Marine Survey

for

Bahia Hotel
Pear Tree Bottom, St. Ann

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Table of contents

1.0 Background

The Pear Tree Bottom property is located in St. Ann, west of Runaway Bay and east of Discovery Bay. The property is 1.4 km long and 0.5 km wide, with approximately 1 km of coastline. The majority of the coastal section of the property is undeveloped, with a few villas and work sheds located on the site. Two rivers enter the sea in the western bay of the property, namely Pear Tree River and Little Pear Tree River.

The western side of the property coastline is divided into two bays, the western bay into which the two rivers flow, and the eastern bay which is Pear Tree Bay. The latter is used as the main swimming beach on the property. The eastern side of the coast is less sheltered and often exposed to high wave action. Two groynes have been constructed, the western one being 'I'-shaped and the eastern one 'T'-shaped. A small cove is formed between these two groynes, and another to the east of the 'T' groyne.

The marine environment along the property coastline has previously been assessed on more than one occasion. The present study serves to update the most recent surveys, which were conducted in 1993 and 1997.

2.0 Methodology

The marine environment was investigated at six sites along the coastline of the Pear Tree Bottom property. The investigation was carried out by SCUBA diving and snorkeling to determine the status of the marine community that exists there, and to evaluate the vulnerability of the environment to any adverse impacts from the development of the property.

A qualitative assessment of each site was conducted to provide a species list and an abundance (DAFOR) rating for each species. The DAFOR is a subjective rating which provides an indication of whether an organism is Dominant, Abundant, Frequent, Occasional or Rare in the environment.

Estimates of overall percent cover of various benthic organisms and descriptions of general features of the site are provided. Quantitative data on coral species and size were collected using 10 m-long transects, and data on percent cover of benthic types were collected using 0.25 m^2 quadrats.

3.0 Site descriptions

3.1 Site 1

This site is located in the shallow western bay where the Pear Tree and Little Pear Tree Rivers enter the sea (See Plate 1). This bay is very shallow, with extensive areas being exposed periodically. This site was inspected on two consecutive days; on the first day large areas of the substrate were exposed so that it was possible to walk on dry ground from the shore approximately 7 m into the bay. On the second day, much of this area was submerged with only 'islands' of emergent substrate visible. Depth ranges from 0 to 1.5 m in this bay, with the deeper areas found along the course of Little Pear Tree river, which enters on the eastern side of the bay and curves around the shore towards Pear Tree Bay.

The substrate is sandy and silt-like with numerous stones and some coral rubble present. It is also rather soft and muddy in areas closer to the river mouths. It is fine-grained and easily suspended. The substrate is mainly covered in seagrass, *Halodule wrightii*, both in the submerged and emergent areas. The blades are particularly short and sparse in the emergent regions. These shallow areas occupy most of the bay, extending seaward out to the reef crest, eastward into Pear Tree Bay, and westward in front of the Pear Tree River mouth and the adjoining red mangrove stands.

Fauna is sparse in this area due to the periodic exposure and desiccation. In the exposed areas, the only animal seen was a small fish which seems to be able to wriggle or dive into the sediment in very shallow puddles and muddy substrate. These fish are not more than 4 cm long and are quite numerous. The substrate is dotted with many small holes into which these fish retreat.

The submerged areas of this bay are also relatively poor in fauna due to the lower salinity and fluctuations in water level. A juvenile Great barracuda was seen in this area as well as damselfish and a few unidentified small fish. No live corals were observed although bits of rubble were present in the bay and all along the shore. Small quantities of algae were present amongst the seagrass, particularly red algae, brown and green fleshy algae and the calcareous green alga *Halimeda sp*. Large areas of the substrate were bare or comprised of silt-covered stones.

3.2 Site 2

This site is located in Pear Tree Bay, where the main swimming beach is found. This bay is mainly sandy with large areas covered in turtle grass, *Thalassia testudinum*. An emergent reef crest is present at the entrance to the bay. The bay ranges in depth from a few centimeters close to shore to 2.7 m close to the reef crest. The sediment is fine grained sand which is easily suspended. In some areas it appears silt-like. Freshwater enters this bay from the Little Pear Tree River in the western bay (site 1).

The turtle grass beds are quite dense in the shallower areas and become sparser up to the reef crest. The blades are covered in large quantities of encrusting epibiota. This suggests that the area may be exposed to elevated nutrient levels, possibly from the rivers which enter the western bay. At the western side of this bay closer to shore, the *Thalassia sp.* beds merge with a small bed of *Syringodium filiforme*. This then transitions into a sandy zone up to the shore.

