BEEF ISLAND DEVELOPMENT PROJECT
BRITISH VIRGIN ISLANDS

ENVIRONMENTAL SCOPING REPORT AND RESOURCE CHARACTERIZATION

printed in Washington DC for
Smiths Gore Overseas Limited

island resources
F O U N D A T I O N
Tortola, British Virgin Islands
and Washington, DC

November 2005

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Cover Photo Beef Island, British Virgin Islands
(*Little Cay, Hans Creek with Mount Alma in the background*)
photo by Jean Pierre Bacle

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ATM	Applied Technology and Management
BAN	Banana Wharf Pond, Beef Island
BIDP	Beef Island Development Project
BLU	Bluff Bay Pond, Beef Island
BVI	British Virgin Islands
CEN	Central Beef Island Pond
CFD	Conservation and Fisheries Department
CITES	Convention on International Trade in Endangered Species of Wild Flora and Fauna
cy	cubic yards
EIA	Environmental Impact Assessment
HAN	Hans Creek Pond, Beef Island
HLSCC	H. Lavity Stoutt Community College
ICLARM	International Centre for Living Aquatic Resource Management
ICT	Information, Computers and Telecommunications
IRF	Island Resources Foundation
IUCN	The World Conservation Union
LBS	Land-based Sources
NPT	National Parks Trust
OECS	Organisation of Eastern Caribbean States
OTEP	Overseas Territories Environmental Programme (UK)
sf	square feet
SPAW	Protocol Concerning Specially Protected Areas and Wildlife
UK	United Kingdom
USVI	U.S. Virgin Islands
VIL	Trellis Bay Village Pond, Beef Island
WAL	Wall Wetland, Beef Island

BEEF ISLAND DEVELOPMENT PROJECT
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ENVIRONMENTAL SCOPING REPORT AND RESOURCE CHARACTERIZATION

1. INTRODUCTION

Traditional activities associated with Beef Island were the natural outcome of a sheltered, once extremely productive marine environment and the presence of fertile, residual pockets of volcanic-derived soils. While boat building, fishing and cattle raising (which gave the name to Beef Island) activities have declined in recent decades, low-key tourism and commercial activities have flourished, particularly in the Trellis Bay vicinity. The residential density of Beef Island has remained low, and its ecosystems relatively stable, especially in the uplands of Mount Alma. Its beautiful, nearshore attributes are enjoyed by both local residents and visitors.

Although tourism is a major contributor to the Territory's economy, no large-scale, land-based resort development has occurred in recent decades. In this regard, the BVI is an anomaly in the Caribbean context. With the exception of the recent redevelopment and expansion of the Beef Island International Airport, it has been close to forty years since any development approaching the magnitude of the Beef Island Development Project (BIDP) has been proposed for the British Virgin Islands. Two generations ago the Territory did entertain the Wickhams Cay landfills and subsequent commercial developments on Tortola and the substantial resort and airport development proposed in the 1960's for Anegada. The Beef Island International Airport redevelopment project (2000-2003) has been the largest public or private project in the BVI in recent years.

It needs to be noted previous projects led to unforeseen consequences, including significant, unpredicted environmental impacts that occurred with the recent extension of the Beef Island airport. These impacts (upon both terrestrial and marine ecosystems) emphasize the need for careful, upfront preparation and planning, and the utilization of environmental best management practices—at the design, construction and operational phases For these reasons, a series of comprehensive Environmental Impact Assessments (EIAs) are being initiated for the BIDP to outline existing resources, potential impacts and development alternatives/construction practices aimed at avoiding, minimizing, and/or mitigating unavoidable impacts.

1.1. Purpose of Information

This Environmental Scoping Report and Characterization Study identifies major issues and concerns that need to be further addressed during the Environmental Impact Assessment process. In the "Characterization" sections of the report — mostly in Annexes C through G, the report provides a depth of information in certain areas, that goes well beyond the normal requirements of a typical environmental scoping report. In other areas, because of the necessary, ongoing changes during the planning and design process, information regarding several aspects of the BIDP is still under development at this time. These areas will continue to be revisited during preparation of the several Environmental Impact Assessments required for the overall development. Also, it must be noted that the level of significance of any impact category as presented herein may well change as more information and data become available.

1.2. Scoping Methodology/Review Comments

A Scoping Report is an integral part of the environmental impact assessment review process. It allows the identification, framing and early exchange of information between the various stakeholders, and provides a mechanism to focus on the major potential impacts of a development project. For this study, particular attention is paid to the environmental aspects relating to those portions of Beef Island most affected by the Beef Island Development.

This report is *not* to be construed as meeting the requirements of an Environmental Impact Assessment. Rather, it is intended to further define the focus of future EIA submissions. By nature, a scoping report is light on data, and strong on data requirements and priorities for information to be included in the EIA. This report assumes that the Beef Island project will go ahead, and is designed to highlight those areas of the overall development that need extra attention and care in design, construction and operation, and therefore in the examination of those issues in the Environmental Impact Assessment.

Section 6 of this report provides summary guidance on future data requirements and priorities for information to be included in the EIA.

Technical field studies have already been undertaken relating to terrestrial and marine habitats, *some* findings of which are presented in the annexes to this report. This information and additional field research will be needed to predict potential impacts, together with assessing preventive, mitigating and alternative measures.

The intent of the Scoping Document is to outline the EIA process as a whole, describing general project components, highlighting potential impacts to environmental resources, and proposing priority needs for mitigative measures based on these potential impacts.

The Scoping Report will be forwarded to Government as part of the *Development Agreement* package and will form part of the discussions between the Environmental Team Members, as defined in the Development Agreement. This report is the preliminary phase of the detailed environmental assessments. The Scoping Report will be submitted as an information document, without an obligation for Government to approve as part of the Development Agreement. Inherent to the production of this document is the assumption that while authorization to proceed with production of project-related assessments is not being sought, valuable feedback from various Government bodies will be received and incorporated into the future EIA submittals.

1.3. Future Procedures

The EIA process in the BVI has only recently been enacted within the framework of new (October 2004) Physical Planning Act, and detailed guidelines and procedures are still being finalized. Following submission of this Scoping Document, it is anticipated that three Environmental Impact Assessments will be submitted sequenced to match the proposed project construction phasing as discussed in Section 2.1 below. All three EIAs together (Phase 1, Golf Course; Phase 2, Resort Core; and Phase 3, Future Developments) will present a comprehensive summary of the entire project—with each submitted as a stand-alone body of work for Government review and approval.

2. EIA DEVELOPMENT PROCESS

The development team has identified the following steps in the Beef Island Development Project:

2.1. Project Phasing and Specific Environmental Impact Assessments (EIAs)

A project of this magnitude cannot enact all facets of development simultaneously; a phased approach to planning, development and construction is required. Likewise, a single, all-inclusive EIA is not feasible given the phased nature of the project. For this reason, three dedicated EIAs will be submitted at separate times.

A Master Plan (the sketch map for which is included at Figure 4.1-1) is to be approved by the BVI Government as an integral part of the Development Agreement between the Government and Developer. The Master Plan will serve as the base reference for future EIAs.

The scope of each EIA will match the expected construction phasing loosely described as follows.

- **Phase 1 – Golf Course, Club House, and Golf Residential Areas**
- **Phase 2 – Resort Core**
    - ❖ Resort Hotel Island
    - ❖ Marina and Marina Village
    - ❖ Infrastructure / Utilities
- **Phase 3 – Future Developments**
    - ❖ Trellis Bay Commercial Area
    - ❖ Beach Enhancements
    - ❖ Bellamy Cay
    - ❖ Exterior Marina Basin
    - ❖ Residential Development, including fractional housing areas
    - ❖ Beach Club
    - ❖ Staff Housing

Environmental Impact Assessments would therefore be provided covering each of the three main phases above (Phase 1, Golf Course; Phase 2, Resort Core; and Phase 3, Future Developments). EIAs for the Golf Course and the Resort Core are being developed in parallel and it is currently anticipated that the Resort Core EIA will be submitted first, followed by the Golf Course EIA, with the Future Developments EIA to follow later.

2.2. EIA Development

Following are the steps in the EIA development process.

1. **Research and Literature Review**
2. **Field Data Collection**
3. **Environmental Resource Identification and Classification**
4. **Proposed Project Overlay and Potential Impacts Summary**
5. **Alternatives Analysis and Proposed Mitigative Measures**
6. **Conclusions**

The focus of these steps will be framed by the issues and priorities developed originally in this Scoping Report and subsequently refined prior to the submission of the dedicated EIAs for the major phases of the project.

2.3. Public Workshops

Public workshops are scheduled for early to mid December.

3. EXISTING CONDITIONS

3.1. Location

The British Virgin Islands (BVI), located in the northeastern Caribbean Sea (Figure 3.1-1), is a part of the Virgin Islands archipelago that forms a connecting link between the Greater and Lesser Antilles. The islands lie approximately 50 miles east of Puerto Rico and are separated from the neighboring U.S. Virgin Islands to the northeast by a narrow sea channel. The British territory, with a total area of 59 square miles (153 square kilometers), comprises about 50 islands and cays, only 16 of which are inhabited. Tortola, the largest (13,567 acres/5,490 ha), is also the most densely populated and the economic and political centre.

Beef Island, the sixth largest of the British Virgin Islands (at 918 acres/371 ha), is situated immediately to the east of Tortola (Figure 3.1-1). A short, two-lane bridge (Queen Elizabeth II Bridge) separates Tortola from the smaller island. Beef Island is sparsely populated with the majority of its land area undeveloped. The Terrance B. Lettsome International Airport is situated on Beef Island and comprises by far the largest land use on the island to date, occupying some 86.5 acres (35 hectares). Residential communities are concentrated in two small areas, around Little Mountain and Well Bay. A number of small businesses are limited to the Trellis Bay area (Figure 3.1-2).

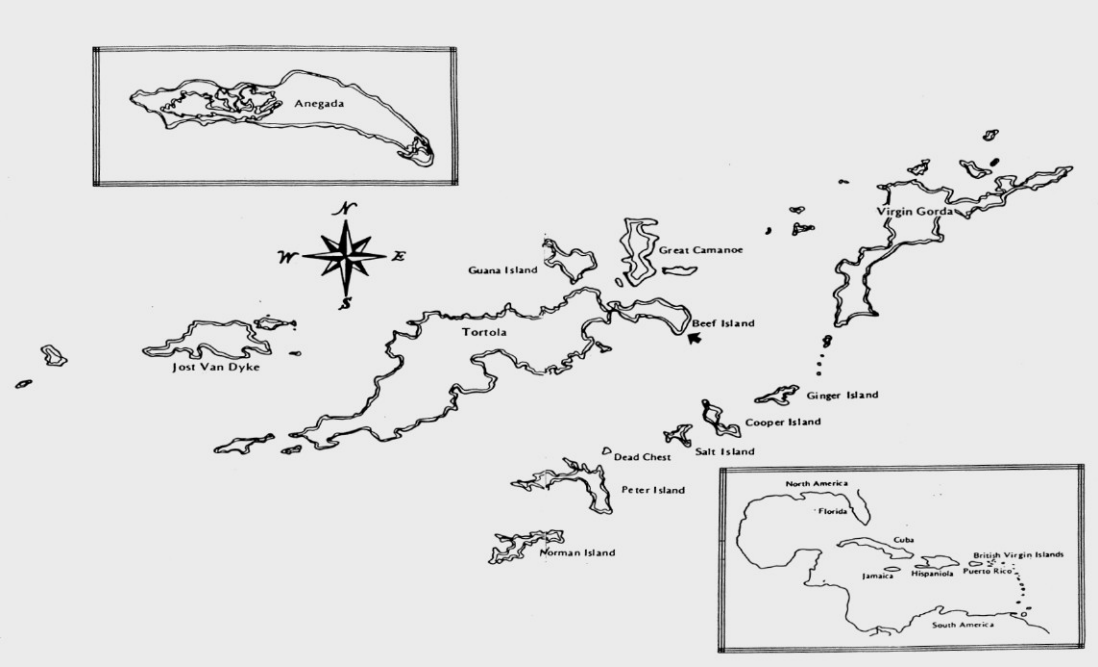

Figure 3.1-1. Locational map of the British Virgin Islands, with Beef Island indicated.

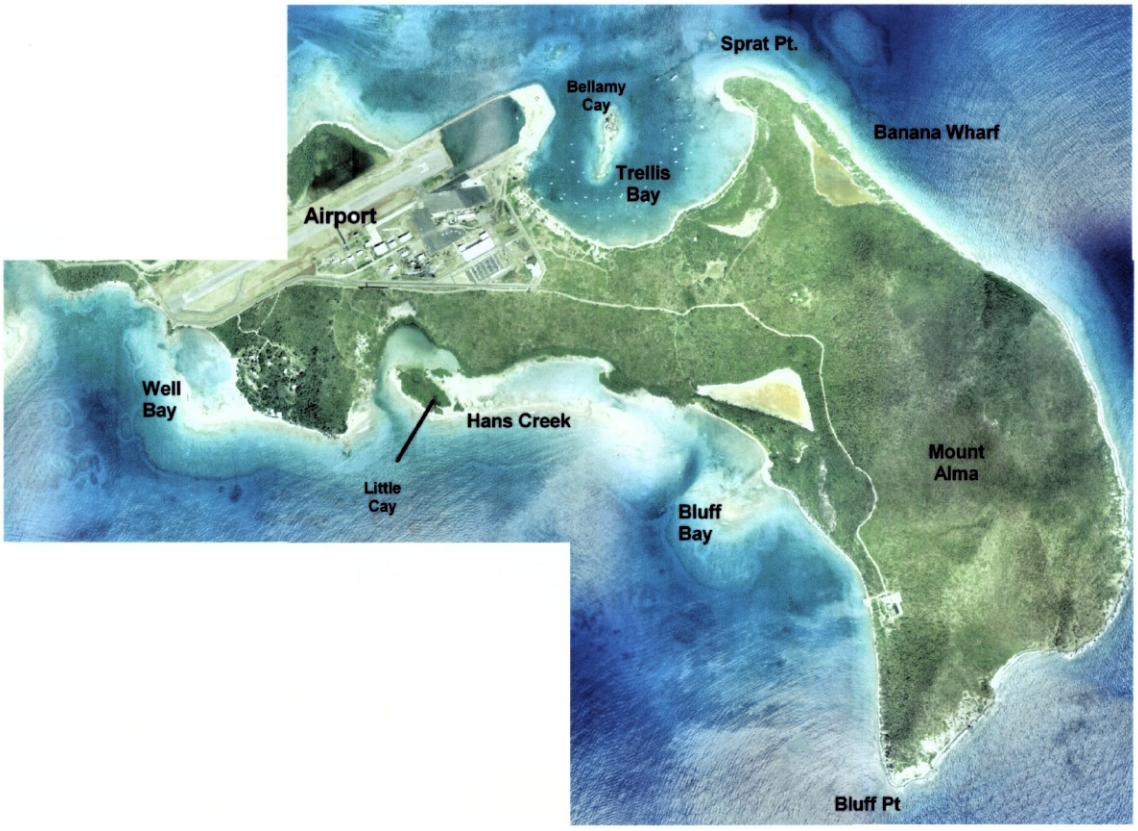

Figure 3.1-2. Location map, Beef Island Features, British Virgin Islands

The 640 acres (~260 ha) of the Beef Island Development Project (BIDP) occupy most of the land south and east of the international airport. The physiography of the project area is varied and includes lowland areas, undulating hills and the impressive backdrop of Mount Alma. The area is also extremely rich in biodiversity including salt ponds, mangrove forests, coral reefs, seagrass beds, and a diverse spectrum of flora and fauna.

3.2. Geology

The geology of Beef Island is mainly composed of intrusive dioritic bedrock associated with the Virgin Gorda Batholith formation. Most of the soils are residual in origin and have been derived from the underlying volcanic rock, slope alluvium and littoral deposits.

3.3. Bathymetry/Topography

Beef Island, like the rest of the American and British Virgin Islands, is a natural appendage of the Puerto Rican Bank and shares similar geological and geographic features. The bank extends from the eastern end of Puerto Rico for 90

miles in an east-northeasterly direction, with depths less than 600 ft. Anegada in the BVI lies to the northeastern end of the bank, while most of the other islands lie near the southern edge.

Mount Alma (735 feet/224 meters) is the most prominent physiographic feature on Beef Island and covers about one-third of the property. Its northwest-southeast elongated ridge is flanked by very steep slopes. Bedrock and boulder talus are common along the slopes. Elsewhere across the property, the landscape is characterized as lowlands ranging from flat to undulating topography. Numerous bedrock outcrops and boulder fields are associated with these undulating hills.

3.4. Climate

The British Virgin Islands (including Beef Island) is directly in the belt of sub-tropical, easterly trade winds. The climate is maritime tropical and characterized by generally fair weather, steady winds and slight but regular annual, seasonal and diurnal temperature ranges.

3.4.1. Temperature (Air and Water)

Temperatures vary little throughout the year; daytime temperatures fall within the range of 25-29 degrees C and generally drop six degrees at night.

3.4.2. Precipitation and Rainfall/Runoff

The average annual rainfall at the higher elevations is recorded at between 55-60 inches and somewhat less in lower elevations. Precipitations records at Hodges Creek over a period of 25 years indicate an annual mean of 38.50 inches (Roy, 1999).

There is no sharply defined wet or dry season. As was learned during Airport construction in February, 2000, one of the features of climate in this region is hard rainfall events (as much as 6 inches in 24-hours) at any time of the year. Light soils and hard rains on steep slopes produce conditions favorable for erosion and sediment events in short periods of time.

3.4.3. Winds / Storms

Normally, except for the occasional hurricane, highest wind speeds are experienced from December to February and again in June and July. Average wind speeds for the months of June and July are around 20 mph, while for October average wind speeds drop to 13.5 mph.

The British Virgin Islands also lie within the hurricane belt. These intense storms occur between June and November, with September being the month when most tropical storms and hurricanes have historically occurred. Within recent years, several hurricanes passed sufficiently close to the BVI to cause significant damage, including:

- Hurricanes David and Frederick, August-September 1979,
- Hurricane Hugo, September 1989
- Hurricanes Luis and Marilyn, September 1995
- Hurricane Bertha, July 1996
- Hurricane Georges, September 1998, and
- Hurricane Lenny, November 1999.

Hurricanes generate high winds and waves, storm surge and heavy rainfall and flooding. Hurricane Hugo, for example, which passed 61 miles south of the BVI in September 1989, resulted in damage to the Territory of US$200 million (BVI National Report to UNCED, 1992).

3.5. Oceanographic Processes (water circulation)

The British Virgin Islands is located within the path of the Northeast Trade Winds. These winds approach with great constancy throughout the year from the north-northeast and southeast. Predominant waves will therefore also approach from these directions. Most of the shorelines of Beef Island are sheltered from these predominant waves thanks to the barrier protection afforded by Mount Alma and offshore coral reef systems. The heaviest surf is along the east coast of Mount Alma and along the southeast shoreline near Bluff Point. Detailed models of storm surge analysis for this project are currently being undertaken and will be presented within the appropriate sections of the dedicated EIAs.

The BVI lies in the path of the North Atlantic Equatorial Current. Generally, these currents flow from east to west in the channel between Beef Island and Great Camanoe Island to the north; similarly, these currents prevail in the area south of Beef Island. More localized current patterns vary in accordance with the ebb and flood tides and can vary in magnitude between less than measurable to more than several feet per second.

3.6. Shoreline Conditions and Coastal Processes

Beef Island offers a diverse range of shoreline types including sandy beaches, coral rubble beaches, steep rocky cliffs, and fringing mangroves. This diversity

provides various habitats for wildlife as well as opportunities for human activities.

The most prominent and popular coastline is at Trellis Bay. It is approximately 1,695 yards (1,550 meters, or approximately 1 mile) in length from Conch Shell Point to Sprat Point. The beach area is dominantly composed of coralline sand starting at the public jetty on the western side of the bay and extending continuously to Sprat Point. At Sprat Point, the beach gradually changes from coral sand to coral rubble from the west side of Sprat Point toward its eastern edge.

From Sprat Point to Bluff Point, all along the east shoreline of Beef Island, the coast is exposed to a high-energy wave environment. The northern half of the eastern shoreline is dominated by a wide coral rubble beach and beach berm which includes more rock rubble and boulders heading south. The southern half of Beef Island's eastern coastline is dominated by steep bedrock cliffs interspersed with a few pocket beaches.

From Bluff Point and extending westward, the coastline gradually changes from rocky boulder beach to coral rubble beach and finally to coralline sandy beach in the Bluff Bay area. The Bluff Bay beach is a remarkably calm environment due to the sheltering effect of a rocky headland and the offshore barrier reef system. The bay also contains a large expanse of seagrass.

West of Bluff Bay, the shoreline is dominated by a fringing mangrove forest that extends along Hans Creek and wraps around the Little Cay Lagoon up to Little Cay Beach. Little Cay Beach is a small pocket beach composed of sand. Extensive boulder fields and bedrock outcrops cover the inland portion of this shoreline.

The pocket beach at Well Bay marks the west end of the BIDP property. This coralline sandy beach with its shallow-water lagoon is a very popular attraction for local users.

3.7. Infrastructure and Utilities

Roads, Parking and Port Facilities. Existing airport facilities represent major road and parking facilities (200+ parking spaces), in addition to the large area of impervious surface for runways and taxi ways.

Apart from the airport access roads and a branch road that provides access to the ferry boats to Bitter End and Biras Creek, Marina Cay, Bellamy Cay and other private facilities nearby, most roads on the Beef Island Development area are

currently unpaved. Traffic on the dirt roads to the facilities on Trellis Bay can generate considerable dust and fine sediments during rainfall runoff.

In addition to several piers for boarding power boats, there is a barge loading area adjacent to the Commercial Area of the Beef Island Development Project.

Electricity and Energy Resources. At the present time all energy and electricity used on Beef Island are imported from the generating station at Pockwood Pond, or from petroleum storage facilities (for aviation fuel) on other parts of Tortola. The airport has emergency generators, only for the operation of some systems in the event of the occasional power outage. The airport is not air conditioned and population of Beef Island is small, so total energy consumption on Beef Island is low.

The main electrical supply to Virgin Gorda from the BVI Electricity Corporation passes through the BIDP above ground to an area just north of the Banana Wharf salt pond, whereupon the line changes to an under water cable to complete the journey to Virgin Gorda.

Water. Cisterns and wells provide water to most users in Beef Island.

Liquid Waste. Individual septic systems are currently used for all facilities on Beef Island, but there is a master waste water plan for the east end of Tortola which would connect all facilities on Beef Island to a central sewage treatment plant in the East End/Long Look area..

Solid Waste. All Beef Island solid waste goes to the existing public landfill operations at Pockwood Pond, on Tortola.

