hotel as far as guest satisfaction is concerned given the lack of beach space alternatives on this site.

Mitigation:

Storm event erosion can be mitigated or minimized by;

- i. Should beach nourishment be desirable, then similar sized or coarser sand should be used for beach nourishment.
- ii. Should the owner decide that the potential erosion losses are unacceptable, as far as operational risks are concerned, then coastal engineering options (such as submerged breakwaters and artificial sand dunes) could be considered. Such options, if carefully thought out, could provide the required protection against erosion while blending with the natural surroundings.
- iii. Preservation of sea grass beds that help to anchor the seabed.

It should be noted that further detailed design conditions will be required to employ any of the aforementioned options.

Impact: Transportation/Traffic

The operation of a hotel requires that delivery trucks and traffic generated from activities of guest is inevitable. This has the potential of directly disrupting the flow of traffic along the Norman Manley Boulevard.

Mitigation:

- i. Design the access road so that one can see clearly in both directions along Norman Manley Boulevard on exiting the development.
- ii. Negotiate with the traffic and local authorities for the widening of the main road to include a turning lane.
- iii. Add adequate and appropriate signs along the roadway in proximity to the proposed site.
- iv. Limit delivery trucks to off-peak periods to minimise traffic hindrance and delay.

Impact: Emergency Response

The operation of the proposed hotel will involve workers and guests, who may become ill or have accidents. In addition, disasters such as earthquakes, floods and fires are real possibilities.

Mitigation:

- i. Have first aid kits located in various sections of the hotel.
- ii. Make prior arrangements with health care facilities such as the Negril Health Center or the Lucea hospital to accommodate any eventualities.

- iii. Arrange with health practitioners to be on call or have an in house physician/nurse.
- iv. Design and implement an emergency response plan.
- v. Staff should be trained in CPR.
- vi. Coordinate with mutual aid organisations/agencies such as with the local fire brigade.

Impact: Water Pollution

There is no surface water source on the site to be polluted by activities at the site. The groundwater below the site is saline and cannot be used in its present state without treatment. There will be no subsurface disposal of effluent at the site and therefore the risk of groundwater contamination is negligible. The disposal of storm water into absorption pits could pose a threat to groundwater. Given that the groundwater below the site is of marginal quality, the risk is moderate to low.

Mitigation

- i. There should be no direct disposal of effluent or storm water into the sea from the site and therefore the risk of coastal pollution from effluent disposal is negligible.