The flora of the seagrass beds includes a number of calcareous green algae such as *Penicillus sp., Udotea sp., Avrainvillea sp., Halimeda sp.* and *Acetabularia sp.* which were dispersed amongst the *Thalassia* blades. The fauna of the bay includes urchins, particularly *Tripneustes ventricosus*, which were numerous in the seagrass beds. Sea cucumbers were also present, but few in number. Fish were few in this bay with almost all being juveniles. Species seen include Balloonfish, Bluehead wrasses, Spotted goatfish, Gray snapper, Harlequin bass, Bucktooth and Bluelip parrotfish, Sharksucker and Houndfish. Occasional small coral heads were seen with one colony undergoing bleaching.

The sandy zones closer to the reef crest and in the back reef were partially covered in coral rubble. Fauna in this area is sparse, and fleshy brown algae are the common type of flora present. This mainly bare, rubbly area continued to the outside of the reef crest, where coral colonies began to occur more regularly, with large (> 1 m) *Siderastrea sp*. colonies being observed. The fleshy brown alga *Dictyota sp.* was also common in this area. Fish became more numerous, and *Diadema sp*. began to occur. In the back reef, the substrate was sandy with large algae-covered rocks. The percent cover of different benthic types in the back reef area just west of the 'Salt Coppers' could be described as: macroalgae 80% cover, coral 5%, gorgonian 3% and sand 12%.

3.3 Site 3

This site is on the fore reef outside of Pear Tree Bay. The depth continues to increase from Site 2 to Site 3, and ranges from 4.5 to 12 m in depth on the fore reef. The reef structure takes on the characteristic spur and groove formation on the fore reef with the grooves covered in fairly coarse grained sand. Live scleractinian coral cover ranged from 15 to 25% on the fore reef, which is quite high compared to other north coast reefs. Commonly occurring species include *Montastraea annularis, Siderastrea siderea, Diploria strigosa, Porites astreoides, Agaricia agaricites* and *Millepora complanata*. Colonies ranged in size from 10 to 40 cm in diameter, with 25 cm being the average size. Larger colonies (> 1m) were also observed. Coral recruits (colonies < 10 cm in diameter) were numerous, at densities of approximately 10 m^{-2}. They were mainly of *Agaricia agaricites* and *Siderastrea siderea*.

Gorgonians (soft corals) were frequently observed on the fore reef. Four species were common while two others occurred infrequently. Approximately 5% of the fore reef substrate was covered by gorgonians. Other cnidarians at the site include zoanthids, Giant anemones, and Sun anemones. These were seen in isolated clumps. Sponges were present at the site but were not very numerous. They covered approximately 2% of the substrate.

Seven species were found, six of which were seen occasionally throughout the site and one which was seen only once. Special mention should be made of the Variable boring sponge which was present in small numbers, as this sponge bores into corals, eroding and weakening reef structure.

Urchins were quite common on the fore reef with *Diadema sp*. being the most frequently seen species. *Echinometra viridis* and *E. lucunter* were also present at lower densities. Three species of worm were observed on the reef, namely Fireworms, Spaghetti worms and Social feather dusters. These were also present in small numbers.

Macroalgal growth is not very extensive on the fore reef, covering approximately 10% of the substrate. The major type found was fleshy brown algae such as *Sargassum sp., Dictyota sp.* and *Turbinaria sp*. These plants were quite short, often less than 5 cm tall on average. This indicates that grazing pressure by urchins and herbivorous fish is sufficient to prevent algal overgrowth. The low levels of fleshy macroalgae and higher levels of crustose coralline algae indicate that the reef is relatively healthy, as there is potential for settlement and growth of corals.

The fish community on the fore reef was quite diverse, with at least 36 species observed. The community is dominated by scarids (parrotfish), acanthurids (surgeonfish), labrids (wrasses), pomacentrids (damselfish) and holocentrids (squirrelfish). Fish were generally larger at this site, at 15 to 25 cm in length, with both adult and juvenile fish observed. However, no terminal phase (mature) parrotfish were seen. A number of fish which are less common were seen at this site. These include the Lane snapper, Mutton snapper, Schoolmaster, Yellowtail hamlet, Tobaccofish, Puddingwife, Reef squirrelfish, Longjaw squirrelfish, Sand tilefish and Spotted Eagle ray.

3.4 Site 4

This site is located in the small bay where the 'Salt Coppers' are situated, just west of the 'I'-shaped groyne. The depth is less than 3 m adjacent to the seaward end of the groyne, and increases to 4.5 m in front of the villas. The substrate is mainly pavement at the eastern side, with fleshy brown algae covering approximately 50% of the substrate. Moving westward, the substrate becomes more sandy with scattered small coral heads and large quantities of coral rubble. Pockets of broken conch and clam shells were also present. The water was rough and turbid in this area, with a strong westerly-flowing current. Fish were few, but became more numerous in the deeper areas in front of the villas. Mainly surgeonfish and squirrelfish were seen, at approximately 20 cm in length. Large coral heads greater than 1 m in diameter were observed, sometimes with clumps of *Diadema sp*. on or around the coral head.