3.8. Airport

The Terrence B. Lettsome International Airport (86.5 acres/35 hectares) has been rebuilt since 2000 to handle increased numbers of inter-island tourists, including eventually 737 jet air service. The redevelopment of the airport re-organized many of the natural features of the east end of Beef Island, including routing a large amount of airport runoff through the Hans Creek salt pond and into drainage channels to the west of the Marine Protected Area in Hans Creek itself.

Polluting accidents during the construction phases of the International Airport, especially heavy rainstorms in February 2000, have served as a cautionary experience for planners of the Beef Island Development Project. The airport

development was being built by internationally experienced construction companies, to the highest international environmental standards.

3.9. Environmental Resources

3.9.1. Areas of Special Concern

As an interim product of the Scoping Report, five classes of areas of special concern for the Beef Island Development Project have been identified: Salt Ponds, Boulder Fields, Beach Berms, Vegetative Communities and Coastal Marine Communities. Because of previous scientific studies, the Salt Ponds and Coastal Marine resources are best known to date.

3.9.1.1. Salt Ponds

Beef Island is home to a series of several salt ponds between the airport and the verges of Mount Alma. This wetlands network is the second to Anegada in the BVI. Six of Beef Island's ponds are located within the boundaries of the Beef Island Development Project. These ponds, of varying habitat quality, perform a variety of ecological services for man and natural systems.

Four species of mangrove (see below, Section 3.9.1.4, Vegetative Communities) are abundant in the lowlands around the ponds. Aquatic animals, aquatic plants, crabs, snails and a diversity of insects abound in the salt ponds and surrounding mangroves. Migratory and resident water birds depend upon these aquatic communities for food, especially during the fall and winter seasons. Many of the birds nest only on the shores of salt ponds, while others nest specifically in mangrove trees.

The six salt ponds within the BIDP area are briefly described below and are identified in Figure 3.9.1.1-1. A more detailed characterization of the ponds affected by the proposed development of Beef Island will be outlined in future EIA submissions.

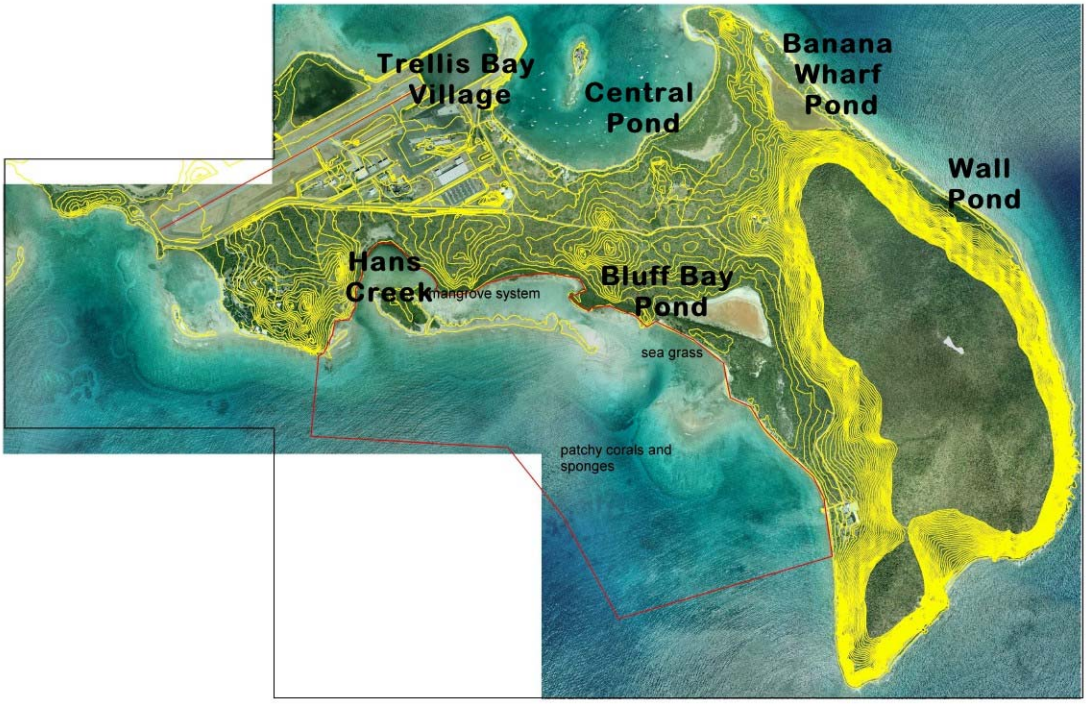

Figure 3.9.1.1-1 Location of the six salt ponds affected by the Beef Island Development Project.

(1)Hans Creek Pond is located on the south shore of Beef Island near the western edge of the BIDP property. It is a small (1.0 acre/0.4 ha) temporary pond, remaining dry for more than 6 months per year. The lagoon and reef system to the east of it is within a marine protected area.

(2)Bluff Bay Pond is located on the south side of Beef Island, also adjacent to the other side of the marine protected area. Bluff Bay Pond is the largest pond (8.9 acres/3.6 ha) on the property. It dries annually, but holds water continuously for six months or more each year, thus fitting the classification criteria of an annual pond.

(3)Trellis Bay Village Pond is a remnant temporary pond behind the commercial buildings along the shore of Trellis Bay. This pond is associated with a fairly large area of black and buttonwood mangroves.

(4)Central Beef Island Pond is an elongated medium-sized (approx. 3.7 acres or 1.5 ha) temporary pond that lies behind the shore on the southeast side of Trellis Bay. It has also been referred to as the Sprat Point Pond.

(5)Banana Wharf Pond is a large (7.4 acres /3.0 ha) pond lying behind a coral berm on the north shore of Beef Island. This is the only permanent pond (in that it never dries out). During prolonged dry weather (usually in spring and

summer), this pond supports an aquatic community and is especially important for resident birds when other ponds are dry.

(6)The Wall Wetland is so named because it lies behind an historical wall constructed along the north shore of Beef Island and to the southeast of the Banana Wharf Salt Pond. This is an area of mangrove forest with pockets of standing water that dry seasonally.

Assessment of Services Provided by Salt Ponds. Table 3.9.1.1-1. "Assessment of Ecosystem Services Provided by Salt Ponds" provides a very coarse summary of a number of factors which illustrate the major ecosystem services provided by the BIDP salt ponds (as summarized from Annex C by Dr. Lianna Jarecki) and the specific issues for each salt pond, as reflected in Dr. Jarecki's paper and interpreted by the Foundation's assessment team. These judgments are preliminary to this stage of the EIA process, and should be subject to revision based on future information.

Note that this table is adapted and re-used in Sections 5.5.1. and 5.6.1., which address the specific possible impacts deriving from Phase 1 (Gulf Course) and Phase 2 (Resort Core) of the Beef Island Development Project. The green and yellow cells in this table reflecting the assessment conclusions about the value of the services provided (yellow being smaller service effects than green; blank cells are assessed as providing no significant amount of the service) are carried forward to Sections 5.5.1. and 5.6.1.

Table 3.9.1.1-1. Assessment of Ecosystem Services Provided by Salt Ponds.

		Hans Creek Pond	Bluff Bay Pond	Trellis Bay Pond	Central Beef Island Pond	Banana Wharf	Wall Salt Pond
	GPS Coordinates						
	Area in acres	1.0/0.4ha	8.9/3.6ha		3.7ac/1.5ha	7.4ac/3.0ha	
	Watershed in acres	49.8*	99.9	*	*	26.9	
	Tidal	No	Yes	No	No	Yes	?yes
	Intermittent	Yes	Yes	Yes	Yes	No	Yes
	Proposed Dev Activity**	13th Fairway Utility Services	Marina & 5-Star Resort	Commercial Area 11th Green	4th Fairway	6th Fairway, Golf Villas D	Practice Range
	Ecosytem Services	Hans Creek Pond	Bluff Bay Pond	Trellis Bay Pond	Central Beef Island Pond	Banana Wharf	Wall Salt Pond
1	storm protection & mitigate onshore flooding	Small	Yes	Small	Small	Yes	No
2	control coastal erosion & mitigate offshore pollutant flow	Yes	Yes	Small	Yes	Yes	Yes
3	nursery services for fish, lobster, etc.	Yes	No	No	No	No	No
4	export food to marine ecosystems	Yes	Yes	Small	Small	Yes	Small
5	habitat & food for wildlife, e.g. migratory birds	Yes	Yes	Yes	Yes	Yes	No
6	green spaces	Yes	Yes	Yes	Yes	Yes	Yes

* Size of watersheds for ponds in lowland areas (Hans, Trellis, Central) subject to major changes, based on project grading and landscaping.
** Proposed development activity is only indicative at this time, based on the June 2005 EDSA map illustrating the Master Plan, at Figure 4.1-1.

3.9.1.2. Boulder Fields

Boulder fields are numerous along the lowlands of Beef Island. In the past, many of the areas were left with a shroud of native vegetation, while the surrounding fields were cleared for agriculture and pasture fields. Following its recent field investigations, Island Resources Foundation scientists now believe that these boulder fields have acted as pocket bio-reserves and micro-climate mediators. These mini reserves have provided nursery and seed banks for later regeneration and the succession of the forest habitat that we now observe to be rebuilding. Removal of these fields would weaken the potential for future regeneration and maintenance of the island's lowland biological diversity.

Detailed locational studies and species surveys need to be performed for the estimated 12 to 15 major boulder fields currently found in the lowlands of the Beef Island Development Project.

Given relatively low development densities planned for the Mount Alma upland areas, and the larger total area involved, maintenance of individual boulder fields in the upland areas is likely to be less important. Nevertheless, given that individual boulder fields are more extensive in size in the uplands and may be unstable during construction, efforts need to be made to prevent rockslides and rockfalls.

3.9.1.3. Beach Berms

Beach berms, particularly at Banana Wharf and Bluff Bay, form an extended part of the salt pond ecosystems. These berm environments are the habitats for several of the Territory's rare plant species as well as nesting sites for numerous bird species (see Annex E). Specials surveys of these two beach berms should note features that may call for attention in the EIA process.

3.9.1.4. Vegetative Communities

For purposes of this Environmental Scoping Report, the vegetation of Beef Island has been characterized using the USVI Rapid Ecological Assessment Vegetation Classification system as developed by the Virgin Islands Conservation Data Center of the University of the Virgin Islands, The Nature Conservancy and Island Resources Foundation (IRF) in 1998. The vegetation types of the BVI are similar in composition and distribution to those of the U.S. Virgin Islands, to which the British islands are related geologically and biogeographically.

Plant species compositions were assessed in April and June, using a rapid quantitative plant sampling. This methodology is designed for situations and conditions where time, energy, resources and the site do not allow for more detailed and long-term methods.

Much, if not all, of the vegetation of Beef Island is secondary. However, some patches of forest on the upland areas, especially on the eastern slopes of Mount Alma and nearby hills, may be "old growth" forest. This area has not yet been investigated.

There are 14 vegetation community types found on Beef Island. These communities are mainly dry forest types, with the dry Semi-deciduous Woodland and Semi-deciduous Forest being the main types. There are some excellent stands of Semi-deciduous Woodland on Beef Island, especially on the eastern side of the island, where non-natives are quite rare to absent, an indication that the forest has remained undisturbed for considerable time.

The physiognomic structure and species composition of these community types are strongly influenced by a number of factors, including prevailing wind patterns, wind velocity, length of the dry season, rainfall, aspect and slope, and land use. The proximity of some of the vegetation to the strong onshore winds, in the presence of heavy salt spray, reduces the height of the vegetation, altering the composition and diversity of the forest. For most of the plant communities, tree strata are generally limited to two layers (emergents and canopy layer), with a maximum height of 16-30 ft (5-9 m).

In the drier areas of the project site, following a gradient of increasing aridity, seasonal vegetation may exhibit leaf specialization, leaning toward deciduousness, while dry evergreen vegetation may exhibit greater degrees of sclerophylly. The vegetation types grade and mix with one another in some areas, and in some parts may be difficult to distinguish, other than by quantitative sampling measures.

The 14 vegetation community types are listed and described below. A species list associated with these community types is provided in Annex D.

(1)Semi-deciduous Forest — This community comprises the tallest and oldest forest vegetation community on Beef Island. Found on upland slopes of Mount Alma, along shallow guts and sheltered slopes, it grades into Drought-deciduous Forest on the lower slopes. Semi-deciduous Forest reaches its most mature stage on the eastern slopes of Mount Alma and surrounding hills. There is a distinct closed canopy layer with emergents species reaching many meters over the canopy. A shrub and herbaceous layer are also present, along with

numerous vines and scandent shrubs. Few exotic species are present, especially on the eastern slopes.

(**2)Drought-deciduous Forest** — This vegetation community, characterized by greater than 75% deciduous species, is found on the steeper slopes on the eastern third of the island. The forest is relatively low in stature, with emergents reaching 49-66 ft (15-20 m), and the main canopy rising to 23-39 ft (7-12 m), especially on the eastern slopes and in sheltered locations. The shrub layer is sparse to abundant, sometimes with numerous vines forming relatively dense entanglement. The herbaceous layer is ephemeral, dying back during the dry season.

(3)Semi-deciduous Woodland — Small areas are found on lower exposed slopes above Trellis Bay and on the eastern, east-south eastern and west-south western slopes. It occurs as a transition between Drought-deciduous Woodland and Thicket/Scrub. It is relatively low in stature, with emergents reaching 26 ft (8 m), but with the canopy rising to 13-16 ft (4-5 m). The canopy cover may be open in some areas, from 25-60%, interspersed with glades of bare earth and/or grasses. There is no stratification of the community, and in some areas, the woodland appears entangled with vines and scandent shrubs.

(4)Thicket/Scrub — This community is intermixed with Drought-deciduous Woodland on the low middle areas of the island, especially in the areas south of the airport. Though there is no canopy layer as such, they are emergents. The trees may attain shrub-like status, while large shrubs occur. These growth habits give this community its "thicket/scrub" characteristics. The Thicket/Scrub is interspersed by Mixed Dry Grassland/Pasture glades and with Drought-deciduous Woodland. During the rainy season, an ephemeral herbaceous layer may crowd amongst the stems and roots of the shrubbery, where enough light is available. Emergents may attain heights of up to 20 ft (6 m).

(5)Coastal Hedge — This community is found along the coast with exposure to prevailing winds and salt spray. The species is generally wind and salt tolerant and is found at Trellis Bay, Bluff Bay, Sprat Point and areas of Banana Wharf.

(6)Drought-deciduous Woodland — This community is the most extensive vegetation type on the island and is found along the lowlands between the Banana Wharf and Bluff Bay Salt Ponds and also just east of Well Bay. Found also on old agricultural fields, this vegetation community is highly secondary and, in some areas, grades into lower stature Semi-deciduous Woodland and Thicket/Scrub. Vegetation consists of large shrubs and small trees. There is no canopy formation.

(7)Mixed Dry Grassland/Pasture — This community includes both native and non-native grassland types. Most non-native grassland communities are dominated by one or more species of introduced grasses, including the guinea grass (*Panicum maximum*). This community is widely distributed in small patches and glades, but the most obvious examples occur around the airport, which is an artificially created and maintained landscape. Away from the airport, the community occurs in patches and small open glades in Thicket/Scrub, Semi-deciduous Woodland, Drought-deciduous Woodland and Rock Pavement communities. In most cases, vegetation may cover less than 10% of the ground.

(8)Mangrove Forest — This community fringes along the entire coastline of the Hans Creek Mangrove Lagoon up to the west edge of Bluff Bay Beach. The forest is dominated by red mangrove (*Rhizophora mangle*), with other mangrove species forming a closed canopy system. All other mangrove species occur along the landward perimeter of the system.

There are also two patches on the eastern side of the island at the "Great Wall" mangrove system. These two patches consist primarily of red mangroves, some of which achieve heights of up to 23 ft (7 m).

(9)Mangrove Woodland — This community is found along the eastern coast parallel to the steep slopes. It is connected to the Banana Wharf Salt Pond by an old drainage channel. This system varies considerably, ranging from stands of white mangroves to mixtures of white, black and button to just button. Some areas are flooded, while others are mostly dry (buttonwood mangroves). Height varies from 3-16 ft (1-5 m).

This vegetation community also occurs southeast of the Bluff Bay Salt Pond. Though connected with the salt pond via surface flow, this system differs from the Banana Wharf system in that it consists of a series of shallow, flooded areas, dominated by white mangroves and buttonwood (*L. racemosa* and *C. erectus*). Open areas are extensively covered by seaside heliotrope (*Heliotropium curassavicum*), sea purslane (*Sesuvium portulacastrum*) and *Trianthema portulacastrum*.

The substrate here changes considerably from thick heavy clays to sandy materials, obviously derived from storm-surge deposits and soil materials washed down from upland areas.

(10) Mangrove Lagoon — Created by the Hans Creek Mangrove system to the east and north and Little Cay to the south, composition is similar to the Mangrove Forest system, except that a lagoon system is contained within the perimeters formed by the Mangrove Forest and the borders of Little Cay.

(11) **Fresh Pond** — Freshwater systems on Beef Island are wholly artificial in nature. Such artificial ponds are located on the grounds of the airport and are part of its storm-water drainage system. These concrete ponds are filled with water and aquatic plants as a result of sediments that have accumulated in the bottom, blocking the outlet. Sediments need to be removed on a regular basis in order for these drains to be effective.

(12) **Rock Pavement** — This community is limited to the rocky outcrops and coastal cliffs on the eastern and southeastern coast of Beef Island. The vegetation is usually sparse, sometimes covering less than 10% of the surface. All species are influenced and affected by the strong winds and salt spray that shape this environment, growing mostly as low shrubs.

(13) **Beach (sand, cobblestone, rubble/coral)** — This community comprises sandy areas throughout the island with less than 10% vegetative cover. It is found at Trellis Bay, Long Bay Beach, Banana Wharf, Bluff Bay Beach, and along the east and southeast coast.

(14) **Cropland** — A single area of cultivated field can be found south of the Trellis Bay area. It contains a number of cultivated plants that are listed in Annex B.

3.9.1.5. Coastal Marine Communities

Most of the marine communities around Beef Island can be found within the shallow-water, nearshore environment. The north and south shores are shallow-water areas sheltered by barriers such as peninsulas, mangroves and fringing reefs. The east coast is situated in more open waters; hence the community there consists mostly of life that can survive in strong currents, frequent disturbances and storm surges. These resources have been described in the BVI's Coastal Resource Inventory (BVI Government, 2004). See also Figure 3.9.1.5-1.

Beef Island's marine communities are broadly grouped into four classes: coral, algae, sediments, and fixed substrate. These are further divided into 16 associations based on the most dominant species and/or characteristics that best describe that association.

The **barrier reef system**, which parallels the **south coastline** from Little Cay to Bluff Bay, is comprised of living coral and prolific marine life and forms an integral part of the island's coastal and nearshore environment. The near-continuous barrier reef in front of the shoreline provides a buffer, thereby reducing the energy of oncoming waves and swells. Keeping this barrier reef

ecosystem healthy and functional is critical to the sustainability of this coastal environment.

The Coral Communities include:

*Acropora (*mostly dead*)*
Coral Rock
Coral Rubble
Other Corals
Montastrea
Reef Crest
Soft Corals

The Algae Communities include:

Seagrasses
Macro Algae
Cyanophytes

The Sediment Communities include:

Sand Bottom
Sand and Rubble Beach
Mud

The Fixed Substrate Communities include:

Terrigenous Rock
Terrigenous Rubble
Mangroves

Coral Communities are most common in the Hans Creek—Bluff Bay area. The narrow fringing reef creates a shallow bay and lagoon around Hans Creek allowing for extensive fringing red mangroves between Bluff Bay Beach in the east and Well Bay to the west.

Trellis Bay has far fewer Coral Communities, but possesses more extensive seagrass and algae habitats.

Sediment Communities are the most temporary of all the marine habitats given their constituent makeup of fine sediment particles and vulnerability to storms and heavy surge. These are most common in areas prone to disturbance such as on the east coast of Beef Island and seaward of the fringing reef at Hans Creek—Bluff Bay.

The Fixed Substrate Communities are scattered throughout the Hans Creek—Bluff Bay area and occur where permanent or semi-permanent substrate

materials are located. The substrate may include rocks, rubble, boulders and red mangrove roots.

Hans Creek provides prime nursery habitat for many Caribbean reef fishes as it has undisturbed mangrove and seagrass beds in proximity to the reef system. Both the BVI National Parks Trust and the Conservation and Fisheries Department have identified the area as one of special importance (see Section 3.11 below). It has been listed as a marine protected area (Figure 3.11-1), given its importance as a nursery for both commercial and non-commercial juvenile fish and shellfish.

Additionally, from 1997-2002, Hans Creek was a research site for the international program of ICLARM (International Centre for Living Aquatic Resource Management) where attention was focused on the settlement recruitment of juvenile reef fish. More recently, as part of a project funded by the UK's Overseas Territories Environmental Programme, the National Parks Trust has established a new coral monitoring site situated 550 yards (half a kilometer) off Bluff Bay Beach.

Further underwater ecological surveys were undertaken by ATM during the summer of 2005 under the auspices of the Beef Island Development Project, but the results of these studies were not made available to Island Resources in time to be included in this report.

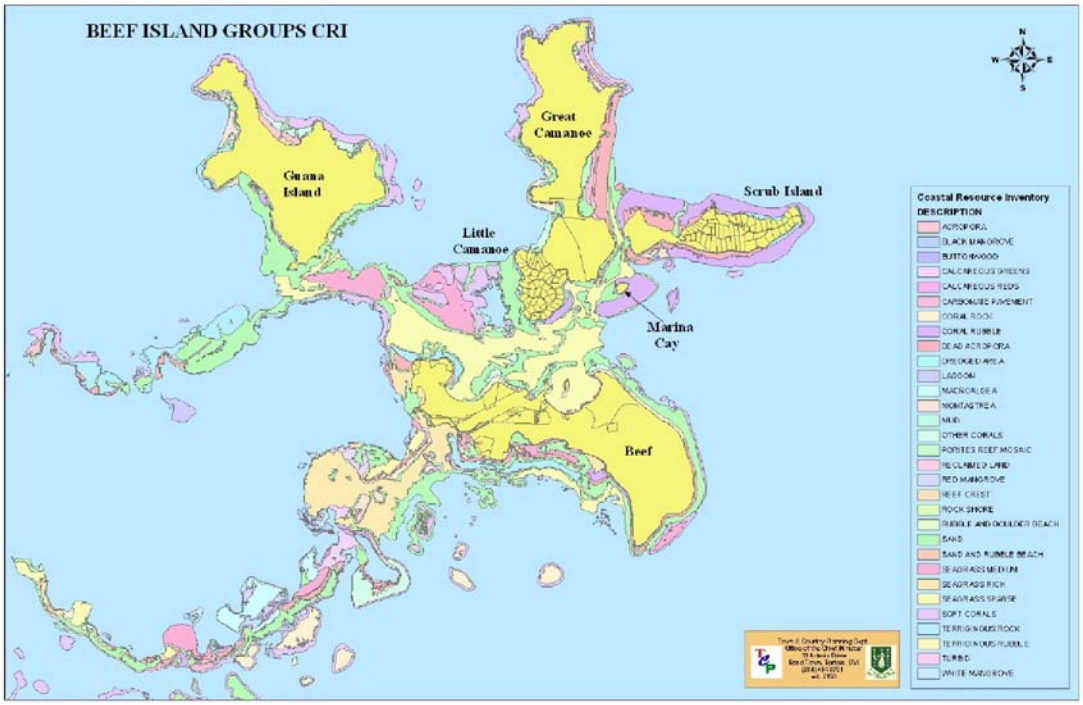

Figure 3.9.1.5-1. Coastal Resource Inventory — Beef Island (BVI Government, 2004).

3.9.2. Terrestrial, Coastal & Marine Fauna

The fauna of Tortola represents a mixture of resilient castaways, stowaways and recent arrivals. Like its flora, the present fauna is a result of natural processes, such as fires, landslides, hurricanes and floods, which over time were critical in shaping the island's environment. Additionally, the natural landscape was gradually transformed to its present composition following the introduction of human activity and pasturing for cattle and goats.

The island's fauna remained relatively stable until European settlement in the 1600s. The wholesale clearing of the land for plantation agriculture; the introduction of non-native species, including rodents, such as the black and brown rats (*Rattus rattus* and *R. norvegicus*) and the house mouse (*Mus muscalus*); the introduction of new diseases, pets, and livestock; and over-hunting all have impacted the faunal composition.

Many of the island's indigenous reptile and mammal species are relatively unknown, while the threat and spread of introduced species such as the Cuban tree frog are largely unstudied.

Although some species receive local legal protection, their habitats continue to disappear. The most significant threat to the island's native fauna is urbanization, grazing and the gradual loss of natural habitat.

Birds. Bird observations at Beef Island were undertaken between April and July of 2005. During this period a total of 55 different species of birds were observed (see Annex E). Previous studies undertaken by the Cambridge Ornithological Expedition to the BVI (1976) totaled 48 species for Beef Island.

Bird point counts focused on the wetlands, beaches and critical habitats. General bird observations were also done along roads, cut lines, trails, ponds, beaches and other coastal areas, guts and bird flyways. It is important to note that the number of species and individuals reflects a short time frame during the daylight hours and within only one season. More frequent observations covering all seasons would yield a greater number of species.

In the BVI Territory, a number of bird species are considered threatened or endangered. These include the brown pelican, the peregrine falcon and the roseate tern. Only the pelican and roseate tern were observed during the current survey of Beef Island. Most of these species may occur on Beef Island at some time—either permanently, seasonally or during some years.

During IRF's survey of Beef Island salt ponds in June, two Caribbean Flamingos were observed making daily feeding trips from Guana Island to the Beef Island ponds. Foraging visits of the Guana flamingos demonstrate that the Beef Island ponds are suitable flamingo habitat. Though the Guana flamingo population is tiny (six birds), is essentially captive (4 of the 6 are unable to fly) and is managed (they are fed when natural food resources are scarce), the Anegada flamingo population is growing, with the current population standing at 120 birds. The food resources abundant in the ponds of Beef Island will be important to sustaining this expanding population and to ensuring the success of the reintroduction of the Caribbean Flamingo to the BVI. The Caribbean Flamingo is listed as endangered species by the Convention on International Trade in Endangered Species of Wild Flora and Fauna.

Mammals. A number of terrestrial mammals were observed on Beef Island. They include:

- Indian mongoose (*Herpestes auropunctatus*)
- Black rat (*Rattus rattus*)
- Feral cats (*Felis catus*)
- Sheep
- Feral goats
- Bats

The Indian mongoose, introduced in the 1800s to control rats in cane fields, seems uncommon throughout the property. Only five specimens were seen in over a month of field surveys. Though still reported, local observers have commented that in recent years they have seen a decline in the number of sightings in Tortola, including Beef Island. The reasons for this are not yet known, but this may prove advantageous for native biodiversity. The species is sometimes seen darting about trails, along roads and nearby to human habituations in search of food and migrating to feeding grounds.

Most of the bats reported for Tortola may occur at Beef Island. The island certainly possesses ample roosting habitat given the numerous large boulders and boulder fields that are present. The Jamaican fruit bat, red fruit bat, and the brown (or cave) bat should be looked for and their status determined given that so little is known about their presence.

The other mammal species—the black and brown rats, the house mouse, feral goats, and cats—are all introduced species to Beef Island. The black rat is a very common pest, frequently seen climbing trees or scurrying about at night. Cats were seen occasionally, but nothing is known about their populations or their impacts on the ecology of the area.

The brown rat and the house mouse arrived with the first Europeans to the Virgin Islands. These mammals occur commonly and widely throughout the island in all habitats and especially around human habitations.

Terrestrial Reptiles. Of the eleven terrestrial reptiles recorded for Beef Island, seven are lizards, three are snakes, and one is a tortoise. These include:

- *Geochelone carbonaria*, Red-footed Tortoise
- *Ameiva exsul exsul*, VI ground lizard
- *Anolis cristatellus wileyae*, VI crested anole
- *Anoilis stratulus*, spotted anole
- *Anoilis pulchellus*, VI grass anole/VI bush anole
- *Mabuya bistriata*, Slipperyback skink
- *Hemidactylus mabouia*, house gecko/woodslave
- *Sphaerodactylus macrolepis macrolepis*, cotton ginner/dwarf gecko
- *Alsophis portoricensis anegadae*, Puerto Rican racer
- *Arrhyton exiguum exiguum*, VI ground snake
- *Typhlops richardi*, blind snake/VI worm snake/coffin borer

Other possible occurrences are:

- *Anolis roosevelti*, Roosevelt's anole
- *Amphisbaena fenestrata*, VI blind snake/worm lizard
- *Epicrates monensis granti*, VI ground boa/VI boa

The three species of Anoles or tree lizards are relatively common on the island, though the grass anole is not commonly observed. On Beef Island, the crested anole (*A. cristatellus*) is the most visible and abundant, commonly observed on tree trunks and rocks, along trails, paths and the main access through the property and in the forest, from the highest elevations down to the coast. It is the second largest species of anole on Tortola, with most adult males having large tails. Females are smaller and duller, and the tail-fan is absent. This species is found commonly throughout the BIDP site.

The spotted anole (A. *stratulus*) is less common and rarely observed, especially given its preference for staying high up in the trees and in the shade, where it is easily over-looked by the observer.

The grass anole (*A. pulchellus*) is a species of open grassy-herbaceous habitat. It is relatively uncommon, and may be found along the paths where grasses, rocks and other suitable perching areas are fairly well exposed to sunlight.

Roosevelt's anole (*Anolis roosevelti*) is a rather rare and cryptic species that has only been collected once from the BVI Territory. Though it has never been collected or observed on Beef Island, its presence there has been strongly suggested, especially on the eastern slopes of the hills. Further research is needed to determine the status of this species, although it may well be extinct.

The house gecko (*Hemidactylus mabouia*) is a nocturnal species believed introduced as a stowaway on slave ships from Africa. By day, it is to be found below dead bark, in rock piles, dead tree stumps and abandoned structures. It is undoubtedly relatively common throughout this area, but given its nocturnal habits, it is often overlooked.

The dwarf gecko (*Sphaerodactylus macrolepis*), or cotton ginner as it is locally called, is the island's smallest reptile species, growing to about 2 in (5 cm) in length. It is the only dwarf gecko known from Beef Island and nearby Tortola. This species is quite common in forested areas throughout the BIDP site and is easily observed darting about the leaf litter, hiding under dead plant matter and amongst the rocks.

The ground snake (*Arrhyton exiguss*) is one of the most common snakes, although it is not as readily observed as one may expect. Most encounters are accidental. A specimen was caught and released during one of IRF's surveys of Beef Island.

The rare Virgin Islands ground boa (*Epicrates monensis*) was not observed during our survey efforts, but given how little is known about the species on Tortola and Beef Island, it is quite possible for the species to occur on the property in very

low numbers. Specimens have been collected throughout most habitats on Tortola, from the coast to the highest point. Further research is needed to determine status of this species on Beef Island.

The legless lizard (*Amphisbaena fenestrata*) is a relatively common species, although rarely encountered. It burrows in the soil where it feeds on other reptiles and invertebrates. It was not observed during this survey, although its presence there is not unexpected.

Marine Reptiles. There are four species of sea turtle known to occur in the BVI. They are:

Hawksbill Turtle – *Eretmochelys imbricata*
Green Turtle – *Chelonia mydas*
Leatherback Turtle – *Dermochelys coriacea*
Loggerhead Turtle – *Caretta caretta*.

The Hawksbill Turtle and Green Turtle are permanent residents in the BVI and occur regularly in the waters off Beef Island. Both species were sighted during IRF's underwater surveys in the Little Cay Bay and the Hans Creek area (April-June 2005). There were six sightings of Hawksbill Turtles in shallow reef areas and in back reef zones. While they were generally noted foraging on reef flats, they also occurred near mangroves. All Hawksbill Turtles seen were juveniles. The single Green Turtle sighted was a juvenile foraging in seagrass beds off the beach at Bluff Bay.

The Leatherback, an endangered, predominantly pelagic species, visits the BVI to nest from March to July. Loggerhead Turtles, rarely seen in the BVI, feed primarily on mollusks such as the Queen Conch. While neither species was noted during IRF's recent surveys, the habitats around Beef Island are ideal for both.

Surveys by the Conservation and Fisheries Department dating to the 1980s confirm nesting activity on Beef Island by the Hawksbill, Green and Leatherback Turtles. Hatchling Leatherback Turtles were found at Long Bay Beach in 1992. The Hawksbill and Green Turtle are known or suspected to nest on beaches at Long Bay, Well Bay and Bluff Bay.

The sightings of Hawksbill and Green Turtles in the Hans Creek area confirm the importance of the surrounding marine habitats as foraging sites, especially for the juveniles. The extensive coral reefs, particularly the shallow back-reef zones, are important for the Hawksbill. Seagrass beds are found in much of the shallow sandy environments of Bluff Bay. Green Turtles, feeding almost exclusively on sea grasses, are totally dependant on these habitats for survival.

More detailed surveys of turtles in the Hans Creek area may help determine specific locations that are most important to protect in order to maintain healthy populations.

Amphibians. There are six and possibly seven species of amphibians on Tortola (two species are non-native). Three of these species occur on Beef Island. These include: *Eleutherodactylus swartzii*, a tree frog that has a preference for the wild pineapple (*Bromelia pinguin*); the white-lipped frog (*Leptodactylus albilabris*), which has a preference for wet places and standing freshwater; and the Cuban tree frog (*Osteopilus septentrionalis*), a relatively recent introduction that has spread throughout Tortola. It has been reported on Beef Island at the Quaker Residence's water cistern and at the Irish Crossing south of the airport. The tree frog is only known from one small area north of the Quaker Ruins, and the white-lipped frog occurs around the lower Trellis Bay area.

Given the increasing human presence on the island and with a number of unexplored areas on the slopes of the hills, it is expected that the number of species of frogs will increase. At least one other species, the Antillean tree frog (*Eleutherodactylus antillensis*), should be looked for.

The coqui (*Eleutherodactylus coqui*), a Puerto Rican species highly valued by Puerto Ricans, has been introduced to many of the Virgin Islands and can easily be transported from island to island in plants and cargo. It would not be surprising if this species is eventually identified on Beef Island.

All of these species are relatively common and widespread throughout Tortola.

Invertebrates. No formal attempts were made to survey the invertebrates of the Beef Island Development Project. Given the intensive nature and detail this type of work requires, it would have proven too extensive and difficult a task given the short timeframe, the resources available and the expertise needed to do a credible job. Very little is known about the status of most terrestrial invertebrates in the Virgin Islands, although we note that Dr. Lianna Jarecki of H. Lavity Stoutt Community College has studied the invertebrates as part of her extensive research on the salt ponds and salt flats of the BVI (Jarecki, 2004).

Even though the IRF team did not undertake a formal survey of Beef Island's invertebrates, this is not an indication of the insignificance of this important group of fauna. As a matter of fact, it is quite the opposite. In addition to being the largest faunal group on the island, Beef Island's invertebrates are a key component of the island's ecology because any adverse impacts on this population will have far-reaching effects on the island's overall environment. Being at the base of the food-web, their decline and/or disappearance will

foretell potential disaster for many other animals and plants which are dependent on them for survival.

During the IRF survey work of Beef Island, investigators took note of the fact that the area is over run with hermit crabs (*Coenobita clypeatus*), as is the case for this species within most forested areas of neighboring St. Thomas in the U.S. Virgin Islands. This species spends most of its life in forests, returning to the sea only to lay its eggs. Large densities are to be found scrambling in the undergrowth of the forests and woodlands, from the upper slopes to the coastal areas of Beef Island.

Other terrestrial crabs, *Gecarcinus lateralis*, G. *ruricola* and the giant land crab (*Cardiosoma guanhumi*), are sometimes encountered in the forest. By day, they may hide in dead logs and in burrows.

Beef Island is also home to numerous butterflies and moths (family *Papilionidae*); termites (*Nasutitermes costalis*), with their giant nests often seen hanging from trees; wasps (*Vespidae* and *Pompilidae*), including the notorious paper wasp known locally as a Jack Spaniard (*Polistes* sp.), a species that builds its nest in low shrubbery and around homes; the spider wasp (*Pepsis* sp.); grasshoppers and crickets (order *Orthoptera*); the millipede (*Anadenobolus arboreus*); scorpions (order *Scorpionida*); and such curious creatures as the whip spider (*Araneae* or *amblipigid*), with its whip-like front legs.

3.9.3. Species of Special Concern, Including Rare, Endangered and Uncommon Species

A number of species of particular concern were observed on Beef Island during Island Resources recent field investigations. Most of these species are considered rare, endangered and uncommon for this area. Vegetation clearing and the alteration of habitats will have a significant impact on the viability of these species. Some are unlikely to survive the impact of the development if a conservation and recovery plan is not implemented. Table 3.9.3-1 and 2 presents a listing of these species encountered during the IRF field work. This list might expand as further EIA investigations continue, and specific locations on Beef Island will be identified and mapped in greater detail than is provided in this report.

Table 3.9.3-1. Beef Island Flora of Special Concern.

Species	Common Names	Habitat	Conservation Status
FLORA			
E. sessiliflora		Forests	Uncommon-Rare
Agave missonium	Century plant/Agave	Forests, Woodlands, Rocks	Uncommon-Endangered
Guaiacum officinale	Lignum vitae	Woodlands, Open areas, Beach	Rare-Endangered
Psychilis macconnelliae	Butterfly Orchid	Forests, Woodlands Open areas, Beach, Rocks, Cliffs	Uncommon-Threatened
Epidemdrum ciliare	Christmas Orchid/eye-lash orchid	Forests, Woodlands Open areas, Rocks, Cliffs	Uncommon-Threatened
Tolumnia prionochila	Yellow dancing lady	Forests, Woodlands, Rocks	Uncommon-Threatened
Tetramicra caniculata	Ground orchid	Woodlands, Open areas Rocks, Beach	Rare-Threatened
Tillandsia fasciculate	Air plant	Forests, Rocks, Cliffs	Rare-Threatened
T. lineatispica	Air plant	Forests, Rocks, Cliffs	Rare-Threatened
Melocactus intortus			Locally common-Threatened
Bastardiopsis eggersii		Forests Woodlands	Unknown

Table 3.9.3-2. Beef Island Fauna of Special Concern.

Species	Common Names	Habitat	Conservation Status
FAUNA			
Pelicanus occidentalis	Brown pelican*	Coastal	Locally common threatened
Sterna maxima	Royal tern*	Coastal	Uncommon-threatened
Sterna dougalii	Roseate tern*	Coastal	Locally common threatened
Sterna antillarum	Least tern*	Coastal	Uncommon-threatened
Ardea herodias	Great blue heron*	Coastal Open Areas	Uncommon
Phoenicopterus ruber	Greater/Caribbean flamingo*	Coastal	Rare-endangered
Columba leucocephala	White-crowned pigeon*	Coastal, Woodlands, Open Areas	Rare-endangered
Asio flammeus	Short-eared owl*	Woodlands, Open Areas	Rare-endangered Maybe extinct(?)
Myiarchus antillarum	Puerto Rican Flycatcher*	Coastal, Woodlands, Open Areas	Uncommon
Vireo altiloquus	Black-Whiskered Vireo*	Coastal, Forests, Woodlands Open Areas	Uncommon-rare
Dendroica petechia	Yellow Warbler*	Coastal, Woodlands	Uncommon
Eretmochelys imbriocota	Hawksbill Turtle	Coastal shallow waters	Rare-endangered
Chelonia mydas	Green Turtle	Coastal shallow waters	Rare-endangered

Some species listed in Table 3.9.3-1 and 2., noted by an asterisk (*), are not included in the BVI/IUCN endangered species list (Annex F), though some previous studies and reports, and discussions with local experts, suggest they possibly occur at Beef Island. Island Resources Foundation has included these on the list of species of special concern because we have concluded that they deserve special attention in the EIA process; they indicate gaps in our existing knowledge of the island's native flora and fauna, and they should be studied further to better determine their status, and, if they are present, what are the potential impacts and what must be done to ensure the conservation of these populations. We have arrived at these conclusions based on the best scientific evidence from the region and on our own previous studies in the BVI, the nearby U.S. Virgin Islands, and Puerto Rico.

A list is provided below of an additional seven species that also are of special concern, given their rarity, population declines over the last 50 years, and the continued threats to their survival. None of these species was observed on Beef Island during our survey work there from April - June, but their occurrence on Beef Island, even as temporary migrants, should be studied further in future development planning for the project.

These species include:

- *Otus nudipes*, Puerto Rican screech Owl
- *Anthracothorax dominicus*, Antillean mango
- *Noctilio leporinus*, Fisherman bat (Greater bulldog bat)
- *Stenoderma rufum*, Red fruit bat (Red fig-eating bat)
- *Brachyphylla cavernarum*, Cave bat (Antillean fruit-eating bat)
- *Anolis roosevelti*, Roosevelt's anole
- *Epicrates monensis granti*, VI ground boa/VI boa.

3.10. Cultural and Historical Features

3.10.1. Archaeological, Historical and Cultural Resources

At first glance, Beef Island seemingly offers few significant historical resources and little evidence of pre-Columbian artifacts. Nevertheless, Beef Island's past is rich and colorful and has served as a backdrop for many of the Territory's most theatrical events and characters.

Amerindians. As Island Resources began its survey work at Beef Island, we were not able to identify documentation of an Amerindian presence on the island. This was somewhat unexpected given the area's rich marine resources and terrestrial physiographic advantages such as available flat lands, accessible beaches, and many look-out points.

Amerindian sites have been reported on nearby Tortola, including villages. IRF's more recent evidence of an Amerindian presence on Beef Island, discovered during our June field work, is in the form of distinct pottery and shell shards observed at one site near Trellis Bay. The evidence, though preliminary, suggests that there may have been at least one "camp" on the island. It sits along a dirt road just north of the cultivated fields, between fairways #2 and #3 of the proposed Beef Island Development Project (see Figure 3.10.1-1). The site may be more extensive than our initial survey would indicate, but it requires further study to determine its exact parameters.

There is a strong possibility that other sites will eventually become known as more structured surveys are made. For example, possible evidence of an Amerindian lookout at Bluff Point has been reported (*pers. comm*., Mitch Kent, HLSCC, June 2005). IRF has not yet been able to verify its exact location and nature.

Figure 3.10.1-1. Historic sites of Beef Island.

Pirates and Treasures. During the late 1600s and throughout the 1700s, the islands of the U.S. and British Virgin Islands were the haunt of many pirates, privateers and smugglers, many of whom were commissioned (*e.g.*, by letters of marque and reprisal) by their respective European governments. The history of

the BVI is, in part, built on a legacy of piracy and smuggling. Even today, many place names such as Hans Creek, Dead Chest Island and Sir Francis Drake Channel evoke the days of piracy that once terrorized the region.

Beef Island was a favorite sanctuary for pirates, including its most famous resident, Black Sam Bellamy, also known as the Prince of Pirates. Black Sam was reputed to have come to Tortola from nearby St. Thomas after being told it was the haunt of renegades and buccaneers. He was openly welcomed and subsequently settled on Blanco Cayo or Blanco Cay in Trellis Bay. It was from this sanctuary and from Sprat Point on the northeastern point of Beef Island that the Prince of Pirates is reported to have spied many of the ships he plundered. Blanco Cay is now known as Bellamy Cay, on which the Last Resort restaurant is situated.

During this period, Beef Island emerged as a primary source for beef and pork—hence its name, Beef Island. Beef production continued on the island into the Twentieth Century but was later abandoned due to declining returns and cheaper imports.

The island's pirate history now lies buried below the sea and hidden amongst the rocks and bushes of the island's shores. Only with additional research and survey work will this colorful past be further illuminated.

Quakers. The Quakers arrived from North America, where they had sought sanctuary from European persecution, that a number of Quaker missionaries arrived in the BVI during the 1730s. Many later settled in Tortola and neighboring islands and became involved in government and commerce and emerged as prominent BVI citizens.

On Beef Island, the so-called "Quaker Ruin" (Figure 3.10.1-1) sits atop a low hill, overlooking Trellis Bay, the airport and Hans Creek. Although the site's early development is believed to be of Quaker origin, some now suggest that the ruins are in fact from a later period (*pers. comm*., Mitch Kent, HLSCC, June 2005). Further research is needed to substantiate the exact nature of the site.

Other Ruins. There are a number of ruins scattered throughout the Beef Island landscape. The precise history and development of these sites remain unknown. There is a small stone ruin at Sprat Point that was reportedly a battery and lookout point erected by the English.

One of the island's most enigmatic ruins comprises a stone wall and enclosures located on the island's eastern coast (Figure 3.10.1-1). Running for a few hundred feet, the ruins have been nicknamed "The Great Wall." Composed entirely of

coral rubble and bedrock boulders, the enclosures encompass a mangrove swamp (the Wall Wetland) and coastal dry forest. It is possible that when the island was used for livestock farming, cattle were corralled in stone pens at this site while awaiting shipment from the eastern shores of Beef Island to neighboring islands.

At Banana Wharf, a small, partially filled-in channel is all that remains of what was once a canal built into the coral beach berm that separates the salt pond from the ocean (Figure 3.10.1-1). This canal was reportedly built sometime in the early Twentieth Century to allow small boats access to the pond. Not much else is known about the site. On the western shore of the Banana Wharf Pond sits a small circular stone ruin that was once a lime kiln. More research is required to assess the historical status of this site.