3.5 Site 5

This site is located in the small cove formed between the two groynes (i.e. on the western side of the 'T' groyne). Depth ranges from a few centimeters deep close to shore to 2 m at the seaward end of the groynes. The sediment is very fine-grained and silt-like, and is

easily suspended making the bay quite turbid. Towards the end of the 'T' groyne, the substrate becomes pavement rather than sand.

From the shore, the biota is mainly macroalgae scattered on the sandy floor. The common types seen include *Padina jamaicensis., Sargassum sp., Penicillus dumetosus., Chaetomorpha linum, Halimeda incrassata, Halimeda tuna* and *Ventricaria ventricosa*. The algal beds transition into seagrass beds with a narrow zone of *Syringodium filiforme* towards the shore followed by *Thalassia testudinum* which makes up the rest of the bed. The seagrass blades are almost entirely covered in silt-like particles, indicative of the high levels of sedimentation in this cove. *Tripneustes sp*. is fairly common amongst the seagrass blades, as well as juvenile fish. These were mainly surgeonfish and parrotfish.

A few isolated coral heads and patch reefs are present in this cove with *Porites astreoides* being the most commonly seen species. These reef structures are quite shallow, some almost breaking the surface of the water. In addition to corals, these structures are also covered in brown algae and small quantities of reef cement. Occasional coral recruits are present, mainly of *Siderastrea sp*. Moving to the outer bounds of the cove, the seagrass beds mostly disappear and mainly patch reef structures are found. On these reef structures there are small coral heads, mainly *Diploria strigosa, D. clivosa* and *Porites astreoides*, which do not exceed 5% cover. Coral recruits are numerous on the reef and pavement substrate, at densities of up to 13 m^{-2}. *Diadema sp*., Giant anemones, and damselfish and their gardens are also present. A few individuals of the Sun anemone and an unidentified crab were seen around the reef. Fish remained scarce and were mainly juveniles as described above. Sponges and sea fans were seen infrequently in this area.

3.6 Site 6

This site is located on the northern side of the 'T' groyne. The patch reefs described at Site 5 merge with a large reef structure on the northern and eastern sides of the 'T' groyne. There is an emergent reef crest along the northern side of the groyne. Between the reef crest and the groyne, the water is quite shallow, at approximately 1 m. This area is comprised of shallow reef flats with sandy grooves in between the patches of reef. The reef flats are dominated by brown and red fleshy macroalgae, and are very shallow, just below the water's surface in many areas. There is a strong westerly current in this back reef area. A few pockets of sparse *Thalassia sp*. blades were seen in the sandy areas. Few fish were observed. Outside the reef crest seemed to be quite rough, with waves approaching the coast obliquely and breaking over the crest.

3.7 Site 7

This site is the small cove formed by the eastern arm of the 'T' groyne. It is very shallow and dominated by dense *Thalassia sp*. beds, with the blades found just below the water's surface. Close to the shore on the western and southern sides of the cove there are a few patches of sand, but the substrate is otherwise entirely covered by turtle grass. It is possible that this dense seagrass meadow serves as a nursery habitat or refuge area for fish, crustaceans, urchins and other organisms. This however, could not be verified due to

the shallow nature of the cove and the unfavorable weather conditions. Waves approach the shore obliquely and break over the shallow reef crest at the entrance to the cove. This results in constant rapid water flow into the cove, which despite baffling by the seagrass, may be unfavorable for juvenile fish and other immature species.

Table 1. Species list and abundance rating of flora and fauna observed at all sites at Pear Tree Bottom.

Common names	Scientific name	DAFOR
Fish		**47 species**
Stoplight parrotfish	*Sparisoma viride*	F
Striped parrotfish	*Scarus iserti*	F
Bucktooth parrotfish	*Sparisoma radians*	O
Bluelip parrotfish	*Cryptotomus roseus*	O
Blue tang	*Acanthurus coeruleus*	F
Ocean surgeonfish	*Acanthurus bahianus*	F
French grunt	*Haemulon flavolineatum*	F
Yellowtail snapper	*Ocyurus chrysurus*	F
Lane snapper	*Lutjanus synagris*	O
Mutton snapper	*Lutjanus analis*	O
Gray snapper	*Lutjanus griseus*	R
Schoolmaster	*Lutjanus apodus*	R
Hogfish	*Lachnolaimus maximus*	R
Spanish hogfish	*Bodianus rufus*	O
Spotted goatfish	*Pseudupeneus maculatus*	O
Graysby	*Epinephelus cruentatus*	O
Bar jack	*Caranx ruber*	O
Indigo hamlet	*Hypoplectrus indigo*	O
Butter hamlet	*Hypoplectrus unicolor*	O
Yellowtail hamlet	*Hypoplectrus chlorurus*	R
Tobaccofish	*Serranus tabacarius*	O
Houndfish	*Tylosurus crocodilus*	O
Mojarra	*Eucinostomus sp.*	O
Great barracuda	*Sphyraena barracuda*	R
Blue chromis	*Chromis cyanea*	A
Brown chromis	*Chromis multilineata*	F
Sergeant major	*Abudefduf saxatilis*	F
Yellowtail damselfish	*Microspathodon chrysurus*	F
Dusky damselfish	*Stegastes adustus*	F
Cocoa damselfish	*Stegastes variabilis*	O
Threespot damselfish	*Stegastes planifrons*	O
Puddingwife	*Halichoeres radiatus*	R
Squirrelfish	*Holocentrus ascensionis*	F
Reef squirrelfish	*Holocentrus coruscus*	O