3.10.2. Social Setting

The airport at Beef Island was first opened in 1968 during a period when the BVI was moving from an agriculture-based economy to development of a tourism industry and other service sectors. The current airport (the Terrance B. Lettsome International Airport) was opened in 2002 and symbolizes the Territory's confidence in its economic future and development.

Aside from the airport—the largest user of land on Beef Island—there are a number of small businesses situated within Trellis Bay, once the staging ground for pirate plunders. These include three restaurants (Last Resort, Cyber Café, and De Loose Mongoose), a small grocery shop, craft shops and a water sports shop. In addition, there are a number of short piers serving the local ferry boat industry. On the southeast side of the island, along the road towards the vessel launch at Bluff Bay, is a plant nursery, Minine's Plants and Landscaping. It is one of Tortola's few commercial plant nurseries and provides nursery and landscaping services to local businesses and homes.

Local residential properties are mostly located in two areas—around Little Mountain on the northwest corner of the island and the Well Bay community to the south of the airport.

On many moonlight nights and weekends, BVIslanders gather on the beaches at Long Bay, Well Bay and Trellis Bay to enjoy parties and special events. Long Bay Beach (which is northwest of the airport, outside of the BIDP boundaries) is by far the most popular beach on Beef Island. Earlier this year, the BVI Government purchased 53.4 acres of land at Long Bay in order to ensure access to this prime beach property for the people of the Virgin Islands.

A passage from the recently published memoirs of one of the BVI's most prominent citizens, the late businessman and conservationist, Joseph R. ("J.R.") O'Neal (1911-2005) illustrates the changes at Beef Island in the last century. In his Life Notes: Reflections of a British Virgin Islander, Mr. O'Neal reflects that his father was once offered Beef Island, or at least half of it, for the bargain sale price of a mere $15.00!

3.11. Beef Island Protected Areas

In 2003, the BVI Fisheries Regulations (under the 1997 Fisheries Act) designated Hans Creek as one of 14 Marine Protected Areas (also referred to as fisheries protected areas). The protected site covers a shallow marine zone and coastal strip from the rocky headlands southwest of Little Cay to the west to Bluff Bay (Figure 3.11-1). It includes exceptional ecological habitats such as the Hans Creek Lagoon and associated mangrove system, Little Cay, and the barrier reef system adjoining it. Under current regulations, the Fisheries Protected Area at Hans Creek may limit construction activities along the coastline adjacent to the protected site.

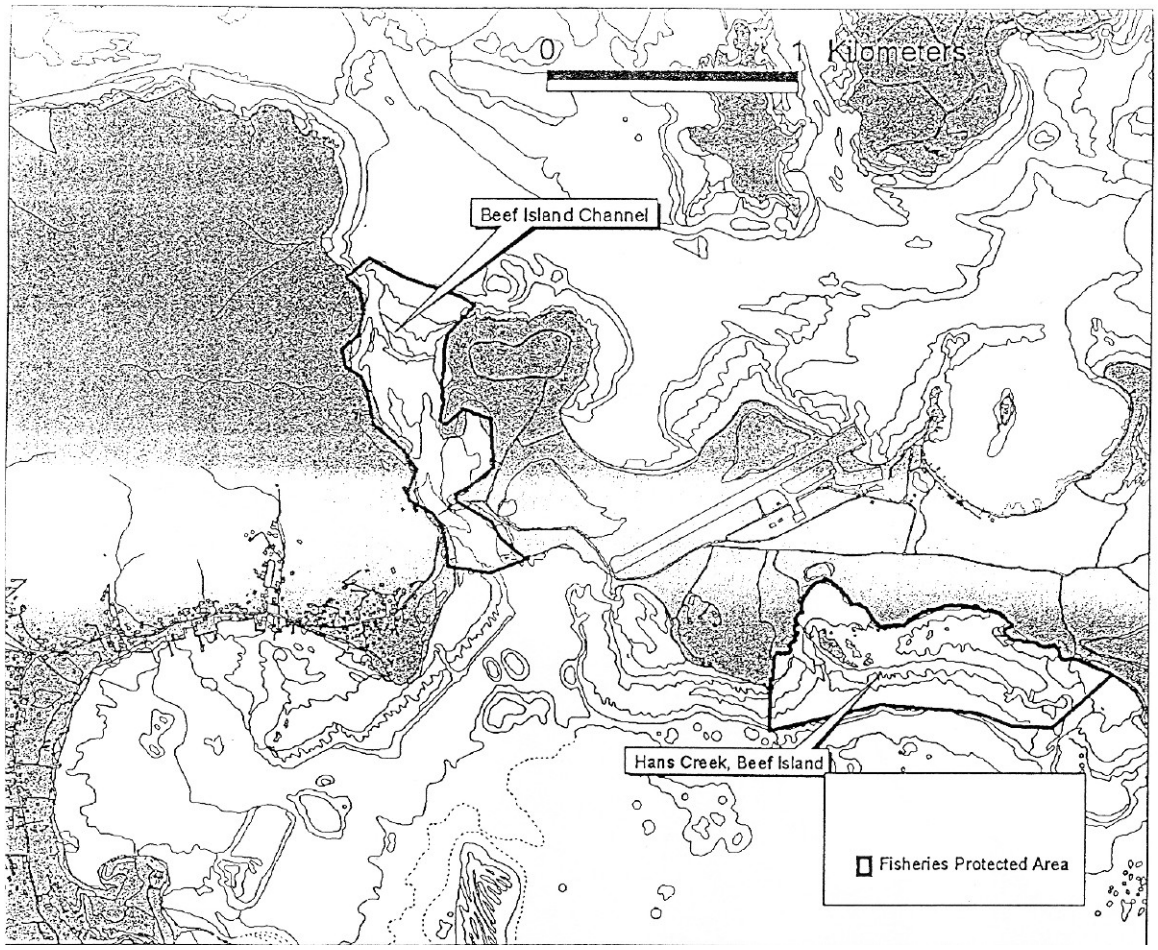

Figure 3.11-1. Location of Hans Creek Marine Protected Area (Schedule 5, Fish Regs).

In addition, a portion of Beef Island has long been identified as a desired national park site by the BVI's National Parks Trust (NPT). It was included as such in the last official revision of the NPT's *System Plan* in 1986, and, it is Island Resources's understanding that it will be included in the updated version of the *System Plan* that is currently under going revision by the Trust.

The national park site proposed by the NPT for Beef Island (designated in the *System Plan* as the Beef Island Protected Area System) incorporates two separate areas (see Figure 3.11-2).

The first area, Hans Creek Lagoon, includes a coastal zone strip from Bluff Bay west to the point between Hans Creek Bay and Well Bay and the Hans Creek Bay itself, including Little Cay. Most of the coastal and marine portions of this site overlap with the Hans Creek Marine Protected.

The second area, Banana Wharf, includes the eastern coastline of Beef Island from Sprat Point to Upper Bluff, inland along the ridgeline to Bluff Hill, as well as a marine strip extending approximately 150 yards offshore.

Additionally, the National Parks Trust, as part of the National GIS program, is currently maintaining a database on historical sites throughout the BVI, which is continuously updated as new site information is acquired. A number of historical sites have been recorded for Beef Island, and these have been incorporated in Figure 3.10.1-1 of this report, along with new site information acquired as a result of Island Resources's recent field surveys at Beef Island.

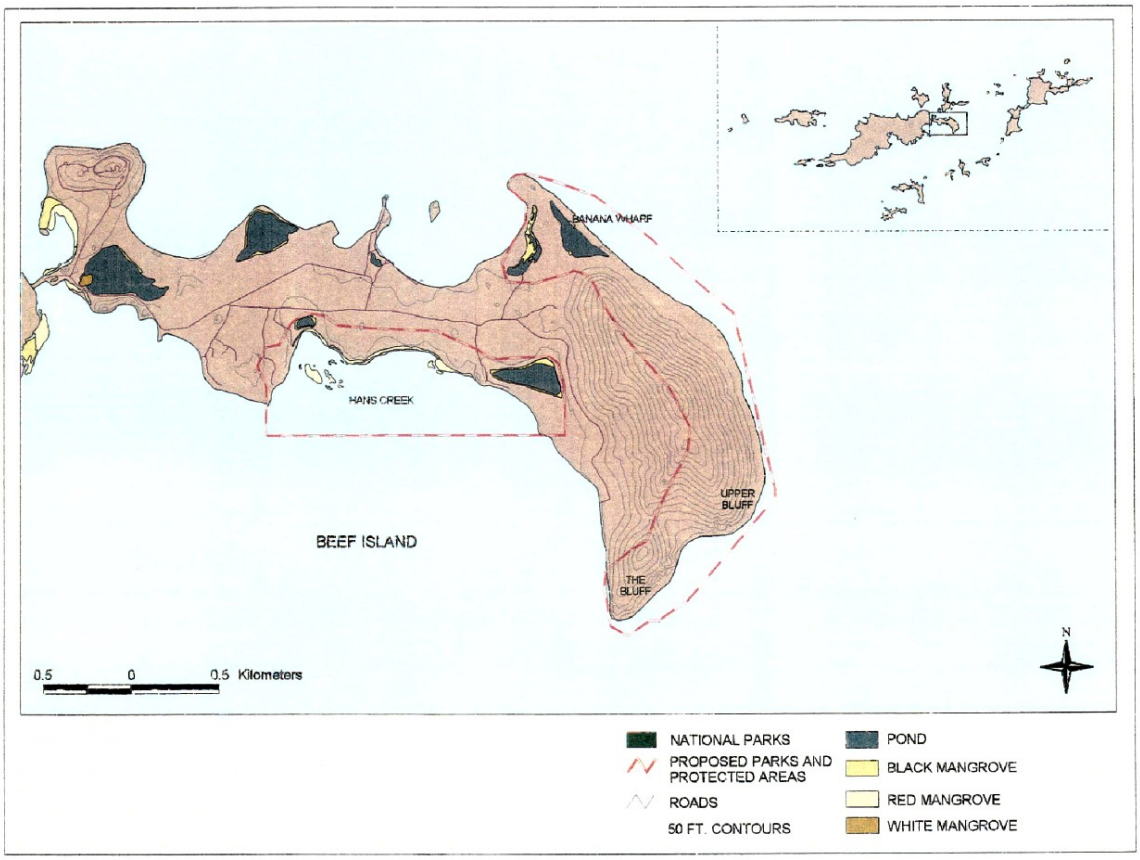

Figure 3.11-2. National Parks Trust Proposed Parks

4. PROJECT DESCRIPTION

4.1. Development Agreement Master Plan

The overview land use map of the project by EDSA (Figure 4.1-1) and other source material as discussed above provided the information about project design that has guided preparation of this report.

In general the Beef Island Development Project is designed to combine three prime features:

- An 18-hole signature golf course;
- A five-star resort hotel and major new marina facilities in the yachting centre of the Caribbean
- Residential areas for several hundred second homes and fractional ownership projects.

The combination of these three prime features promises to make Beef Island one of the major resort complexes in the Caribbean, many times larger than any other resort development existing in the British Virgin Islands.

The site is characterized by the many environmental features and amenities (Section 3, above) that give the area its unique attractiveness and provide important environmental services. It is important that the Master Plan provides a picture of the total scope of the BIDP and the strategy for implementing that development in a way that maximizes the long-term values of the property for both the owner and the larger Virgin Islands community.

The Beef Island Development Master Plan encompasses approximately 640 acres of Beef Island and is centered around a five-star resort hotel located adjacent to Bluff Bay. The resort will be surrounded by matching high-end spa, conference and marina facilities, as well as an eighteen-hole signature golf course. The development plan also calls for a re-development of the commercial area adjacent to the airport along Trellis Bay, along with improvements to the beaches at Trellis Bay, Bluff Bay and Well Bay.

Scattered throughout the remainder of the property are planned residential developments of varying densities, preserved historical ruins, as well as natural and landscaped greenspace areas. The following sections further describe each component of the total proposed development, grouping components according to the proposed construction phasing outlined previously herein.

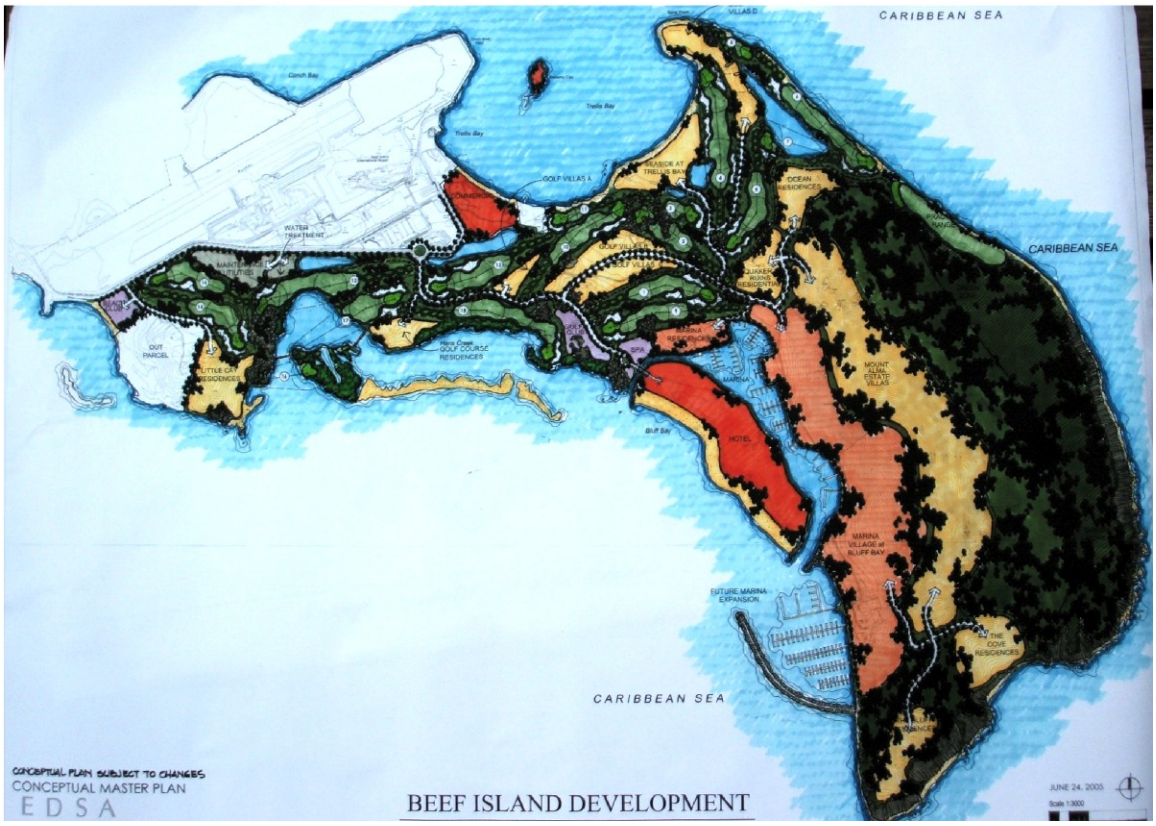

Figure 4.1-1. Conceptual Land Use Map of the Beef Island Development Project (EDSA, June 2005).

4.2. Golf Course and Golf Residences

An eighteen-hole signature golf course will be constructed as a primary amenity to the resort. It will be the first of its kind in the BVI. The course layout will exceed 7,000 yards in length and be designed to make best use of the existing environmental, historical, topographical and geological conditions. The golf course will cover approximately 180 acres of the development. A golf club will be incorporated into the resort hotel's check-in facility. Additionally, a 6-acre practice facility is proposed for construction along the northeast side of Beef Island, adjacent to golf hole numbers 6 and 7.

Approximately 65,000 cubic yards of fill will be required to properly grade the course. Four water features are planned for the golf course, two of which are comprised of existing salt ponds and two other shall be excavated into the surrounding topography.

Five clusters of varying density golf residences are planned for construction within the general vicinity of the golf course. Altogether the residences encompass approximately 26 acres. Sixty units (+/-) are planned for construction

within this footprint. Details on vertical construction, landscaping, etc. are not known at this time and shall be further detailed in the Golf Course EIA.

It has been noted that the current airport drainage into Hans Creek has induced negative impacts to this environmentally sensitive area. As possible, improvements to the existing airport drainage system will be made by buffering the airport runoff impacts by routing part of the runoff into the golf course ponds before discharging overflow into the ocean. Selected water features will be used as water sources for irrigation of the golf course.

Additional detail on golf residences, pest control, ground cover, clearing and grading, stormwater runoff, sediment and erosion control, maintenance and operations of the golf course, etc. will be detailed within the Golf Course EIA.

4.3. Resort Core – Hotel Island, Marina, and Infrastructure/ Utilities

4.3.1. Resort Hotel Island

The five-star resort hotel will be situated on a 24-acre island to be created through the excavation of the interior marina basin (refer to Figure 4.1-1). Between 250,000 to 350,000 cubic yards (cy) of the excavated marina basin material will be used as both non-structural and structural fill to raise the hotel island to final grade. Finished floor elevations for the hotel island are to be finalized upon completion of a site-specific storm surge analysis – the results of which will be outlined in the Resort Core EIA.

The hotel island will house 120 hotel units, 80 condominium keys, as well as a centrally located restaurant facility. The hotel island shoreline will be stabilized utilizing a combination of vertical bulkhead and sloped revetment. The various types of construction on the island, including all hotel rooms, lobbies, pools, roads, beaches, drainage systems, utilities, etc. will be addressed in further detail in the Resort Core EIA.

4.3.2. Marina and Marina Village

A 200-slip marina capable of accommodating vessels up to 170 feet in length is to be excavated within what is currently designated as the Bluff Bay salt pond. This "interior basin" will cover roughly 23 acres of land area and will require between 600,000 and 1,000,000 cy of excavation. Over 7,500 linear feet of vertical bulkhead and sloped revetment will be installed to stabilize the newly formed shoreline, including the hotel island shoreline.

The interior basin will be connected to the sea through excavation of a 150-ft wide navigation channel located at the southern limit of the hotel island. The controlling depth of the channel will be 14 feet below local Mean Low Water (MLW). The estimated length of the navigation channel is 280 feet from shore out to –14 ft MLW.

A secondary channel excavated to create the "island" effect of the hotel resort is proposed at the northern limit of the marina basin. The secondary channel will be approximately 50 feet wide and 200 feet in length. No direct connection between the marina basin and open water will be made through this channel. Water exchange will be prevented through the construction of a dike incorporated into the substructure of the bridge access. Adequate flushing of the marina basin to maintain water quality will be accomplished through *pumping offshore seawater* into the northern end of the marina basin.

A programmed marina village complex, complete with retail shops, restaurants, boat charters, fractionally-owned resort units, and other attractive waterfront amenities will be developed along the interior marina basin shoreline. Details about the marina village complex and all marina-related infrastructure and utilities will be addressed in the dedicated Resort Core EIA.

4.3.3 Infrastructure / Utilities

All of the necessary infrastructure required for the resort core, as well as all main infrastructure and utility links to the golf course and future development will be outlined. These will include, at a minimum, the following:

- Transportation and road networks;
- Potable water;
- Irrigation water;
- Primary and backup electricity;
- Sewage treatment;
- Solid and liquid waste;
- Stormwater collection and handling;
- Communications;
- Maintenance Facilities; and,

The basic premise for all services for the Beef Island Development is that it will be self sufficient with respect all utilities (or standby power for electricity). Water will be provided by the development's desalinization plant, solid waste will be treated by mechanical systems to be designed for the Development, runoff will be collected in the water features and salt ponds on the golf course, and will be

combined with grey water for irrigation. Electrical standby generation will be provided for all facilities.

One of the more difficult challenges of the proposed development plan will be to meet the design challenges of establishing adequate infrastructure and utilities to support a project of this magnitude. Issues of "scale" are often difficult to integrate into small-island development planning projects. Such scale issues and the unique conditions of small tropical islands have been a primary focus of study by Island Resources Foundation for more than three decades. Tortola is a small island in a small country in the Caribbean. The Beef Island Development is a large project, which will have a measurable impact on many features of the island, including the public infrastructure of the British Virgin Islands.

Roads, Parking and Port Facilities. Among infrastructure issues, roads are likely to be the most significant because of their long-term impacts on runoff and sedimentation processes. During the last ten years, researchers from Island Resources Foundation have confirmed that erosion and sediment runoff in the U.S. Virgin Islands are several times greater than was previously indicated by conventional engineering models using assumptions common to continental areas. Additionally, Island Resource's researchers have identified unpaved roads as the dominant contributor to erosion and runoff in Virgin Islands watersheds.

Available concept drawings for the BIDP (see Figure 4.1-1) provide general pictures of the road networks, parking lots and port areas planned for the Beef Island project, but critical issues—such as the increases in impervious surfaces, maintenance regimes for "unimproved" roads and port areas, the nature of and controls on construction roads, and the design standards for pitch and drainage on access roads for residences on Mount Alma and other smaller elevations in the development—will be resolved prior to submission of the Resort Core EIA.

Electricity and Energy Resources. The amount and density of electricity use in the Beef Island Development Project is likely to be higher than any area of Tortola except Road Town. Reliability of electrical power provision will be a critical value for the up-market users of the BIDP, many of whom will be long-term or full-time residents, rather than one-time tourists. The unreliability of power provision has been a long-standing issue in Tortola. In addition, generating facilities are at Pockwood Pond, close to the western end of Tortola, with all that implies for day-to-day reliability for consumers at the east end of the island as well as quick resumption of power in the aftermath of a hurricane, earthquake or other major disaster.

As a general guideline, environmental audits of hotels in Jamaica showed an average electrical demand of 21.4 kwh per guest night (Hagler Bailly, 1999).

Given the number of hotel and residential units, together with commercial and other facilities, it can only presently be stated that electricity demand will be substantial.

Water. Management of the range of required water uses and available resources for the Beef Island Development Project may be the most complicated issue facing planners, with major consequences for the long-term viability of the resort and the conditions of adjacent areas in the Territory. As a general estimate, however, audits for Jamaican hotels suggest an average consumption of 216 imperial gallons per guest night (Hagler Bailly, 1999).

Liquid Waste. The conceptual Master Plan indicates a water treatment facility in the utility complex on the northwest side of the property, just south of the airport runway; but we are uncertain if this refers to possible desalinization or grey water treatment systems for water consumption, or if this is some form of pre-treatment for liquid waste.

It is our understanding that the proposed public sewage treatment system for the East End/Long Look area of Tortola will be planned and constructed to include all waste from the Beef Island Development Project. However, there remain many unknown factors in the design of the total system (including the pipeline construction routing from Beef Island to the treatment plant), which will affect the reliability and security of this system as well as related risks to human and natural environments.

Solid Waste. In common with other high-income areas, the Beef Island Development Project will generate relatively large volumes of solid waste, particularly when compared with other BVI communities. On average, a hotel produces 2 to 4 lbs per room per day, a restaurant 1 lbs/seat/day, and a golf course 0.5 lbs/golfer/day (www.wasteline.com). Solid waste streams will also originate from the marina and commercial areas. It is not known if these large additions from Beef Island to the existing landfill operations on Tortola have been factored into plans for the operation of the Territorial solid waste system.

4.4 Future Development

4.4.1. Trellis Bay Commercial Area

A portion of the future phase development of Beef Island seeks to improve the existing commercial area adjacent to the airport on Trellis Bay. Island Resources Foundation authored an Environmental Impact Assessment of a previously proposed "Phase 1 Commercial Development" within this area. The 1998 EIA covered redevelopment of 1.9 acres, including the renovation of four single story

buildings and the construction of two, two-story buildings. This EIA was submitted to the Government of the BVI and was consequently (not) approved.

The current plans for the Trellis Bay Commercial Area have grown to encompass 9 acres of land, with approximately 300 feet of shoreline frontage along Trellis Bay. A series of retail shops, offices, guesthouse residences, and commercial villas/condos, totaling 115,000 square feet of building area will be constructed. Three new pier structures will be constructed to provide improved water access and parking will be provided for up to 120 vehicles.

The existing salt pond will be enhanced as a water feature for the development. The Commercial Area will be open to the public and to resort guests for entertainment and shopping opportunities.

4.4.2. Beach Enhancements to Trellis Bay, Well Bay, Little Cay, and The Cove

The beaches along Trellis Bay, Well Bay, and at the Cove residences will require aesthetic improvements to meet the expectations of the resort hotel guests and residents. Consequently, between 2.5 to 3.0 acres along Trellis Bay's shoreline will be selectively cleared, degrubbed, and graded above the mean water line (MWL) to create additional upland beach areas. The same will be done for approximately one acre of Well Bay shoreline at the western end of the property.

Selective dredging of nearshore areas to provide adequate beach sand to upland portions of the beaches at Trellis Bay the Cove, Little Cay and Well Bay is being evaluated. Because of the open exposure to the predominant wind and wave fields, the small pocket beach at the Cove Residences will require importation of sand and substantial structuring to retain a beach.

Any proposed excavation and dedicated structures related to beach enhancement activities will be further detailed within the appropriate sections of the Future Development EIA.

4.4.3. Bellamy Cay

Bellamy Cay is situated within Trellis Bay and is currently home to the Last Resort. The existing structures on the cay will be rehabilitated to provide an improved authentic experience to resort guests, other tourists and locals alike.

While no significant alterations to the cay are proposed, the shoreline will be cleaned and the existing old dock structure will be replaced.

4.4.4. Future Phase Exterior Marina Basin

To supplement future demand for additional marina berths, a future phase exterior marina basin is proposed along Bluff Bay. The exterior basin will sit in the lee of the prevailing trade winds behind Mount Alma and will be further protected from wind/wave actions by a pre-cast concrete or stone breakwater. Approximately 200 additional slips will be provided through the construction of fixed piers. No excavation is anticipated for the exterior basin, as there is adequate water depth within close proximity of the shoreline.

4.4.5. Residential Development

Approximately 220 residential units are planned for a group of seven future phase residential developments, not including the residential construction associated with the marina village (to be outlined in the Resort Core EIA). The seven development groups are currently referred to as:

- *Golf Villas and Residences* – five clusters of townhouses and single-family residences spread across the project site adjacent to the golf course.
- *Little Cay Estates* – a cluster of single-family residences overlooking Little Cay.
- *Mount Alma Estates* – selected lots along the western flank of Mount Alma, elevated above the marina village.
- *The Cove Residences* – single-family residences located on the southeastern end of Beef Island within an existing low point between Mount Alma and the tip of the island.
- *The Bluff Residences* – single-family residences located on the southeastern tip of Beef Island.
- *Ritz Carlton Clubs* – two clusters of free-standing fractional units located along the northern portion of Trellis Bay up to Sprat Point.

Details on buildings, landscaping, construction management, etc. will be further detailed in the Future Development EIA.

4.4.6. Beach Club Option at Trellis Bay

An optional beach club is being considered for the area adjacent and to the east of the Commercial Area at Trellis Bay. The club would consist of a small reception area, changing rooms, and food and beverage outlet for residential property owners. As of the date of this scoping document, no details on space requirements, parking, landscaping, etc. were available. These details will be provided in the Future Development EIA.

4.4.7. Staff Housing

As of the date of this scoping document, details on staff housing are yet to be determined. The Future Development EIA will outline all details regarding staff housing, including location, capacity, construction types, etc.

4.5. Environmental Amenities

Cliff Juillerat of Ocean Caraibes, in association with Smiths Gore and Island Resources Foundation, has identified a preliminary list of environmental amenities, mitigation activities and other benefits that may be implemented as a result of the Beef Island Development Project. These include:

1. Pest Control
    a. Mosquitoes
    b. Sand flies
    c. Goats
2. Beach Improvement
    a. Wells Bay
    b. Trellis Bay
    c. Little Cay
    d. Bellamy Cay
3. Salt Ponds (improvement, prevention of smell and mosquito breeding area)
    a. Commercial area
    b. Banana Wharf
    c. Trellis Bay Pond
    d. Hans Creek (airport run-off area)
4. Hans Creek
    a. Implementation of Management Plan
    b. Artificial reefs
    c. Boardwalk access
    d. Snorkeling trails
5. Landside Projects
    a. Nature trails
    b. Boulder park (overlooking Hans Creek)
    c. Signage (for environmental and educational programmes)
    d. Indigenous species project including protection of rare and endangered species
    e. Feasibility of a botanical garden
    f. Protection plan for historic sites
6. Marine Projects

a. Replanting mangroves
b. Replanting/transplanting sea grass
c. Artificial reef project in Trellis Bay

7. Environmental Projects
   a. Appointment of local environmental supervisor (training programme if necessary) and Terms of Engagement
   b. Local educational programmes
   c. Building and operation to secure Green Globe 21 Destination Certification.

While some of these elements are one-time activities or clearly designed to offset negative effects of the construction and final development, many of them represent positive contributions to the natural and human communities of the British Virgin Islands.

4.7. Proposed Timing of the Project and Major Construction Impacts

Based on general discussions and an understanding that separate approvals will be issued for each EIA, the following represents the relative project phasing (initiation of construction and periods of time to complete per the Development Agreement):

- *Rough grading of golf course should commence immediately upon Government approval of the Golf Course EIA. The golf course will be completed within three years of start of construction.*

- *Marina basin excavation should commence immediately upon Government approval of the Resort Core EIA. The marina will be completed within four years of start of construction.*

- *The resort hotel island should commence immediately upon Government approval of the Resort Core EIA. The resort hotel will be completed within six years of start of construction.*

- *Airport commercial area work should commence immediately upon Government approval of the Future Development EIA. The completion of the commercial area is not currently subject to any specific development timetable and shall be undertaken as the plans, resources, and market conditions dictate.*

- *Site infrastructure will start soon after Government approval of the Resort Core EIA and shall be phased in accordance with construction of other project components (i.e., golf course infrastructure shall be constructed at same time table as golf course, etc.).*

- *Residential construction will begin at an unknown time after Government approval of the Future Development EIA. The completion of the residences is not currently subject to any specific development timetable and shall be undertaken as the plans, resources, and market conditions dictate.*

Based on these estimates, it seems that the project's major construction activities — especially those with very large-scale earth changes that imply major environmental impacts — will hinge upon the review and approval process of the dedicated EIAs.

Upon initiation of construction, environmental impacts of the project will be managed through mechanisms established during the EIA process of the project or in the Development Agreement. The adopted management protocols will likely be coordinated by the office of the proposed Project Environment Officer (an innovative staff position employed at few other major resorts in the Caribbean).

5. POTENTIAL IMPACTS

5.1. Socio-Economic Impacts

The development of a resort at Beef Island will undoubtedly increase human traffic to and from the island, which is connected to Tortola via a single bridge. Though tourists patronizing the facilities will usually arrive at the adjacent airport, and to a lesser extent through the marina, the development will attract non-airport-originating traffic and most of the workers are expected to be resident on Tortola.

The bridge connecting Beef Island to Tortola has only two traffic lanes, with no shoulders. While traffic to and from the island is normally minimal, this can periodically increase and create congestion. For example, on weekends, especially on Sundays, local residents frequent the popular Long Bay Beach for parties and other social events. Hundreds of patrons park vehicles along the road to the beach, and this can extend well along the road toward the bridge. A parking plan is essential to better control and regulate vehicular traffic on the island.

Traffic and parking issues may also be important in relation to the Beef Island Development as a draw for cruise ship passengers. With a political commitment to permitting up to three cruise ships with up to 3,500 passengers (and as many as 1500 crew members) to land at Road Town, the traffic load to Beef Island and the parking and facilities needs at public Beef Island facilities, such as the Golf Course or the Trellis Bay Commercial Area will be considerable.

The demands of the BIDP for electricity, solid waste disposal, potable water, water to irrigate the greens and gardens, and similar requirements will need to be considered within the context of the overall needs of the larger BVI community and the tourism industry it supports. In addition, these potential impacts should be considered within the commitment of the Development to being self-sufficient as necessary with respect to all utilities. Already Tortola suffers from periodic "brown-outs" and staggered power schedules, while the rapid increase in recent years of cruise ship tourism has raised community concerns about quality-of-life issues associated with tourism expansion and the island's capacity to adequately provide necessary services for further growth.

The noise impact of the development is expected to be minimal, especially within the context of its location adjacent to the airport which is responsible for the most significant noise pollution in the area. Though the potential for noise pollution

from the BIDP cannot be dismissed, especially during construction phases, it will likely be less than what is caused by the airport.

Beef Island has a small population of local residents, and it is also a favorite escape for Tortola residents who use its beaches, particularly on weekends. As indicated above, this widespread cultural practice is quite evident on Sundays, especially at Long Bay Beach and at Trellis Bay Beach. The salt ponds are also used by science faculty and students from the H. Lavity Stoutt Community College for field courses on coastal and marine ecology.

A few residents continue to harvest the natural resources of the island. These include: collecting hermit crabs for use as fish bait, whelks (from along the eastern rocky shoreline), and conch (especially from Hans Creek to Bluff Bay); collecting plants for home remedies and other applications; the existence of one relatively large area for crop cultivation; and the use of beaches and coastal waters by fishers to harvest various marine resources.

Trellis Bay is currently the centre of economic activities on Beef Island. There are a number of ferry docks that service facilities and establishments in Virgin Gorda and other nearby islands. There are also restaurants, picnic facilities, an Internet café, craft outlets, and a car rental establishment. The Last Resort on Bellamy Cay in the centre of Trellis Bay is a restaurant of longstanding. This well-known facility is recognized as a cultural icon to residents and visitors alike.

The impact of the BIDP on those economic enterprises currently based at Trellis Bay will need to be addressed in the Beef Island Economic Feasibility Study (see Annex B, for the Future Development). Additionally, an assessment is needed of the anchorage population at Trellis Bay; the bay is heavily used by boaters, both long-term live-aboard residents and by charterers and other transients who use the services and entertainments facilities of the area.

5.2. Impacts on Archaeological and Historical Resources

Archaeological and historical resources that might be impacted by the Beef Island Development Project are preliminarily reviewed in Section 3.10 of this Scoping Report. Further study is needed to determine if additional survey work is required (particularly pertaining to a potential Amerindian site identified by the IRF team in June). Known archaeological ruins such as the "Quaker Ruins" will be preserved and incorporated into the development as educational and aesthetic amenities.

5.3. Hazard Risks

Natural hazards that could impact the Beef Island Development Project are primarily associated with hurricanes, storms, earthquakes, land slides, flooding and wave action. Although such natural phenomena occur only intermittently, the consequences of these hazards could be of disastrous dimensions in terms of impact on the physical and economic environment of Beef Island.

Given the intensity of development expected on the lowland areas of the Beef Island Development, and the absence of flood plain mapping in the British Virgin Islands (which would be available routinely to development in the USVI, for example) special attention needs to be given to modeling and analysis of surge and waves which might be expected from storms and tsunamis, such as was developed several years ago for the Caribbean Disaster Management Programme (CDMP) of the OAS. The CDMP recommended standard for wind damage for Beef Island for example, would be to design the project with a maximum likelihood of estimated survival for the housing and development facilities of 75% for a 100-year storm event.

A site-specific storm surge analysis is being developed based on this information and other resources to determine adequate levels of protection from tropical storm events, etc.

Man-made hazards with potential for adverse environmental impacts are principally associated with the operation of the marina facilities, the fuel storage facilities, and utility services, such as sewerage treatment facilities, and with the use of fertilizers, pesticides and herbicides for maintenance of the golf course. The possibility of toxic substance accidents and the potential discharge of toxic materials to coastal waters should be addressed in the Environmental Impact Assessment, along with mitigation strategies.

5.4. Global Climate Change

Global climate change predictions are still preliminary and tentative in their accuracy, and coarse in terms of sub-regional precision. Nevertheless, the fourth assessment report of the Intergovernmental Panel for Climate Change (in draft) indicates that in the tropics, especially in small island areas, the probable local effects of climate change include:

Increased water depth of 0.3 to 0.7 metres over the next fifty years;

Increased frequency of major storms;

Increased climate variability; and (with less assurance for the Eastern Caribbean)

Possible decreases in average annual precipitation.

All of these possible predicted effects of global climate change for the Virgin Islands have direct implications for the environmental and socio-economic impacts of the Beef Island Development Project.

5.5. Phase 1: Golf Course

5.5.1. Salt Ponds Impacts

Table 5.5.1-1, below is adapted from "Table 3.9.1.1-1. Assessment of Ecosystem Services Provided by Salt Ponds." In Table 5.5.1-1, we have attempted to identify the major salt pond impacts expected during short term and long term effects of the Phase 1 Golf Course development..

Because Phase 1, the Gulf Course covers most of the lowland areas of the Beef Island Development it affects virtually all of the Salt Ponds.

Colors of the Table are derived from the original Table 3.9.1.1-1, and are indicative of current services, with greener colors intended to convey the idea of larger, richer services provided by the current systems, yellow cells being less signficant.

Table 5.5.1-1. Assessment of Ecosystem Services Impacted by Phase 1: Golf Course Construction and Operation

		Hans Creek Pond	Bluff Bay Pond	Trellis Bay Pond	Central Beef Island Pond	Banana Wharf	Wall Salt Pond
	Area in acres	1.0/0.4ha	N/A		3.7ac/1.5ha	7.4ac/3.0ha	
	Watershed acres	49.8/20.2 ha*	99.9/40.4 ha	*	*	26.9/10.9 ha	
	Proposed Dev Activity	13th Fairway Utility Services	**Impacts Addressed in Phase 2 EIA**	Commercial Area 11th Green	4th Fairway	6th & 7th Fairway Golf Villas D?	Practice Range
1	**storm protection & mitigate onshore flooding**	Minimal Impact	**N/A**	Minimal Impact	Minimal Impact	Minimal Impact	No Impact
2	**control coastal erosion & mitigate offshore pollutant flow**	Potential Improvement re Airport drainage	**N/A**	Min: Potential Improvement re Airport drainage	Potential Improvement re Airport drainage	Potential Improvement re Airport drainage	No Impact
3	**nursery services for fish, lobster, etc.**	Potential Negative Impact	**N/A**	No Impact	No Impact	No Impact	No Impact
4	**export food to marine ecosystems**	Potential Negative Impact	**N/A**	Minimal Impact	Potential Improvement re Airport drainage	Potential Negative: Investigate	No Impact
5	**habitat & food for wildlife, e.g. migratory birds**	Potential Negative: Impact	**N/A**	Potential Negative: Investigate	Potential Negative: Investigate	Potential Negative: Investigate	Potential Negative: Investigate
6	**green spaces**	Flora change; aesthetic improved	**N/A**	Flora change; aesthetic improved	Flora change; aesthetic improved	Flora change; aesthetic improved	Flora change; aesthetic improved

* Size of watersheds for ponds in lowland areas (Hans, Trellis, Central) subject to major changes, based on project grading and landscaping.
** Plans for two additional water features on the Golf Course may call for adding two columns to this table which could capture services which these new features might provide.

5.5.2. Boulder Fields

It is unknown at this time the extent of changes to the existing boulder fields. These will be further detailed pending additional fieldwork and golf course design and included in the Golf Course EIA. In general it can be anticipated that cluster of boulders will have to be moved and/or blasted to enable the golf course to be suitably graded into the surrounding landscape. Attempts to retain boulders will be made by incorporating significant outcroppings into the golf course architecture where possible.

5.5.3. Banana Wharf Pond Berm

The berm and its vegetation protect the pond and inland areas from seawater inundation and consequent rapid erosion during storms. The proposed construction of the sixth and seventh fairways on the berm that separates the pond from the sea will have to be redesigned to retain the integrity of the salt pond, beach and shore waters in the area of Banana Wharf Pond. The removal of seashore shrubs can increase the susceptibility of this shoreline to erosion. Additionally, grass will be difficult to maintain on this berm as intense salt spray occurs on windy days, and the potential use of fertilizers and pesticides to enhance grass growth in such close proximity to both the pond and the sea (with rich seagrass beds close offshore at this point) is of concern. Runoff in both directions will undoubtedly occur.

5.5.4. Fragmentation of Natural Vegetative Communities

The development the golf course will result in significant changes in the island's original landscape, modifying and transforming it to a developed and maintained landscape. The construction of the 18-hole golf course with its fairways, tees, greens, roads, and other facilities will result in the removal of native habitats, the potential introduction of exotics, a decline in native biodiversity and the spread of non-native species throughout the island. It will also increase the risk of habitat fragmentation.

Increasing habitat fragmentation and increasing open areas is likely to produce drier conditions, and, for the Beef Island Development Project, drier conditions will necessitate the use of large amounts of water and supporting facilities, including water conservation and management regimes and methods to ensure that the landscape of the development is maintained in the manner envisioned by its owner and planners.

In the short-term, some species of plants and animals may benefit from habitat fragmentation. This occurs because opening up the current forest and shrub habitats of the lowland areas of the Golf Course will increase herbaceous growth, including grasses, and many weedy species. These attract many passerine birds, especially seed eaters such as the black-faced Grassquit (*Tiaris bicolor*) and other generalist such as the bananaquit (*Coereba flaveola*), the gray kingbird (*Tyrannus dominicensis*) and the Caribbean elaenia (*Elaenia martinica*), and the ubiquitous pearly-eyed thrasher (*Margarops fuscatus*), one of the commonest and most dominant avian species in the BVI.

Perhaps the most negative long-term faunal impacts of fragmentation may affect the island's invertebrates. Fragmentation could potentially reduce the amount of habitat necessary for healthy invertebrate populations in the golf course area, and there may be a gradual decline in species and populations which needs to be considered in the EIA. Additionally increasing habitat fragmentation may aid in the spread and infestation of termites.

5.5.5. Coastal Marine Communities

A golf course green (hole #16) and tee-off (hole #17) are proposed for Little Cay and the Hans Creek area, where the environment has already been disturbed but habitats are slowly recovering from the major insults that occurred during the construction of the Airport in 2000 and 2001 (Petrovic, 2005).

5.5.6. Special Concerns of Golf Course Development

In addition to the potential impacts already discussed above regarding salt ponds and coastal wetlands and their dependent wildlife and habitats, the size and scope of the current golf course design raises additional issues that will need to be addressed in the Environmental Impact Assessment, including:

- Future impact of drainage from altered natural guts and wetlands and from the clearing and excavation of steep slops above.
- Confirmation of the scope and amount of earth moving, cut-and-fill required to shape the golf course.
- Evaluation of the amount of area required for turfgrass cover, in order to minimize requirements.
- Determination of water sources, water quality and water use requirements, on a seasonal basis.
- Quantification of the amount of fertilizers, pesticides and herbicides to be used.

- Assessment of the source, quantity and delivery of topsoil mix for greens and fairways.
- Consideration of the effect of placing certain individual tees and greens on or adjacent to boulder piles or clusters.
- Extent of maintenance personnel and equipment required for golf course grooming and long-term care.
- Consideration of developing the golf course as a "golf preserve and sanctuary," which would—through its design—preserve and enhance critical and sensitive natural assets and amenities.

A "signature" golf course is a blend of the natural and unnatural environment that includes shaping and draining the golf course setting, thus improving the golf layout and protecting the natural environment. This includes protecting natural features within the golf course boundary to help enhance the golfing experience. Existing natural conditions may have to be altered in some areas to produce a playable situation and this may include but not limited to earthwork, and removal or relocation of trees and boulders. Golf course designers (the Jack Nicklaus group) add that additional issues addressed in the EIA will be:

- Turf and Irrigation Management program
- Types of proposed grasses,
- Water demand,
- Storm water control plan, and
- Fertilizer/pesticide/herbicide and larvacide application regimes program including volume and frequency

5.6. Phase 2: Marina / Resort Hotel and Infrastructure/Utilities

Conceptual drawings of the resort core provide a picture of dispersed, small low rise units, set back from and facing the beach, running the length of the constructed resort island.

The resort island itself will be built up with approximately 250,000 cubic yards of locally derived fill and bulwarked, as described in Section 4.3. Although well protected from open sea and normal trade wind conditions, the shore of the resort island will be exposed (prior to the possible future construction of the Outer Marina) to a five-mile-or-greater fetch from the south and southwest. This can result in considerable wave action during hurricanes and other unusual weather events. The multiple re-buildings and extensive repairs to the Queen

Elizabeth Highway south of Road Town provide a gauge of the scale of wave effects that might be expected at the Bluff Bay site.

The major protection for the resort island (in addition to good design, engineering, and construction) will be the nearshore reef system in Bluff Bay in front of the resort island. Strategies to protect this system will be critical, given the extent of the proposed alterations to the shore and the substantial dredging and land excavation that will occur behind the resort island to excavate for the Inner Marina.

5.6.1. Salt Pond Impacts from Core Resort Development

Table 5.6.1-1, below is adapted from "Table 3.9.1.1-1. Assessment of Ecosystem Services Provided by Salt Ponds." In Table 5.6.1-1, we have attempted to identify the major salt pond impacts expected during short term and long-term effects of the Phase 2, Core Resort development.

Because Phase 2 is concentrated largely in the area of the resort and marina development in the Bluff Point area, and in the identified utility area behind the Hans Creek Salt Pond, these are the only Salt Pond areas with identified impacts. Colors of the Table are derived from the original Table 3.9.1.1-1, and are indicative of current services, with darker, greener colors intended to convey the idea of larger, richer services provided by the current systems.