Longjaw squirrelfish	*Holocentrus marianus*	O
Blackbar soldierfish	*Myripristis jacobus*	O
Bluehead wrasse	*Thalassoma bifasciatum*	F
Yellowhead wrasse	*Halichoeres garnoti*	F
Cleaning goby	*Gobiosoma genie*	F
Rock beauty	*Holacanthus tricolor*	O
Harlequin bass	*Serranus tigrinus*	O
Fairy basslet	*Gramma loreto*	O
Sand diver	*Synodus intermedius*	O
Sand tilefish	*Malacanthus plumieri*	R
Balloonfish	*Diodon holocanthus*	R
Sharksucker	*Echeneis naucrates*	R
Spotted eagle ray	*Aetobatus narinari*	R
Scleractinian (stony) corals		**25 species**
Lesser starlet coral	*Siderastrea radians*	O
Massive starlet coral	*Siderastrea siderea*	F
Lettuce coral	*Agaricia agaricites*	F
Lobed star coral	*Montastraea annularis*	F
Great star coral	*Montastraea cavernosa*	O
Boulder star coral	*Montastraea franksi*	O
Rough star coral	*Isophyllastrea rigida*	O
Blushing star coral	*Stephanocoenia intersepts*	O
Symmetrical brain coral	*Diploria strigosa*	F
Grooved brain coral	*Diploria labyrinthiformis*	O
Knobby brain coral	*Diploria clivosa*	O
Boulder brain coral	*Colpophyllia natans*	O
Maze coral	*Meandrina meandrites*	O
Mustard hill coral	*Porites astreoides*	F
Finger coral	*Porites porites*	O
Golfball coral	*Favia fragum*	O
Yellow pencil coral	*Madracis mirabilis*	O
Smooth flower coral	*Eusmilia fastigiata*	O
Spiny flower coral	*Mussa angulosa*	R
Elkhorn coral	*Acropora palmata*	R
Staghorn coral	*Acropora cervicornis*	R
Pillar coral	*Dendrogyra cylindrus*	R
Artichoke coral	*Scolymia cubensis*	R
Blade fire coral	*Millepora complanata*	F
Branching fire coral	*Millepora alcicornis*	F
Gorgonian (soft) corals		**6 species**
Corky sea finger	*Briareum asbestinum*	F
Porous sea rod	*Pseudoplexaura sp.*	F
Bent sea rod	*Plexaura flexuosa*	F

Common sea fan	*Gorgonia ventalina*	F
Black sea rod	*Plexaura homomalla*	O
Bipinnate sea plume	*Pseudopterogorgia bipinnata*	R
Other cnidarians		**4 species**
White encrusting zoanthid	*Palythoa caribaeorum*	O
Mat zoanthid	*Zoanthus pulchellus*	O
Giant anemone	*Condylactis gigantea*	O
Sun anemone	*Stichodactyla helianthus*	R
Sponges		**7 species**
Loggerhead sponge	*Spheciospongia vesparium*	O
Red-orange encrusting sponge	*Diplastrella megastellata*	O
Brown variable sponge	*Anthosigmella varians*	O
Variable boring sponge	*Siphonodictyon coralliphagum*	O
Scattered pore rope sponge	*Aplysina fulva*	O
Orange elephant ear sponge	*Agelas clathrodes*	O
Branching vase sponge	*Callyspongia vaginalis*	R
Echinoderms		**7 species**
West Indian sea egg	*Tripneustes ventricosus*	A
Long-spined urchin	*Diadema antillarum*	F
Variegated urchin	*Lytechinus variegatus*	F
Reef urchin	*Echinometra viridis*	O
Rock-boring urchin	*Echinometra lucunter*	O
Donkey dung sea cucumber	*Holothuria mexicana*	O
Slender sea cucumber	*Holothuria impatiens*	R
Worms		**3 species**
Spaghetti worm	*Eupolymnia crassicornis*	O
Social feather duster	*Bispira brunnea*	O
Fireworm	*Hermodice carunculata*	O
Green algae		**11 species**
Paddle blade alga	*Avrainvillea longicaulis*	F
Mermaid's fans	*Udotea sp.*	F
Bristle ball brush	*Penicillus dumetosus*	F
Watercress alga	*Halimeda opuntia.*	F
Stalked lettuce leaf alga	*Halimeda tuna*	O
Large leaf watercress alga	*Halimeda discoidea*	O
Three finger leaf alga	*Halimeda incrassata*	O
Mermaid's wine glass	*Acetabularia sp.*	O
Sea pearl	*Ventricaria ventricosa*	O
Chaetomorpha	*Chaetomorpha linum*	O
Cactus tree alga	*Caulerpa cupressoides*	O