Construction of the inner marina will eliminate the largest pond on the island, and dredging in this area could introduce fine sediments to the Hans Creek protected area. Dredging this pond will have operational and construction-period impacts that need to be considered in the Environmental Impact Assessment, including (as also illustrated more succinctly in Table 5.6.1-1, below):

- A reduction of available habitat for water birds, thus reducing the number of birds that can be supported by the resources of the BVI.

- Removal of a Wigeongrass community, which occurs regularly in Bluff Bay Pond but in only a few other ponds in the BVI.

- A reduction in the capacity of this wetland to retain erosion sediments and pollutants and to prevent their discharge to the coastal environment in runoff water.

- Potential production or disturbance of sediments that need to be managed during dredging and transport.

Soil erosion is likely to be a problem during the construction phase of the project and until all of the open land is revegetated and/or paved. Nutrients from fertilizers and from sewage, as well as pesticides, engine oils, and cleaning products are likely pollutants during the operational phase of the project. Any of these pollutants that are applied, disposed of or leaked into the open environment will be washed downhill and into one or more salt ponds during rains. Opening Bluff Bay Pond to the sea could allow these pollutants to flush out to the sea rather than be retained in the pond. Sediments and pollutants entering the sea here will have the potential to negatively impact the coral reef and seagrass communities at Hans Creek and Bluff Bay.

Table 5.6.1-1. Assessment of Potential Impacts on Services Provided by Salt Ponds Affected by Phase 2 Resort Core & Utility Development

		Hans Creek Pond	Bluff Bay Pond	Trellis Bay Pond	Central Beef Island Pond	Banana Wharf	Wall Salt Pond
	Area in acres	1.0/0.4 ha	8.9/3.6 ha		3.7ac/1.5 ha	7.4ac/3.0 ha	
	Watershed in acres	49.8/20.2 ha*	99.9/40.4 ha	*	*	26.9/10.9 ha	
	Proposed Dev Activity	13th Fairway **Utility Services**	Marina & 5-Star Resort	EIA: Golf Course & Future Development	EIA in Golf Course	EIA: Golf Course & Future Development	EIA in Golf Course
1	**storm protection & mitigate onshore flooding**	Not a major value	Dredging and conversion of will impact all functions of this pond				
2	**control coastal erosion & mitigate offshore pollutant flow**	Potential Improvement re Airport drainage	EIA to Analyze: Stormwater and erosion control impacted				
3	**nursery services for fish, lobster, etc.**	EIA: Coastal impacts of utility facilities	No impact				
4	**export food to marine ecosystems**	Impact not known, should be monitored	EIA; monitoring should track loss impacts				
5	**habitat & food for wildlife, *e.g.* migratory birds**	Impact not clear, may not be major	Potential negative impact from major habitat change				
6	**green spaces**	Change: Monitor	Conversion to Marina and Hotel				

* Size of watersheds for ponds in lowland areas (Hans, Trellis, Central) subject to major changes, based on project grading and landscaping.

5.6.2. Boulder Fields

There is one boulder field at the western end of the resort island area which has been mentioned as a natural feature that the developer intends to incorporate as a natural amenity for the overall resort design. The mini-refuge aspects of this field will probably be lost, but this is not the only boulder field in the lowlands of the overall development.

5.6.3. Beach Berm

Natural features and services of the beach berm in front of the Bluff Bay salt pond will be lost to the marina channel dredging and construction of the elevations for the resort island. Shoreline protection services will obviously be provided by the new resort island and related facilities. Unique environmental aspects of the berm, such as habitat especially attractive to certain species will probably be lost given the intensity of the resort core development.

5.6.4. Fragmentation of Natural Communities

The development of the Beef Island Resort Core (Phase 2) for tourism will result in significant changes in the core area's landscape, modifying and transforming it to a developed and maintained landscape. The construction of roads, a resort hotel, marinas, and other facilities will result in the removal of native habitats, the probable introduction of more exotic species leading to possible decline in native biodiversity. It will also increase the risk of habitat fragmentation.

In the short-term, some species of plants and animals in the Resort Core area may benefit from habitat fragmentation. This occurs because opening up mangrove habitat will increase herbaceous growth, including grasses, and many weedy species. These attract many passerine birds, especially seed eaters such as the black-faced Grassquit (*Tiaris bicolor*) and other generalist such as the bananaquit (Coereba flaveola), the gray kingbird (*Tyrannus dominicensis*) and the Caribbean elaenia (*Elaenia martinica*), and the ubiquitous pearly-eyed thrasher (*Margarops fuscatus*), one of the commonest and most dominant avian species in the BVI.

All of these species are relatively common today on all of the Virgin Islands. These species do well in fragmented and disturbed habitats and are able to exploit various food sources from around human habitations, especially at hotels and restaurants.

Perhaps the most severe long-term impacts may be on the island's invertebrates. Fragmentation and intensive habitat alteration, while increasing certain populations in the initial stages, will certainly reduce the amount of habitat necessary for healthy invertebrate populations in the core resort area and there will be a gradual decline in species and populations.

5.6.5. Coastal Marine Communities

The Beef Island Development Project calls for an inland marina at the Bluff Bay Salt Pond and a five-star hotel along the beach berm. The marina will be built by dredging the pond and thereby restructuring the coastline and nearby offshore area. The hotel is to be built on a reclaimed "island" constructed as a centerpiece for the resort hotel facility.

Without proper environmental controls, these proposed development activities could impact the marine environment of Beef Island and alter the integrity of the coastline and nearshore environment. It is well documented that the potential of terrestrial sedimentation poses the greatest risk for coastal marine environments, and the Virgin Islands—both U.S. and British—provide ample evidence of marine habitats substantially damaged or destroyed by sediment runoff.

Therefore, the impact of sediments on the coastal wetlands and marine habitats of Beef Island (particularly at Bluff Bay) is of major concern. Dredged materials from the Bluff Bay Salt Pond have potential for suspension in the nearshore waters, especially if the sediments are of silty clays, which would present a risk for the fringing coral reef system. Additionally, the proposed pond dredging and creation of a "resort island" will destroy extensive nearshore seagrass areas and result in the elimination of most of the mangrove communities associated with the Bluff Bay Pond.

Since other natural coastal features and benthic communities are also at risk, appropriate monitoring of the marine environment—both before construction commences, during the construction phase, and following—should be integrated into all development planning for the Beef Island Development Project. It will be especially important to collect "before" data to provide an adequate baseline for future comparisons.

Of particular concern is the use and application of sloughing boat hull paints containing TBT on the boats in the Marina. TBT has serious impacts on shellfish and other marine life and is currently banned for most commercial marine applications. Although technically illegal in the BVI, TBT is routinely mixed in hull paints applied to boats serviced in the Territory, and the use of such

formulations has rarely, if ever, been grounds to deny docking to boats anywhere in the BVI.

5.7. Phase 3: Future Development

Impacts for most future development activities should be estimated from the issues presented above for the Resort Core and Golf Course Developments, and especially from the information developed and presented in the EIAs for these two Environmental Impact Assessments.

5.7.1. Salt Ponds

The Trellis Bay Commercial area will potentially impact the temporary salt pond at Trellis Bay as described in Table 5.5.1-1 above. Additional detail on the types of impacts, along with the proposed changes to the Trellis Bay salt pond (and other ponds) will be addressed in future dedicated EIA submissions.

5.7.2. Boulder Fields

Residential development will potentially impact boulder fields. The level of impact (if any) is uknown at this time. Additional details on the types of impacts, along with the proposed changes to known boulder fields will be outlined in future dedictated EIA submissions.

5.7.3. Vegetative Communities

As outlined in Sections 5.2.3. and 5.3.5. above, construction of the future development phases will directly impact existing vegetative communities, leading to potential fragmentation of natural communities, introduction of exotic species, and decline in biodiversity.

5.7.4. Coastal Marine Communities

Other potential marine impacts to be considered in the Future Development Environmental Impact Assessment include:

- The construction of the second, offshore marina could potentially change or alter nearshore currents, which in turn could affect other marine communities downstream and adjacent to Hans Creek. This is an area where the EIA process will need to consider marine and coastal impacts well beyond the geographic boundaries of the Development.

- Beach enhancement activities such as dredging could potentially impact local benthic communities, including seagrass beds.

- Increased anchorage offshore of the development could have adverse impacts on corals and seagrass beds if left unchecked.

5.7.5 Cultural Resources

Additional identified cultural resources that may be impacted by future development will have to be assessed on a case-by-case basis. Where possible, significant historical and cultural findings will be preserved. As described in Section 3, areas such as Bellamy Cay have special known and presumed cultural significance for periods such as the pirate era in BVI history.

5.8. Scoping Report Summary Impact Rankings

5.8.1. Overview

Results of the scoping study for the Beef Island Development Project are presented in Table 5.8.2-1 (construction phase) and Table 5.8.3-1 (operational phase) as rankings of the anticipated impacts. These rankings are based on field and other research undertaken to date and relate to the potential impact of each of the development components upon the various marine and terrestrial habitats of Beef Island, and the cumulative impact of the development as a whole. They are intended to serve as guidelines for areas of activity that need special attention in the EIA—with regard to implementation, monitoring, review of alternative and mitigating actions, and general circumspection.

Because of the lack of detailed design and other information regarding the BIDP, several of the rankings are educated guesses only, while others are definitive due to the complete destruction or alteration of habitats. As such, the final Scoping Report may well have different rankings, depending upon further information received. Infrastructure and utilities, for example, have not been assessed because of the near complete lack of pertinent information at this time.

5.8.2. Short-term (Construction) Impact Rankings

5.8.2.1. Short Term Impacts and Lessons Learned

Short-term impacts to the Beef Island environment will occur principally during the construction phases of the proposed development activities, and careful design and planning is therefore crucial before, during and after construction.

The most significant recent development on Beef Island was the airport expansion project carried out from 2000 to 2003. Most of the heavy construction took place during 2001 and 2002. During that period, large areas were denuded of vegetation and topographically modified. Major redesigning of landforms, coupled with few or very limited environmental safeguards, resulted in numerous problems. Heavy rains, which can be encountered in any season, produced substantial erosion of soil with serious consequences for nearby wetlands and estuaries. The area around the Little Cay Lagoon/Hans Creek was one of the sites most severely impacted.

Recent investigations in the Little Cay Bay area (Petrovic, 2005, see also Annex G) indicate that while the impacts from airport construction were substantial, repeated, and continued long after major construction ceased, the bay is not now devoid of life and much of the area is recovering from its heavily impacted status in 2001 and 2002. Habitats that were damaged are slowly recovering and will continue to do so, barring renewed impacts.

Had proper environmental safeguards, monitoring and response systems been in place during the years of airport construction, the negative environmental impacts realized could have been substantially reduced. Also, had a more serious strategy been employed for the preservation of endangered species, the careless destruction of several groves of *Lignum Vitae* trees (identified for preservation in pre-EIA studies), a slow-growing and valuable species, might have been prevented.

Engineers involved in the Airport construction process have also stressed that the project design process for the Airport concentrated on the environmental impacts of the completed project, but *did not address* the question of designing the project in order to minimize the potential *environmental impacts of the construction process itself*.

These recent experiences from an area adjacent to the proposed Beef Island Development Project provide important lessons for BIDP planners. Such lessons point to development of better mitigation strategies for protecting the nearshore and marine environments and also to development of species protection plans for both construction and project operation.

5.8.2.2. Cumulative Short-term Impacts

As shown in Table 6.13.1-1, particular attention needs to be paid in the draft EIA to the golf course and related activities. Also ranked high are impacts of the inner marina and resort island, the outer marina, and the construction of residential

units and access roads especially on steep slopes. At this time, infrastructure and utilities cannot be ranked.

The currently proposed start of construction activities for the golf course, marina basin, commercial area, site infrastructure and resort island is from late 2005 through April 2006, although build-out could take over five years. It is not known presently whether the access road network will be completed at one time or in phases and the extent of the network that will be paved (which drastically reduces sediment runoff). Also, the build-out schedule for residential housing construction is currently unknown.

Be that as it may, substantial areas of vegetative cover will be removed. This, together with dredging and landfill associated with the marina and resort island, leads to the possibility of sedimentation and turbidity problems in nearshore waters, and an adverse impact on all six salt ponds—not merely Bluff Bay Pond, which will be dredged, and Banana Wharf Pond where berm changes will be made. Of special concern is the potential cumulative impact on the Hans Creek area. Heavy rain events can occur during any given season, and it will require a major undertaking and extensive planning and preparation to ensure that storm water is contained on site.

Construction activities will produce waste products in addition to scrub and brush to be removed from the golf course and other areas, Fire risks include consideration for the environmentally safe disposal of hydrocarbon-based fuels, lubricating oils, greases from heavy earth-moving machinery and vehicles, and other construction materials that could damage vegetation and pollute coastal environments.

Within the BIDP area itself, more than half of the 640 acres will be heavily impacted at build-out, with vegetation fragmented or altered. While the golf course may have a direct footprint of possibly 180 acres or so (in addition to at least partially affecting other habitat areas), residences and other units may impact more than three times that area. Unlike the golf course, however, construction of the latter will be in phases, so that the overall impact will be ameliorated to some extent.

Off-site cumulative impacts include increase in vehicular traffic (both heavy and commuter) associated with construction activities. It is assumed that the heaviest and largest equipment will be brought in by barge. However, the construction work force at times could be well over 100, given the concentrated schedule, and it is predicted that traffic congestion will worsen at times along the coastal highway as well as at the Beef Island bridge.

The accompanying Economic Feasibility Study to the EIA (Annex B, page 8), as requested by the Town and Country Planning Department, no doubt will

address the probable size of the construction labour force that will need to be brought into the Territory. This obviously will have socio-economic ramifications (both positive and negative), together with the potential need for accommodations in such areas as Long Look/East End.

Also, utilities and public services could be strained on Beef Island itself, particularly relating to sanitary and solid waste disposal. Vegetative disposal, by itself, will be a major concern that could impact air quality through burning. The lifestyle of current Beef Island residents and patrons will be disrupted, although many of the commercial enterprises probably will benefit economically.

The utilization of heavy equipment necessarily will result in a relatively large amount of hazardous materials needing to be managed and disposed of, including oil and other lubricants, coolant liquids and spilled gasoline and diesel fuels. Careful monitoring, clean-up and disposal methods will be required.

Table 5.8.2-1. Potential short-term (construction) impacts of the Beef Island Development Project.

	SALT PONDS	BOULDER FIELDS	COASTAL MANGROVES	BEACH BERMS	SEAGRASS BEDS	CORAL REEFS	UPLAND VEGETATION	LOWLAND VEGETATION	HISTORIC SITES	OFF-SITE
GOLF COURSE AND RELATED FACILITIES	**M-H**	**M**	**M-H**	**M**	**M**	**H**	**N/A**	**H**	**M-H**	**L-M**
INNER MARINA	**H**	**N/A**	**L**	**H**	**M**	**M-H**	**N/A**	**H**	**N/A**	**L-M**
OUTER MARINA	**N/A**	**N/A**	**L**	**N/A**	**M-H**	**M-H**	**N/A**	**N/A**	**N/A**	**L-M**
HOTEL RESORT ISLAND	**H**	**L**	**L**	**H**	**M-H**	**H**	**N/A**	**M**	**N/A**	**L-M**
COMMERCIAL AREA	**L**	**N/A**	**N/A**	**N/A**	**L-M**	**L**	**N/A**	**M**	**N/A**	**L-M**
RESIDENTIAL	**L-M**	**M**	**L**	**N/A**	**L**	**H**	**M**	**L**	**H**	**L**
INFRASTRUCTURE AND UTILITIES	**U**	**U**	**U**	**U**	**U**	**U**	**U**	**U**	**U**	**U**
ACCESS ROADS (unpaved)	**M-H**	**U**	**L-M**	**M**	**H**	**H**	**M-H**	**M-H**	**U**	**L**

KEY:

H **High Impact — shaded for High and Medium-High Potential Impacts**
M **Medium Impact**
L **Low Impact**
U **Undetermined Impact (insufficient information)**
N/A **Non Applicable (absent or destroyed during construction)**

Table 5.8.3-1. Potential long-term (operational) impacts of the Beef Island Development Project.

	SALT PONDS	BOULDER FIELDS	COASTAL MANGROVES	SEAGRASS BEDS	CORAL REEFS	UPLAND VEGETATION	LOWLAND VEGETATION	HISTORIC SITES	OFF-SITE
GOLF COURSE AND RELATED FACILITIES	**M-H**	**N/A**	**M**	**L-M**	**M-H**	**N/A**	**M**	**L**	**L-M**
INNER MARINA	**N/A**	**N/A**	**L**	**M**	**M-H**	**N/A**	**N/A**	**N/A**	**M**
OUTER MARINA	**N/A**	**N/A**	**L**	**M**	**M-H**	**N/A**	**N/A**	**N/A**	**L-M**
HOTEL RESORT ISLAND	**N/A**	**N/A**	**L**	**M**	**M-H**	**N/A**	**N/A**	**N/A**	**L-M**
COMMERCIAL AREA	**N/A**	**N/A**	**N/A**	**M**	**L**	**N/A**	**L**	**N/A**	**M-H**
RESIDENTIAL	**M-H**	**N/A**	**L**	**M**	**M**	**M-H**	**L**	**L**	**L**
INFRASTRUCTURE AND UTILITIES	**U**	**U**	**U**	**U**	**U**	**U**	**U**	**N/A**	**U**
ACCESS ROADS (unpaved)	**H**	**N/A**	**M**	**M-H**	**H**	**L**	**M**	**U**	**N/A**

KEY:

H **High Impact — shaded for High and Medium-High Potential Impacts**
M **Medium Impact**
L **Low Impact**
U **Undetermined Impact (insufficient information)**
N/A **Non Applicable (absent or destroyed during construction)**

5.8.3. Long-term (Operational) Impact Rankings

Long-term (operational) impact rankings are displayed in Table 4. A primary concern is the continuous potential impact of storm water and chemical pollution from the development's activities upon the marine environment and remaining salt pond systems. Related sedentary and migratory fauna also will be diminished by the total removal, alteration or fragmentation of critical terrestrial habitats.

The resort, golf course, marinas, residential housing and access roads all could have severe impacts upon nearshore systems. All are potential large storm water sources, and all are potential sources of chemical and other pollutants. The marinas especially are of concern because of the widespread and continued use of sloughing paints containing TBT. Insufficient information has been provided for infrastructure and utilities in order to rank this component, although the potential for pollutant runoff is also high.

While the present, land-based, residential density of Beef Island is low, anchorage and marine traffic capacities are already being reached, notably in Trellis Bay. Although not part of the EIA itself, an Integrated Coastal Management Plan is urgently required, given the probable level of additional activities resulting from the proposed development.

The two proposed marinas will have a combined capacity of approximately 370 berths. [In addition, the nearby Scrub Island project proposes an additional 90 new yacht berths.] Additional demand will be placed on vicinity moorings and other popular visitation sites, such as the day-time "snorkeling moorings" maintained by the National Parks Trust throughout the territorial marine protected areas system.

In addition to marine traffic, road traffic will increase substantially—from the patrons, employees, commercial operations, and day visitors to the development site, and especially including visiting cruise ship passengers. It is anticipated that periodically severe congestion could occur both on the major road system leading to, and on, Beef Island.

Natural habitats could well be subject to long-term adverse environmental impacts, depending on the level of environmental best management practices implemented. Of particular note is the threat to salt ponds and marine habitats, especially seagrass beds and coral reefs, through storm water runoff laden with sediments, chemicals and other pollutants from the golf course, commercial and residential areas, and sedimentation transported by access roads. With regard to the existing terrestrial vegetation, maintenance activities will largely preclude its

reappearance in the more developed areas, and exotic species will likely become more dominant.

Some of the major off-site impacts of the long-term operations of the Beef Island Development will include employment, housing and secondary commercial effects, which will be addressed in the socio-economic analyses of the three EIAs.

Mitigation measures will be outlined in the Environmental Impact Assessments for all three phases of the Bird Island Development Project. These measures will include construction management practices to prevent, minimize and control spills, erosion and other construction phase related issues.

6. SUMMARY OF EIA CONSIDERATIONS FOR THE BEEF ISLAND DEVELOPMENT

6.1. Salt Ponds

With the exception of the Bluff Bay salt pond, the remaining five salt ponds will be modified to varying degrees. The Banana Wharf pond modifications will be relatively small and could potentially result in an increase in wildlife. More detail on specific mitigation measures for each of the six salt ponds will be outlined in future EIA submissions.

6.2. Boulder Fields

As previously stated, boulder fields will be retained in as naturally a state as possible during land planning. This means that where possible during construction of the golf course, hotel, and residences (areas most likely to impact these fields), site-specific considerations will be given to incorporating the boulders into the natural landscaping.

6.3. Beach Berm

Design of the golf course features (fairways 6 and 7) around the Banana Wharf Salt Pond and its beach berm will be re-examined in light of the issues raised in section 5.

6.4. Vegetative Communities

To avoid excessive introduction of exotic plans species, the Developer can provide a proposed plant species list that favors native species. Additionally, rare and endangered plant species may be flagged either for transplantation or for incorporation into the project's landscaping plan.

6.5. Coastal Marine Communities

Most risk to coastal marine communities will occur during construction. A combination of physical barriers, management and monitoring techniques will be implemented to minimize adverse impacts such as excessive erosion and sedimentation or turbidity increases.

Where direct impacts to coastal marine communities are unavoidable, transplantation of seagrass beds and corals will be considered along with the installation of nearshore artificial reef units to enhance local biodiversity.

Other marine impacts to be considered in the Environmental Impact Assessment include:

- The construction of the second, offshore marina could potentially change or alter nearshore currents, which in turn could affect other marine communities downstream and adjacent to Hans Creek.
- Siting of storage and utility facilities within short distances of the shoreline increases the possibility of fuel spillage and other pollution contaminants being released into the marine environment. The effects will not be limited to the immediate area of the facilities for currents will take pollution downstream as well.
- The construction of roads and other infrastructure, clearing of vegetation, gardening, and the use of fertilizers, pesticides and other chemicals all have potential to increase nutrient loads in the surrounding waters, producing reduced water quality and declining marine biodiversity.
- The impact of high-nutrient sewage discharge into the marine environment from tourist facilities and residential accommodations will need to be assessed, including pollution effects and environmental health risks.

6.6. Environmental Management Plan

An Environmental Management Plan (EMP) will be developed for each dedicated EIA that will ensure that the development of Beef Island proceeds with controls designed to protect the long-term health of the environmental resources of Beef Island and the vicinity. The EMP will address the following items at a minimum:

1. Pre-construction surveys and baseline sampling
2. Construction planning
3. Upland Best Management Practices
4. Construction safety issues
5. Marina basin construction (excavation)
6. Marina operations (fuel/hazardous materials handling, etc.)
7. Cultural resources (designated for protection)
8. Coastal construction and monitoring

9. Water quality monitoring
10. Marine resource protection measures

It is proposed that the Environmental Management Plans written for the project be adopted by the Developer during construction.