Brown algae		**6 species**
Sargassum	*Sargassum sp.*	A
Saucer leaf alga	*Turbinaria tricostata*	F
Encrusting fan-leaf alga	*Lobophora variegata*	F
Y-branched algae	*Dictyota cervicornis*	F
Leafy flat-blade alga	*Stypopodium zonale*	F
White scroll alga	*Padina jamaicensis*	F
Red algae		**2 species**
Reef cement	*Porolithon pachydermum*	F
Burgundy crust algae	*Peyssonnelia sp.*	F
Seagrass		**3 species**
Turtle grass	*Thalassia testudinum*	A
Eel grass	*Halodule wrightii*	A
Manatee grass	*Syringodium filiforme*	F
Total number of species		**121 species**

Table 2. Data collected on size and position of scleractinian corals along a 10 m transect laid on the fore reef at Site 2.

Species	Diameter/cm	Height/cm
Agaricia agaricites	40	5
Agaricia agaricites	20	10
Montastraea cavernosa	10	5
Agaricia agaricites	20	10
Agaricia agaricites	25	10
Stephanocoenia intersepts	15	7
Agaricia agaricites	5	25
Montastraea cavernosa	35	20
Stephanocoenia intersepts	15	10
Montastraea franksi	40	50
Siderastrea siderea	40	10
Agaricia agaricites	20	20
Porites astreoides	40	5
Average	**25**	**14**

Table 3. Quadrat data collected at two locations at Site 4 describing the composition of the benthos by percent cover.

Benthic type	Percent cover
Quadrat 1 – laid close to the shore west of the 'T' groyne	
Thalassia sp.	5
Calcareous macroalgae	15
Fleshy macroalgae	65
Sand	15
Quadrat 2 – laid close to the seaward end of the 'I' groyne on the eastern side	
Coral	10
Calcareous macroalgae	5
Fleshy macroalgae	25
Sand	60

4.0 Impacts and Mitigations

A number of impacts related to development of the Pear Tree Bottom property may affect the marine environment. These include habitat destruction, sedimentation and contamination. These will be discussed in further detail.

The significant habitats found at the study sites include the extensive seagrass beds and coral reefs. Both of these habitats are known to host diverse species of flora and fauna, and act as nursery and refuge areas for juvenile and mature organisms. Coral reefs also protect the shore and lagoon areas from wave action and subsequent erosion. Seagrass beds, particularly of *Thalassia sp*., are known to aid in sediment consolidation and deposition from the water column.

Seagrass removal may be proposed during development of the Pear Tree Bottom property to extend the swimming areas around the beaches. Although the fauna observed in the *Thalassia sp*. beds was not abundant, one should take into consideration the benefits of turtle grass beds with regards to sediment stability. The very shallow *Halodule sp*. beds in the western bay do not host a particularly rich or diverse community due to the harsh conditions such as changes in salinity and fluctuating water levels resulting in frequent exposure. It does not appear be an effective nursery habitat, so direct impacts to the ecosystem by removal of these shallow or emergent beds may not be particularly severe. These extensive beds do, however, seem to provide protection to the fore reef from changes in salinity, nutrient and contaminant levels which are introduced by the rivers. The shallow and emergent beds channel the freshwater eastward along the inside of the reef crest and into Pear Tree Bay, where it can then move seaward over the fore reef. By this time, however, it has undergone significant mixing and dilution so that the fore reef

is not subjected to direct freshwater exposure. This is advantageous as corals are known to experience bleaching and sometimes death when exposed to low salinity.

The coral reefs are not very extensive in the near-shore region, but the fore reef is significant along this section of the coast. The fore reef is in relatively good condition compared to other reefs on the north coast of Jamaica. This area is also known to have a number of tunnels and caves on the deeper parts of the fore reef (i.e. 24 m and greater). These caves supposedly host unique fauna which are typically found in much deeper water. This is an important feature of the site and every effort should be made to conserve it. The major threat to the coral reefs is indirect, in the form of sedimentation and contamination.

Construction and operation of the proposed development may result in large quantities of sediments being washed into the sea and subsequently deposited on the reef. This can be detrimental to the reef-building corals as they are effectively smothered by high levels of sediments. All construction and waste materials should be carefully contained to reduce quantities washed into the sea by rainfall and run-off water. In the operational phase of the development, proper drainage mechanisms should also be put in place to further reduce run-off levels to the sea.

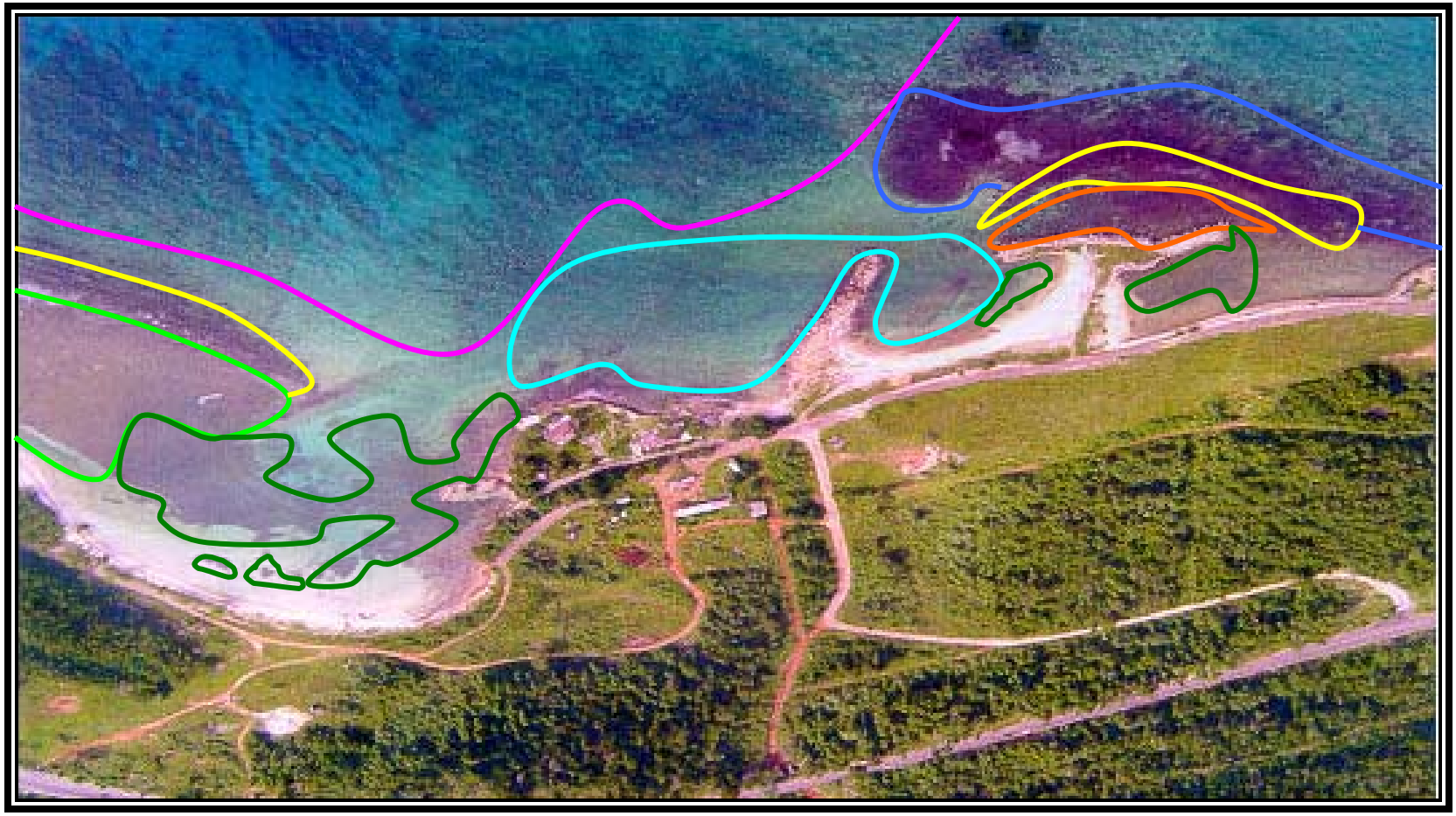
Besides sediments, run-off water may also contain contaminants that are hazardous to the marine environment. These include oils, fuel, paint, solvents and other substances used during construction and maintenance of the hotels and associated facilities. These substances should be properly stored and monitored to prevent spillage. Another contaminant is sewage, which should be properly treated and disposed of. Use of treated effluent as irrigation water is desirable, rather than disposal into the sea.

As the coral reefs at this site are in relatively good condition and host diverse and unique biota, efforts should be made to monitor the status of the reef and to preserve it. It would also be beneficial to educate staff and guests participating in water sports or SCUBA diving on various hazards to the reefs, such as breaking, touching or removing organisms. This would aid in preservation of this ecosystem.

5.0 Plates

Plate 1. Aerial photograph of a section of the Pear Tree Bottom property showing study sites for the marine survey.

Plate 2. Aerial view of section of the Pear Tree Bottom property showing benthic types at the study sites.



KEY *Halodule* seagrass *Thalassia* seagrass Reef crest Fore reef

Sand flats and patch reefs Algal flats Reef structure

Plate 3. View of Site 1, the western bay, when mostly submerged.
In the background (center) the stands of Red mangrove are visible. Red arrow indicates mouth of the Pear Tree River, and the yellow arrow indicates mouth of the Little Pear Tree River.