6.7. Best Management Practices During Construction

Best Management Practices (BMPs) are defined as schedules of activities, prohibitions of practices, maintenance procedures, and other management practices to prevent or reduce pollution. BMPs will be developed to address concerns associated with construction activities such as marine dredging (coral and seagrass relocation, turbidity monitoring, etc.), clearing and excavation of upland areas (structures, roads, and other infrastructure), impacts to protected habitats (salt ponds, mangroves, coral communities, seagrasses, national parks, etc.), introduction of non-native or invasive plant and animal species, noise pollution, and hazardous waste containment. Recommended BMPs for the development will include techniques, both operational and structural, which will be used to limit potential pollution.

6.8. Operations Management

Normal operation of the marina and development infrastructure will require routine maintenance and monitoring to ensure proper function. Facilities which contain hazardous materials such as fuel storage areas, chemical storage areas, the wastewater treatment facility, and the reverse osmosis desalinization plant will require regular monitoring for leaks. Collection of various waste products (garbage, landscaping debris, dewatered wastewater sludge, spent oil and fuel, etc.) will have to be collected and appropriately disposed of.

Contingency plans for both the marina and the upland development should be developed for emergencies such as hurricanes and other natural disasters, hazardous waste spills, medical emergencies, sinking or sunk boats, fires, etc. Each plan should include a designated point of contact, a list of emergency contact numbers, and standard forms to document the event or emergency. A mandatory training program for all new staff should be required prior to the first day of work to familiarize new employees with emergency procedures.

6.9. Impact Mitigation

Mitigation for unavoidable impacts resulting from island development can take many forms including conservation strategies, designation of protected areas,

plant salvage and relocation strategies, seagrass and coral relocation plans, contributions to the habitat conservation bank and others. Avoidance of existing critical habitats and endangered plant communities, through pre-construction ecological surveys, will play an important role in the final layout of the development. However, in areas such as the marina basin, hotel site, commercial centre, golf villas, golf course fairways and greens, roads, maintenance and utility areas, etc, direct impacts to existing terrestrial and aquatic resources will be unavoidable. In order to mitigate for these losses; seagrasses, corals and endangered upland plant species will be relocated to other suitable habitats around Beef Island or a nearby island.

6.10. Environmental Education and Eco-Tourism

Educating guests and residents as to the local aquatic and terrestrial resources on and around Beef Island is an important component of the environmental preservation effort. Making the public aware, through posted signs and displays, of critical or protected habitats for certain plant and animal species will lessen the chance that they maybe impacted by human activities. Eco-tours can further this educational effort while creating an additional attraction or amenity for guests and the public.

Consideration of public outreach programs are being considered as well. Additional detail on this and other potential mitigation strategies will be outlined in the appropriate EIA submissions.

6.11. EIA Requirements

Island Resources Foundation has received Terms of Reference for the EIA and an Economic Feasibility Study for the Beef Island Development Project from the Town and Country Planning Department (*Annex B*., Louis Potter, April 15, 2005). The purpose of this Scoping Report is not to replace or alter these Terms of Reference. Rather, it is to emphasize those activities for which additional consideration and monitoring need to be undertaken because of the severity of their potential impact upon Beef Island and its vicinity. It also is noted that cumulative and interactive impacts will need to be addressed for the Territory as a whole.

6.12. Summary

Environmental impacts are an inherent result of development projects like the one proposed for Beef Island; however through pre-construction environmental planning, utilization of BMPs during construction, post-construction operations

management, monitoring and mitigation efforts and educational programs, these impacts can be offset to a degree that is suitable for the size of the development.

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ANNEX A: BEEF ISLAND SCOPING REPORT PROJECT TEAM

Dr. Edward L. Towle, Beef Island Project Team Leader
[Chairman, Island Resources Foundation]

Mr. Jean-Pierre Bacle, Beef Island Project Deputy Team Leader
[Natural Resource Analyst, Island Resources Foundation]

Mr. Kevel C. Lindsay, Ecologist
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Mr. Bruce G. Potter
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Mr. Clive Petrovic, Marine Scientist
[Former Director, Applied Marine Studies Centre, HLSCC]

Dr. Barbara Lausche, Environmental Lawyer
[Senior Programme Associate, Island Resources Foundation]

Dr. Barry Devine, Ecologist
[Chief Scientist, Conservation Data Center, University of the Virgin Islands]

ANNEX B: TERMS OF REFERENCE — BEEF ISLAND EIA

TOWN & COUNTRY PLANNING DEPARTMENT

Office of The Chief Minister

Admin Drive, P.O. Box 834, Road Town, Tortola, British Virgin Islands
Phone No.: 284-494-3701, Ext. 2158, Fax No.: 284-494-5794 E-Mail: <bvitcp@candwbvi.net>

15 April 2005

Dr. Edward Towle
Chairman
Island Resources Foundation
Tortola
British Virgin Islands

Dear Dr. Towle,

Trellis Bay/Beef Island Development

Reference is made to proposals outlined to the Town and Country Planning Department by Island Resources Foundation on 31 March 2005 for the development of lands at Beef Island for resort purposes (hotel, resort residential, golf course, marina). It has been determined that significant impacts could arise from the development and that an Environmental Impact Assessment (EIA) and an Economic Feasibility Study (EFS) would be required for proper assessment of the proposals. Terms of Reference for the respective studies are attached for your guidance.

Please do not hesitate to contact the Town and Country Planning Department if you require clarification of any aspect of the Terms of Reference.

Yours respectfully,

(signed) Gerard Frantin for
Louis Potter
Chief Physical Planning Officer

cc: Permanent Secretary, Chief Minister's Office

TOWN & COUNTRY PLANNING DEPARTMENT

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TERMS OF REFERENCE FOR THE ENVIRONMENTAL IMPACT ASSESSMENT OF PROPOSALS TO DEVELOP TRELLIS BAY/BEEF ISLAND FOR RESORT PURPOSES

Reference is made to proposals outlined to the Town and Country Planning Department by Island Resources Foundation on 31 March 2005 for the development of lands at Beef Island for resort purposes (hotel, resort residential, golf course, marina), it has been determined that significant environmental impacts could arise from the development and that an Environmental Impact Assessment (EIA) of the proposals should be undertaken in accordance with the following terms.

A. Study Area

The study area should be determined by the extent of direct and indirect impacts on the physical, biological, and socio-cultural environments. This should include the site proposed for development and adjacent or nearby mangrove swamps, ponds, coastlines, reefs, marine waters, and developed areas (airport, recreation and resort areas, residential communities, etc.),

The study area should be properly identified and described with accompanying maps and other illustrations to show the spatial extent of the project and the impact area.

The reasons for selecting the proposed location for the project should also be provided as well as brief descriptions of alternative sites that may have been considered.

B. Project Description

Information should be provided on the nature of the project and the activities that are likely to be generated, including:

1. Statement on the purpose of and justification for the project

2. Description of all aspects of the project, including:

a) Proposed spatial and quantitative distribution of land and water uses, including:
- Resort accommodation (hotel, villas, apartments, residential lots, etc.).
- Golf course,
- Amenity areas (recreational open space, beaches, etc.).
- Environmental conservation areas.
- Marina and associated facilities.

A site plan should be provided indicating the general layout of the proposed project components in relation to one another and to surrounding features,

b) Detailed description of the individual components of the project (resort accommodation, golf course, marina, etc.).

c) Detailed description of the proposed infrastructure facilities for the project, including:
- Water supply (quantity, source, storage).
- Solid and liquid waste management (quality, quantity) method of disposal/recycling).
- Drainage and irrigation proposals.
- Access and circulation patterns and facilities for vehicles, pedestrians, and marine vessels.
- Electricity supply and distribution,
- Telecommunication and navigation facilities.
- Marine infrastructure (breakwaters, jetties, fuel supply, etc,),

d) Proposed phasing of the development.

e) Details of project activities and support facilities and services during the pre-construction, construction, and operational stages of the development, including:
- Employment projections.
- Source of construction labour.
- Sources of construction materials and means of transport to the site.
- Types of construction equipment and machinery.
- Proposed earthworks and dredging activities, including dredging of ponds and channels and means of disposal of dredged material.
- Proposed building, landscaping, and infrastructure works.
- Projected resident 6taffpopulation.
- Visitor projections.
- Projected demand for and use of proposed facilities, including utility consumption and waste generation rates.

C. Description of the Environment

Determine the baseline characteristics of the study area relating to the physical, biological, and socio-cultural environments. Details of the study area should include:

1. Physical Environment

a) Geology, including unique geological formations, seismic hazards, slope stability, and landslide potential.
b) Soil conditions, including engineering and landscaping capability and hazard potential (erosion. subsidence or expansiveness).
c) Site topography and drainage.
d) Climate and meteorology, relating to potential impacts OD the proposed development.
e) Surface and ground water hydrology and present levels of water quality.
f) Ambient air quality,
g) Visual quality (scenic features, views, and viewpoints).
h) Coastal and oceanographic conditions (offshore water depth and topography, tidal conditions, wave climate and currents, long shore sand movement, shoreline erosion, recreational beaches, sheltered anchorages, marine water quality and recreational capability for swimming and boating, etc.).
i) Vulnerability to natural hazards.

2. Biological Environment

a) Flora and fauna, including dominant species, rare 01' endangered species, and species of commercial importance.
b) Ecologically significant marine and terrestrial habitats (ponds, mangroves, turtle nesting beaches, reefs, lagoons, sea grass beds, etc.).
c) Fishing areas and species important to commercial fishing.
d) Presence of insect pests and vectors of diseases.

3. Socio-Cultural Environment

a) Current economic activities and employment levels.
b) Traditional and existing land uses (residential, resort, forest, etc.),
c) Current development approvals and commitments,
d) Existing tourism and recreational activities (tourist resort, beach recreation, dive sites. etc.).
e) Existing archaeological, historic, and architectural resources,
f) Community characteristics (population size, employment, skills, community values and attitudes, etc.),
g) Parks and protected areas.
h) Existing infrastructure facilities (roads, water supply, electricity, ferry terminal. jetties, etc.).

D. Identification of Potential Impacts

Identify all impacts that could arise during the different stages of the project and distinguish between significant positive and negative impacts, direct and indirect impacts, and immediate and long-term impacts. Impacts that are unavoidable or irreversible must be specifically identified and as far as possible, significant changes to baseline conditions should be quantified.

Possible impacts to be determined include, but are not limited to the following:

1. Physical/Chemical Impacts

a) Land
- ϖ Change in land use (loss of natural areas, loss afforested land, etc,).
- ϖ Compatibility of land use.
- ϖ Loss of unique physical features and loss or creation of open space.
- ϖ Intrusion into sensitive visual landscapes or improvement of landscape quality.
- ϖ Risk of erosion (soil erosion, beach erosion, etc.).
- ϖ Modification of coastal processes and coastal stability.

b) Water and Air
- ϖ Changes in drainage patterns.
- ϖ Changes in surface and ground water quantity/quality.
- ϖ Changes in marine water quality (chemical pollution from boating, etc.).
- ϖ Modification of oceanographic conditions.
- ϖ Air pollution.

2, Ecological/Biological Impacts

a) Changes in terrestrial species, populations, and habitats of flora and fauna,
b) Creation of new habitats.
c) Loss of rare plant or animal species and introduction of exotic species.
d) Impacts due to visitor access to sensitive habitats.
e) Impacts resulting from measures to deal with problems of insect pests.
f) Changes in coastal and marine species and habitats.
g) Impacts on fish nurseries and traditional fishing grounds.

3. Socio-Economic Impacts

a) Employment (jobs to be created, availability of labour. skills, etc.).
b) Effects on traditional fishing activities carried out in the area.
c) Capacity of social and community facilities to cater for demands of the project, including resident staff population if any.
d) Changes in the patterns of use of the island (e.g. public access to beaches).
e) Conservation or loss of features of historical archaeological, or architectural interest.

4, Infrastructural Impacts

a) Demands on infrastructure facilities (roads, water supply, electricity, etc.) in relation to existing capacities.
b) Demands on infrastructure facilities in relation to proposed improvements.

The risk of occurrence of potential hazards as a result of the development should also be assessed,

E. Alternatives to the Proposed Project

Describe reasonable alternatives to the proposed project or elements of the project, and evaluate the alternatives in terms of their potential impacts.

F. Mitigation Plan

Propose feasible measures to avoid, reduce, or mitigate any significant adverse impacts to acceptable levels. A management plan must be submitted to implement the mitigation measures during the different stages of the project.

G. Monitoring Plan

A detailed monitoring plan should be provided for the different stages of the project to ensure that the mitigation measures are meeting their objectives,

H. Consultation

Determine the stakeholders that are knowledgeable about the area and can assist in the provision of information relevant to the project, and seek their inputs into the impact assessment process. Key stakeholders will include relevant government agencies, environmental organisations, and persons working in the area or using" the area for tourism and recreational purposes.

I. The Report

The EIA report should be concise and limited to significant environmental issues. Detailed data and unpublished documents should be presented as an appendix to the main report. A list of the persons or organisations involved in carrying out the EIA as well as their particular areas of coverage should also be presented as an appendix to the document.

April 2005

TOWN & COUNTRY PLANNING DEPARTMENT

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TERMS OF REFERENCE FOR THE ECONOMIC FEASIBILITY STUDY OF PROPOSALS TO DEVELOP TRELLIS BAY/BEEF ISLAND FOR RESORT PURPOSES

Reference is made to proposals outlined to the Town and Country Planning Department by Island Resources Foundation on 31 March 2005 for the development of lands at Beef Island for resort purposes (hotel, resort residential, golf course. marina). It has been determined that an Economic Feasibility Study (EFS) of the proposals should be conducted in accordance with the following guidelines. The purpose of an EFS is to evaluate, both qualitatively and quantitatively, the benefits to the economy that arc associated with the project and to compare those benefits, in a systematic manner, to the costs of developing the project. The EFS consists of both a financial analysis and an economic analysis.

GUIDELINES FOR ECONOMIC FEASIBILITY STUDY

A Background Information

B Project Description & Plans

Overall Project Site Plan

C Attendance Projections

D Operating Capacity

E Cost Estimate

1. Construction Cost
2. Furniture, Fixtures and Equipment Costs
3. Miscellaneous Costs

F Pro Forma Projections

1. Per Capita Expenditures
2. Allocation of Revenues by Event or Activity
3. 5 Year Pro Forma Projections of Revenue, Expenses & Cash Flow
4. Conversion of Projections from Cash Flow to Profit Basis
5. Return on Investment

G Sensitivity & Breakeven Analysis

H General Limiting Conditions

April 2005

ANNEX C: EVALUATION OF SALT PONDS

Methodology

Six salt ponds were visited from June 14-16, 2005. General habitat notes were taken during each visit.

Chemical data included temperature, dissolved oxygen and salinity. The first two were measured using an YSI 85 electronic field meter (Yellow Springs Instruments). Salinity was measured with a hand refractometer because the electronic salinity readings were known to be inaccurate in hypersaline water. Salinity is reported in parts per thousand (ppt). As a point of reference, seawater salinity in the Caribbean is normally between 35 and 37ppt; salt ponds are often hypersaline (with salinity greater than seawater).

Water color and turbidity were assessed visually. Turbidity was scored on a scale of 1 – 3 as follows:

1 clear water
2 cloudy water, bottom at 20cm depth visible from surface
3 cloudy water, bottom at 20cm depth not visible from surface

Biological parameters evaluated consisted of the following:

- A 20 minute bird-count upon entering each pond. Only birds associated with wetlands (shorebirds, herons and ducks) were recorded; forest birds were ignored. After 20 minutes of observing birds, further sightings were ignored unless the bird was of a different species than previously noted. The practice of ending counts after 20 minutes was a caution against counting single birds more than once.

- General assessment of mangrove health

- Visual analysis of benthic photosynthetic communities

- Visual searches for larger (0.5cm or longer) aquatic invertebrates in the shallow, near shore water

- Plankton samples. This method employed a hand pump to filter 33 liters of pond water through a plankton net that had mesh hole diameters of 80□m. These samples were taken back to the laboratory and analyzed microscopically within two hours of collection. Organisms captured were living during analysis and samples were not preserved. Organisms were

identified to the lowest taxonomic group possible. The following score criteria was used to describe the abundance of each species or group:

For species in which adults are larger than 0.5cm (estimated)

1 < 5 specimens in sample; ***2*** 5 – 25 specimens; ***3*** > 25

For species in which adults are smaller than 0.5 cm (estimated)

1 < 20 specimens in sample; ***2*** 21 – 100 specimens; ***3*** > 100

- Fiddler crab population density assessment. A 0.5 m^2 quadrat was used to count crab holes along the shores of two ponds. In each sampling area, five replicate quadrats were counted along the pond water edge and another five replicates were counted within the fringing shore vegetation. Quadrats were placed arbitrarily within each sampling zone.

- Great land crab (*Cardisoma guanhumi*) hole counts. Land crab holes were counted within a 30m x 2m transect along the path to Bluff Bay Pond.

Biological and chemical parameters were assessed in three different areas (west, central and east) of Banana Wharf Pond and in two areas (west and east) of Bluff Bay Pond. At three smaller ponds, one area near the center was sampled.

Detection of tidal influence on pond water level was attempted, but there was insufficient time to conduct the necessary quantity of measurements.

Mangroves were not counted or mapped as a comprehensive vegetation survey of the area was conducted by other study team members.

Location of Salt Ponds (refer to Figure C-1)

- Hans Creek Pond (HAN) is located on the south shore of Beef Island near the western extreme of the property. The lagoon and reef system adjacent to it is legally protected by the Fisheries Regulations, 2003 (see Figure C-2).

- Bluff Bay Pond (BLU) is located on the south side of Beef Island, also adjacent to the marine protected area shown in Figure C-2.

- Trellis Bay Village Pond (VIL) is a remnant temporary pond behind the buildings along the shore of Trellis Bay.

- Central Beef Island Pond (CEN) lies behind the shore on the east side of Trellis Bay.

- Banana Wharf Pond (BAN) is a large pond lying behind a coral rubble berm on the north shore of Beef Island.

- The Wall wetland (WAL) is so named because it lies behind an historical wall constructed along the north shore of Beef Island and to the east of BAN.

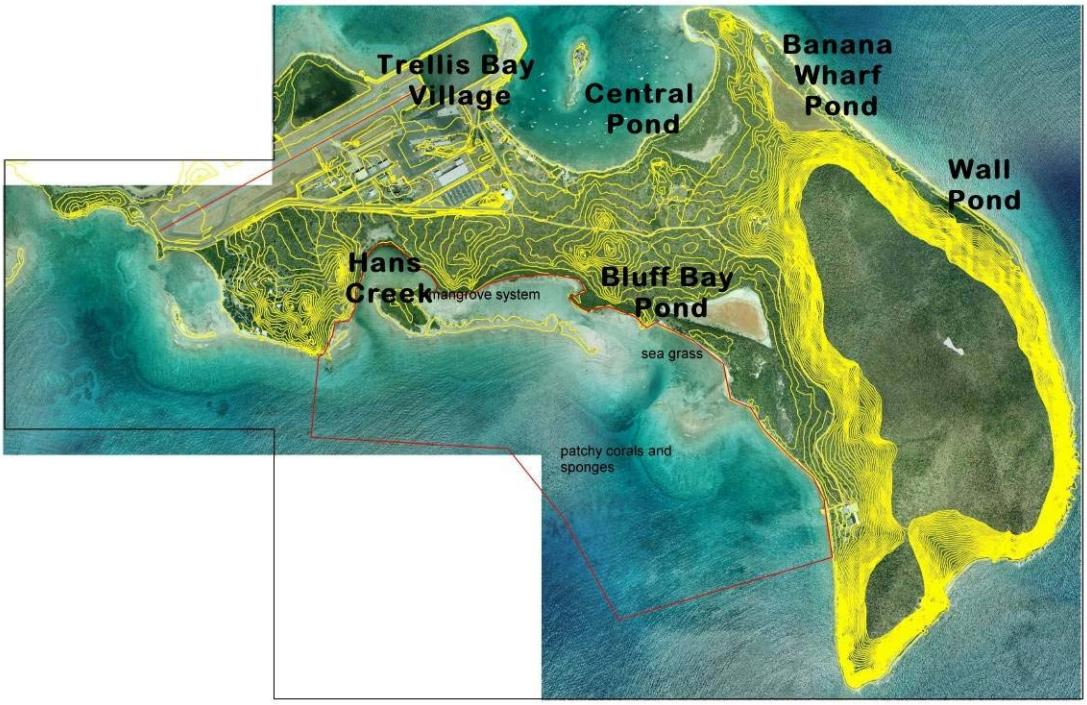


Figure C-1. Location of the six salt ponds affected by the proposed Beef Island Development Project.

Figure C-2. Location of Hans Creek Marine Protected Area (Fisheries Regulations 2003).

Chemistry, Hydrology and Biology of Beef Island Salt Ponds Surveyed

(1) Hans Creek Pond (HAN)

HAN was dry at the time of sampling (June 16, 2005), despite abundant rainfall several days before. Extensive accumulation of eroded topsoil was evident over the open area of the pond. This soil is darker and redder than the normal pond sediments and thus was easily identified. The soil entered this pond via runoff water during and since the airport construction, which began in 2001. Areas of runoff were clearly visible in the pattern of soil accumulation over the pond. Prior to the onset of the airport project, the pond showed no evidence of soil accumulation. The rapid siltation of this pond has resulted in a lower capacity for water retention and thus an inability to maintain an aquatic community, which was present in all other ponds on Beef Island during the mid-June sampling period.

Despite the lack of pond water, mangroves around this wetland appeared lush and healthy. A community of fiddler crabs (*Uca burgersi*) occurred in the mangroves separating the pond from the small lagoon at Little Cay. Crab hole density at HAN should be measured during a follow-up sampling period.

The vegetation at the north side of HAN, which was disturbed during the airport construction, had regenerated so that it was difficult to enter the pond from this side. Instead, a new road has been cut into the pond from the east.

(2) Bluff Bay Pond (BLU)

General description

The amount of water in BLU was approximately two-thirds of this pond's full capacity. Average salinity was 83 ppt, over twice that of seawater but typical of a hypersaline pond. The salinity varied little (2 ppt) over the length of the pond.

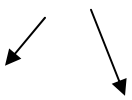
Tidal measurements were attempted, and the resulting data suggested a positive influence of tides on the water level. These measurements must be confirmed by measurements over a longer period. Tidal influence on water level is typical in ponds with large patches of red mangrove (*Rhizophora mangle*) as are present along the southwestern shore of this pond.