Plate 4. Mouth of the Little Pear Tree River at Site 1.

Plate 5. Underwater view of Site 1 showing *Halodule sp.* beds and substrate.

Plate 6. Site 1 showing emergent *Halodule sp.* beds.

Plate 7. View of Site 1 showing extensive areas of emergent seagrass throughout the western bay.

Plate 8. View of Site 1 showing emergent seagrass beds extending around the point into Pear Tree Bay (Site 2). Little Pear Tree River follows the shore closely and enters into Pear Tree Bay (seen in foreground). Waves breaking in background indicate position of reef crest.

Plate 9. Part of reef crest as seen from Site 1.

Plate 10. View of Site 2, Pear Tree Bay, where the main swimming beach is located. Dark areas indicate patchy seagrass (*Thalassia sp*.) beds. The emergent reef crest is visible at the left of the image.

Plate 11. View of a *Thalassia sp*. bed at Site 2.
Brown or grayish areas on the blades are due to encrusting epibiota.

Plate 12. View of the rubbly substrate found shoreward of the reef crest at Site 2.
Brown fleshy algae attached to the rubble are also visible in the image.

Plate 13. View of the back reef zone at Site 2.
Large colonies of *Siderastrea sp*. are visible.

Plate 14. View of the fore reef at Site 3. The hard corals *Porites astreoides* and *Montastraea annularis* are visible, as well as the gorgonian *Plexaura sp*. Note large bare areas and low macroalgal cover.

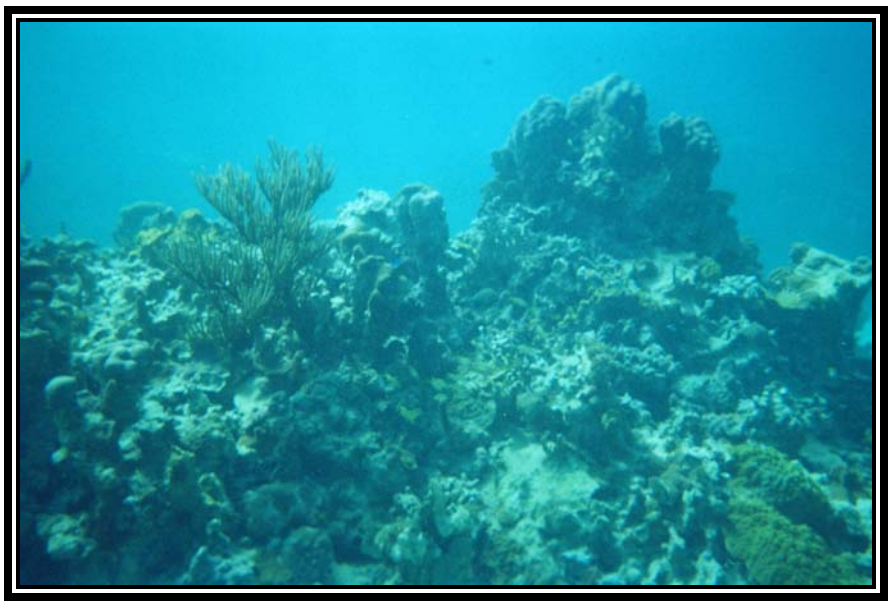


Plate 15. View of fore reef at Site 3. Large colonies of *M. annularis* are visible to the left of the image. Note low macroalgal cover and relatively high coral cover.

Plate 16. View of the fore reef at Site 3. Note large numbers of Blue chromis at top center of image, as well as relatively high coral cover and low macroalgal cover.

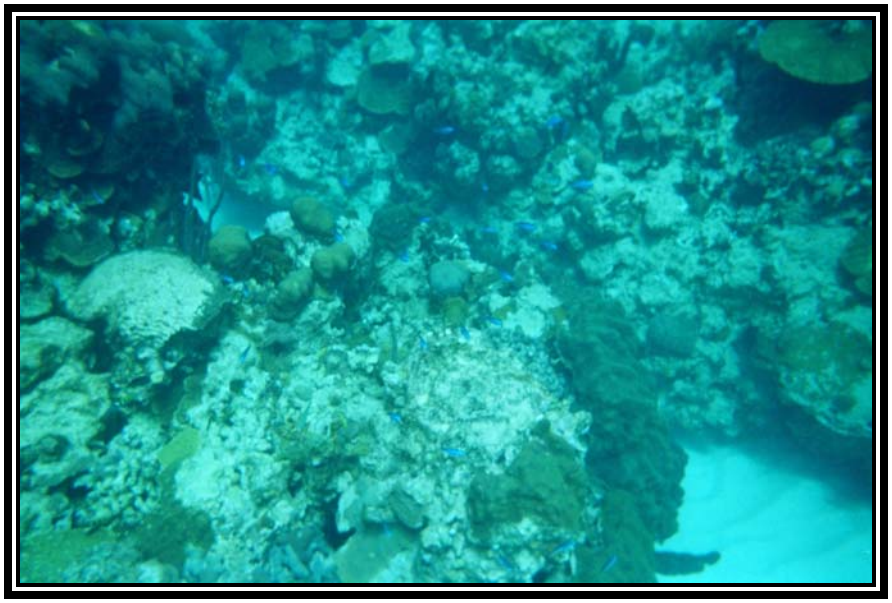


Plate 17. View of fore reef at Site 3. Note Bipinnate sea plume at center of image.

Plate 18. View of back reef area at Site 4. *Diploria sp*. colonies are visible at center.

Plate 19. View of Site 5, small cove flanked by groynes.

Plate 20. View of substrate at Site 5 where data for Quadrat 2 was collected. Note coral recruits circled in red.

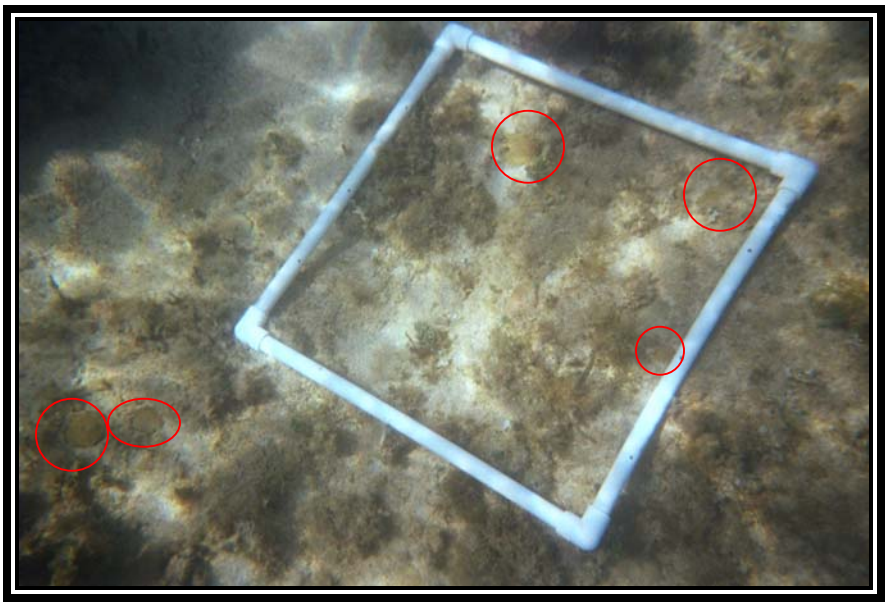


Plate 21. Seagrass (*Thalassia sp.*) bed at Site 5.
Note blades almost entirely covered in sediment.

Plate 22. Sun anemones at left of image; photographed at Site 5.

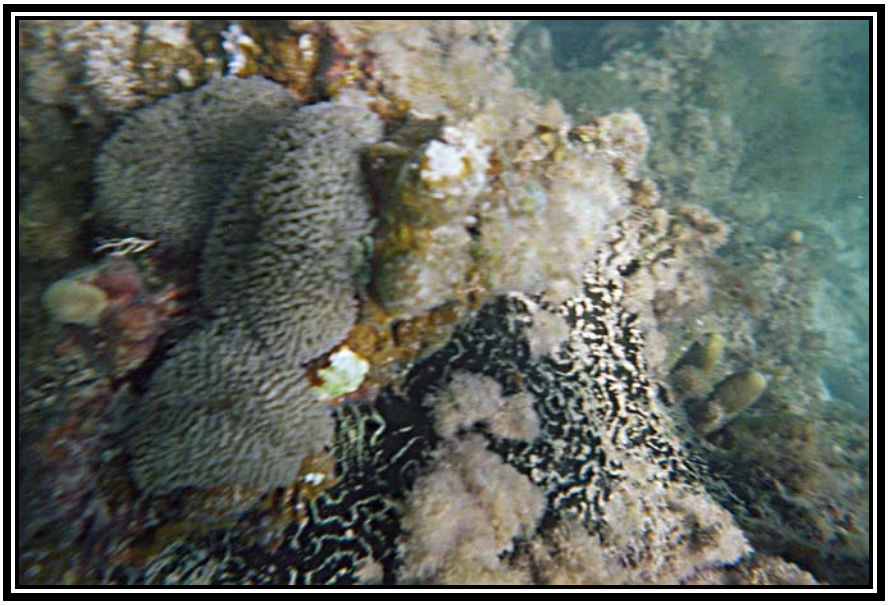


Plate 23. View overlooking Site 6, area north of the 'T' groyne. Note emergent reef crest in the background and strong wave action. Dark areas are algal flats with sandy zones (pale areas) interspersed.

Plate 24. View of Site 7, cove formed by eastern arm of 'T' groyne. Note waves breaking over shallow reef crest in the background. Dark areas are dense beds of *Thalassia sp*.

6.0 References

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