Several of the red mangrove trees that were previously growing in a more central area of the pond near the southwestern shore were dead in June. These trees were recorded as being alive and healthy as recently as three years ago (see Figure C-3). It is likely that the torrential rains of November 2003 and November 2004 and an uncharacteristically high rainfall during 2004 may have adversely affected these mangroves which were growing in an area of the pond that is likely to retain standing hypersaline water.

Chemistry (see Table C-1)

On the afternoon (15:55 pm) of June 15th, the water temperature was 41.1°C, too high for an accurate electronic reading of dissolved oxygen. The following morning (8:15 am) the water temperature was 30 °C and the dissolved oxygen concentration was 5.5 mg/L. This is high for warm hypersaline water, in which oxygen solubility is low, and it indicates active photosynthesis within the aquatic community.

R. mangle growing toward center of BLU



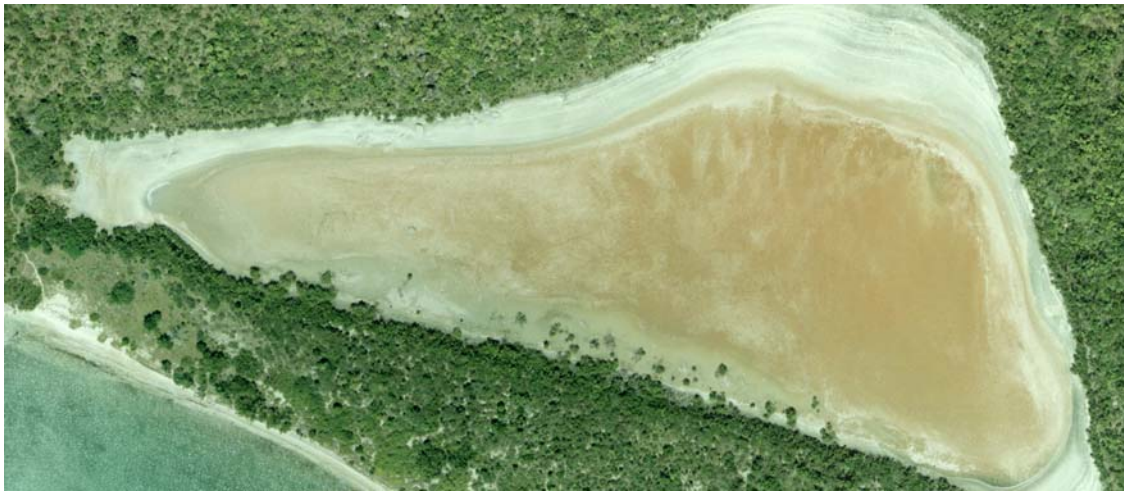


Figure C-3. 2003 Aerial photo showing red mangroves growing away from the Bluff Bay pond edge. These mangroves were dead in June 2005.

Biota

Benthos. A benthic microbial community appeared to be primarily responsible for photosynthetic production. The BMC existed as a thin green film over the bottom sediments, and in many areas it was covered by flocculent sediments and dead cells (light orange-brown sediments). Phytoplankton were present but not abundant as the water was clear (turbidity score 1). Dead tufts of aquatic grass (*Ruppia maritima* or wigeongrass) were present in patches covering about 10% of the bottom. Wigeongrass forms meadows covering the entire bottom of BLU when rainfall causes the salinity to drop below 60 ppt. It does not tolerate salinities greater than 75 ppt, as were present in the pond at the time of sampling. Wigeongrass seeds were abundant in the sediments, and these are expected to germinate during the rainy season later in the year.

Water Column (Table B-2). The aquatic fauna included corixids (water boatmen), aquatic fly larvae, copepods, rotifers, and ciliates. These organisms were abundant and their populations were healthy in that they showed signs of reproduction (juvenile stages present and/or adults carrying eggs). Corixids and aquatic fly larvae populations are consumed by many wading birds, which were also abundant at BLU (see next).

Shore fauna. Fiddler crabs were extremely abundant among the pneumatophores of the fringing black mangroves around BLU (Table C-3). There were also crab holes at the water line, and these were being preyed upon by thick-billed plovers. Twenty-nine percent of the crab holes found at the water's edge showed evidence of plover predation (hole widened and shape changed by bill insertion). Predation was not apparent among the mangrove roots.

Great Land Crabs were abundant near the entrance to the pond from the track leading to Bluff Bay. The density of their holes in this area was 0.67/m^2. Assuming that a crab digs two entrances to its burrow, this translates at least 3 crabs per 10 m^2. The inside burrow diameters ranged from 9 cm to 12 cm, indicating that these were large adult crabs.

Figure C-4: Black necked stilt nest on boulder at Bluff Bay Pond.

Birds (Table C-4 and Figure C-4). Forty-two water birds of six different species were counted in the pond over two visits to BLU. These are listed in Table B-4. Two stilt nests, one with 2 eggs and the other with three, were found on top of boulders in the pond (see Figure C-4). Adult stilts were aggressively guarding these nests.

(3) Trellis Bay Village Pond (VIL)

General description

A small pool of water stood within the black mangrove forest behind the village at Trellis Bay. This pool indicates the lowest point in this wetland, and it occurs just in front of a constructed culvert through which runoff can pass under one of the roads leading to Trellis Bay (see Figure C-5). Much of the runoff from the flat lands around Trellis Bay and parts of the airport passes through this pond (see Figure B-6). This wetland was once larger, having been gradually filled from the north and west sides as the construction of waterfront shops progressed along the Trellis Bay shoreline. It exists now as a remnant of the original wetland, and it has little capacity for holding water.

Figure C-5. The wetland (VIL) behind the village at Trellis Bay, showing a drainage culvert leading into the pond.

Chemistry (Table C-1)

The salinity of the water at VIL was very low (12 ppt), and it was the only pond with a salinity lower than that of seawater. Chemistry measurements were taken late in the afternoon, and the water was very warm (39.7 ˚C). While no oxygen measurement was possible at this temperature, an aquatic photosynthetic community was present both in planktonic and benthic forms (see next section). It is thus likely that the water was supersaturated with dissolved oxygen as was the case in all other ponds sampled.

Abundant phytoplankton was suggested by turbid water conditions (turbidity score 2). The water was stained brown from the tannins in the leaves of surrounding mangrove trees.

Biota

Benthos. A thin dark-green film of photosynthetic microbial mat covered most of the bottom of the pond. Sparse new growth of Wigeongrass (*R. maritima*) was also present, covering approximately 5% of the bottom.

Water Column (Table C-2). This pond was unique in holding large populations of cladocerans (water fleas), which have low salinity tolerance and

thus are not normally found in salt ponds. At least two distinct species were present and both were highly abundant (more than 100 in sample). Water boatmen were also abundant (5-25 in sample). Copepods were present, but no adults were seen in the plankton sample. One nematode was caught in the plankton sample though these worms are normally buried in the sediments.

The low salinity of this pond makes it suitable for mosquito larvae. Mosquito larvae prefer shaded areas, which were present. No mosquito larvae were caught in the plankton sample perhaps because it was taken from an open area of the pond where there was no shade.

Adult dragonflies flew in abundance over the pond water, but no larvae were observed in the pond.

Figure C-6. Aerial photograph of Trellis Bay Village (VIL) pond, showing the capture of sediment-laden water due to inadequate erosion control measures during the airport construction project in 2001.

Shore fauna. Fiddler crabs were especially abundant near the shore of VIL (Table C-3). They also occurred throughout the surrounding vegetated areas, though in lesser abundance.

Birds (Table C-4). Twelve birds of six different species were counted at this pond in two visits (see Table C-4). This is an unexpectedly high number considering the small size of the water body, and it illustrates the value of

abundant aquatic invertebrate populations (Table C-2) that can exist even in small pools of water.

(4) Central Beef Island Pond (CEN)

General description

This pond was about two-thirds full. Here, as in the Bluff Bay salt pond, mangroves growing inside the pond had died, despite that they were alive and healthy just three years ago (see discussion in BLU section).

The most interesting finding regarding this pond was that both live and dead trees growing within the inundated areas appeared to be preferred nesting sites for birds. Within a very small area (adjacent trees), a hummingbird nest, a yellow warbler nest, and a stick nest (probably a dove or kingbird nest) was found (see Figures B-7 and B- 8). The position of these trees within the inundated area likely gives these nesting birds some protection against terrestrial predators that prefer not to enter the water.

Chemistry (Table C-1)

The water salinity at the Central Beef Island pond was 35 ppt, equivalent to that of seawater. Salinity would be expected to increase as the water evaporates during dry periods, but this pond probably dries completely before it reaches salinities greater than 100 ppt, as is typical of larger ponds such as BLU and BAN.

Pond temperature at the time of sampling was 37.8 ˚C. The water was supersaturated (163%) with oxygen, indicating active aquatic photosynthesis. The water was highly turbid (turbidity score 3) with a yellow-brown color, suggesting that planktonic algae were major contributors to production in this pond.

Biota

Benthos. A very thin greenish-brown film of photosynthetic microbes grew over the sediments near the shore. In waters deeper than a few centimeters, this community disappeared, presumably due to the water turbidity. Wigeongrass was not present, but meadows of this aquatic grass have been observed here on previous visits.

Figure C-7. Nest of a Yellow Warbler with two eggs and two chicks. Nest is in mangrove tree growing within Central Beef Island Pond.

Figure C-8. Nest of an Antillean Crested Hummingbird with two eggs. Nest is in mangrove tree growing within Central Beef Island Pond.

Water Column (Table C-2). A diversity of aquatic invertebrates inhabited the pond water, and several of these, particularly ostracods, fiddler crab larvae and cyclopoid copepods, were highly abundant. The abundance of fiddler crab larvae and ostracods was unique to this pond during this sampling period, but they are known to occur commonly in ponds. Water boatmen were present but not abundant. Mosquito larvae were present in shaded.

Birds (Table C-4). In addition to the nesting birds discussed earlier in this section, 11 wetland birds of five different species were counted during one visit.

(5) Banana Wharf Pond (BAN)

General description

This pond has a relatively deep main body (nearly 1 m deep when pond is full) and a shallower "tongue" that extends to the west. The tongue becomes a salt flat during dry periods. The pond water extended about three-quarters of the way to the western mangrove fringe during this sampling period. Measurements of tidal influence in this pond indicated that the water is isolated from the influence of tides, but more frequent sampling is required to confirm this.

Chemistry (Table C-1)

Salinity in BAN averaged 78 ppt and varied by only 1 ppt across the length of the pond. Temperature was highest on the shallow western side (37.3 ˚C) and coolest on the eastern side (35 ˚C). The water was supersaturated with dissolved oxygen (153% in central area, 185% in eastern part). The surface of the benthic microbial

community in BAN is composed of cyanobacteria and diatoms, which are groups of photosynthetic microbes capable of supplying the water column with oxygen.

Biota

Benthos. A permanent, thick and gelatinous microbial mat covers the bottom of BAN. The exceptional development of this microbial mat makes BAN unique among BVI ponds, and this mat supports populations of fly larvae (both midges and brine flies) that feed on the microbes within the mat community. These populations of fly larvae are a preferred food item for wading birds. Populations of fly larvae fluctuate in salt ponds, and no living specimens were found during this sampling period. That the larvae were recently living in BAN was illustrated by an abundance of head capsules (the only hard part of a midge larvae) and crysalids (the pupa-like capsule in which brine flies metamorphose) in the plankton sample.

Water Column (Table C-2). Corixids and cyclopoid copepods were highly abundant in BAN. Harpacticoid copepods were also present in lesser numbers. Skeletal evidence of recent populations of ostracods, brine fly larvae and midge larvae were also present in the plankton sample.

BAN is the only pond on Beef Island that reaches salinities high enough to support brine shrimp (*Artemia salina*) and brine fly (*Ephydra sp*.) populations. During extended dry periods, when other ponds on Beef Island are typically desiccated, these species abound in BAN. Populations of these highly salinity-tolerant animals provide a critical food reserve for birds when other sources are unavailable.

Birds (Table C-4). Black necked stilts, Bahama pintail ducks and a green-backed heron were observed during the sampling visit. The stilts behaved as though they were nesting, but no nest was found.

(6) The Wall Wetland (WAL)

General description

The Wall wetland (WAL) is so named because it lies behind an historical wall constructed along the north shore of Beef Island, to the east of BAN. This is a large area of mangrove forest with pockets of standing water that dry seasonally. Salinity was 34 ppt in the pool sampled. This pool was shaded by surrounding mangrove trees, and its water, though clear, was stained brown with tannins from fallen mangrove leaves. A green-backed heron was seen here.

Data Tables

Table C-1: Salinity, temperature and dissolved oxygen measurements

Site	Salinity (ppt)	Temperature *CC)*	Dissolved Oxygen mg/L	Dissolved Oxygen % saturation	Date	Time
BLU west**	82	41.1	*	*	15-Jun	16:00
BLU east**	84	30.0"	5.5	110%	16-Jun	08:15
VIL	12	39.7	*	*	14-Jun	16:20
CEN	35	37.0	9.5	163%	15-Jun	14:40
BAN west	78	37.3	*	*	14-Jun	14:55
BAN centr	78	36.4	7.3	153%	14-Jun	15:10
BAN east	77	35.0	8.9	185%	14-Jun	15:40
WAL	34				16-Jun	14:20

* The YSI meter cannot measure dissolved oxygen when the temperature is greater than *3TC*

** a note that the east end of *BLU* was sampled in the morning (cool) and the west end in the aftemoon (hot).

Table C-2: Aquatic invertebrate fauna and their abundance

Taxon	**BLU** West	**BLU** East	**VIL**	**CEN**	**BAN** West	**BAN** Centr	**BAN** East
Water boatmen (T *richocorixa reticulata*)	2	2	2	I	3	2	I
Cyclopoid copepods (*Apocyclops panamensis*)	2	I	I	3	3	3	3
Harpacticoid copepods (*Cletocamptus sp* .)	2	2			2	I	2
Ciliates	2	3					
Water fleas (*Cladocerans*)			3				
Clam shrimps (Ostracods)				3			
Fiddler crab larvae (*Uca burgersi*)				3			
Midge larvae (*Dasyhelea sp.*)					I		
Mosquito larvae (*Aedes teniorhynchus*)				I			
Rotifer							
Nematodes			I				

Cells are blank where none of an organism occurred.

Table C-3: Mean fiddler crab holes/m 2, *Uca burgersi* . Typical hole diameter (em) is shown in brackets beside the hole count.

Salt Pond	Date	Notes
BLU, east	16-Jun	near runoff entry
BLU, west	16-Jun	near first boulder
VIL	16-Jun	

Table C-4: Bird counts

Species	BLU	VIL	CEN	BAN	WAL
Bahama white-cheeked pintail	3	2	2	2	
Black-crowned night heron	1				
Black-necked stilt	10	1	3	5	
Green-backed heron		1			1
Killdeer		1			
Laughing gull		1			
Ruddy Turnstone	3				
Terns (unidentified)	3				
Thick-billed plover	7	2	5		
Yellow warbler		1			
Yellowlegs (Lesser and Greater)	1		2		

ANNEX D: VEGETATION COMMUNITY TYPES/SPECIES LIST FOR BEEF ISLAND, BVI

Special Note: Uplands Vegetative Community Priorities

Within the total vegetative ecosystems of Beef Island, Island Resources Foundation has flagged the upland vegetative communities as areas of special concern. Because the BIDP phases which will impact these areas will be developed in the future, these may not be important to analyze during the EIAs for Phase 1 and Phase 2.

The upland areas (Mount Alma), comprising **Drought-deciduous Woodlands** and **Semi-deciduous Forests**, represent some of the most mature plant communities on Beef Island. They provide a visual image of how the island may have looked over 500 years ago. While conditions today are altered, much of the eastern slopes are still covered with intact forest and display few exotics and invasives. Fortunately, the east-facing slopes are designated as a "green zone" in the Beef Island development plans.

The western slopes contain a few exotics and have been more disturbed; the proposed development of the Mt. Alma Estate Villas will likely further disturb these forest communities. Fragmentation of these areas may cause this dry forest habitat to desiccate, and this will affect species composition, versatility and ability to recover from natural disasters such as storms.

Semi-deciduous Forest

Emergents: turpentine (*Bursera simaruba*), Genip (*Melicoccus bijugatus*), manjacks (*Cordia* spp.), pigeon berry (*Bourreria succulenta*), fishpoison (*Piscidia carthagenensis*), water mampoo (*Pisonia subcordata*), tamarind (*Tamarindus indica*), black mampoo (*Guapira fragrans*), white cedar (*Tabebuia heterophylla*), and *Rondeletia pilosa*.

Canopy: fiddlewood (*Citharexylum fruticosum*), turpentine (*Bursera simaruba*), genip (*Melicoccus bijugatus*), manjacks (*Cordia* spp.), pigeon berry (*Bourreria succulenta*), fishpoison (*Piscidia carthagenensis*), water mampoo (*Pisonia subcordata*), black mampoo (*Guapira fragrans*), Coccoloba (*Coccoloba* spp.), ficus (*Ficus citrifolia*), marble tree (*Cassine xylocarpa*), and yellow box (*Schaefferia frutescens*).

Shrub layer (including vines and scandent shrubs): sea amyris (*Amyris elemifera*), eugenias (*Eugenia* spp.), capers (*Capparis* spp.), pipe organs (*Pilosocereus royenii*), brisselet (*Erythroxylum brevipes*), ironwood (*Krugiodendon ferreum*), inkberry (*Randia aculeata*), cackalake (*Solanum polygamum*), tan-tan (*Leucaena leucocephala*), wild frangipani (*Plumeria alba*), crabwood (*Gymnanthes lucida*), *Malpighia woodburyana*, coccolobas (*Coccoloba* spp.), blackberry (*Guettarda odorata*), crotons (*Croton* spp.), yellow wiss (*Stigmaphyllon emarginatum*), *Heteropteris purpurea*, jumbie potato (*Ipomoea eggersii*), and clashi mulat (*Convolvulus nodiflorus*).

Herbaceous layer: agave (*Agave missonium*), French weed (*Commelina erecta*), wild pineapple (*Bromelia pinguin*), air plants (*Tillandsia utriculata, T. fasciculata,* & *T. lineatispica*), Turk's-cap (*Melocactus intortus*), suckers (*Opuntia repens*), bamboo grass (*Lasiacis divaricata*), forest sedge (*Scleria lithosperma*), and orchids (*Psychilis macconnelliae*, *Epidemdrum ciliare* & *Tolumnia prionochila*).

Drought-deciduous Forest

Emergents: turpentine (*Bursera simaruba*), Genip (*Melicoccus bijugatus*), manjacks (*Cordia* spp.), pigeon berry (*Bourreria succulenta*), fishpoison (*Piscidia carthagenensis*), water mampoo (*Pisonia subcordata*), tamarind (*Tamarindus indica*), black mampoo (*Guapira fragrans*), white cedar (*Tabebuia heterophylla*), and *Rondeletia pilosa*.

Canopy: fiddlewood (*Citharexylum fruticosum*), turpentine (*Bursera simaruba*), genip (*Melicoccus bijugatus*), manjacks (*Cordia* spp.), pigeon berry (*Bourreria succulenta*), fishpoison (*Piscidia carthagenensis*), Acacias (*Acacia* spp.), water mampoo (*Pisonia subcordata*), black mampoo (*Guapira fragrans*), Coccoloba (*Coccoloba* spp.), ficus (*Ficus citrifolia*), marble tree (*Cassine xylocarpa*), and yellow box (*Schaefferia frutescens*).

Shrub layer (including vines and scandent shrubs): sea amyris (*Amyris elemifera*), eugenias (*Eugenia* spp.), capers (*Capparis* spp.), pipe organs (*Pilosocereus royenii*), brisselet (*Erythroxylum brevipes*), ironwood (*Krugiodendon ferreum*), inkberry (*Randia aculeata*), tan-tan (*Leucaena leucocephala*), wild frangipani (*Plumeria alba*), crabwood (*Gymnanthes lucida*), coccolobas (*Coccoloba* spp.), blackberry (*Guettarda odorata*), crotons (*Croton* spp.), yellow wiss (*Stigmaphyllon emarginatum*), and clashi mulat (*Convolvulus nodiflorus*).

Herbaceous layer: agave (*Agave missonium*), French weed (*Commelina erecta*), wild pineapple (*Bromelia pinguin*), air plant (*Tillandsia utriculata*), Turk's-cap (*Melocactus intortus*), opuntia (*Opuntia* spp.), and orchids (*Tolumnia prionochila*).

Semi-deciduous Woodland

Emergents: fish poison (Piscidia carthagenensis), tamarind (Tamarindus indica), black mampoo (Guapira fragrans), pigeon berry (Bourreria succulenta), turpentine (Bursera simaruba), marble tree (Cassine xylocarpa), and white cedar (Tabebuia heterophylla)

Canopy (including shrub layer and vines): Talinum fruticosum, (Leucaena leucocephala), black caper (Capparis cynophallophora), limber caper (C. flexuosa), white caper (C. indica), fish poison (Piscidia carthagenensis), pigeon berry (Bourreria succulenta), white cedar (Tabebuia heterophylla), yellow box (Schaefferia frutescens), marble tree (Cassine xylocarpa), bitter bush (Rauvolfia viridis), pigeon berry (Bourreria succulenta), sea amyris (Amyris elemifera), pipe organ (Pilosocereus royenii), inkberry (Randia aculeata), water mampoo (Pison subcordata), princewood (Exostema caribaeum), brisselet (Erythroxylum brevipes), bully mastic (Sideroxylon foetidissimum), fiddlewood (Citharexylum fruticosum), maran (Croton astroites), pistarckle bush (C. betulinus), Galactia sp., Rynchosia minima, R. reticulata, yellow wiss (Stigmaphyllon emaginatum), Tournefortia microphylla, basket wiss (Serjania polyphylla), cat's claw (Macfadayena unguis-cati), air plant (Tillandsia utriculata), wild pineapple (Bromelia pinguin), and agave (Agave missonium),

Herbaceous layer: Malvastrum sp., jumbie-pepper (Rivina humilis), mini-root (Ruellia tuberosa), ground cherry (Physalis angulata), opuntia (Opuntia spp.), snake plant (Sansevieria trifasciata), French weed (Commelina erecta), and guinea grass (Panicum maximum).

Thicket/Scrub

Emergents: white cedar (*Tabebuia heterophylla*), Prosopis (*Prosopis* sp.), fustic (*Pictetia aculeata*), neem (*Azadirachta indica*), fiddlewood (*Citharexylum fruticosum*), and Acacias (*Acacia* spp.).

Tree/Shrub layer (including vines and scandent shrubs): Wild allamanda (*Pentalinon luteum*), maran (Croton astroites), love vine (*Cuscuta americana*), fustic (*Pictetia aculeata*), fiddlewood (*Citharexylum fruticosum*), Acacias (*Acacia* sp.), white cedar (*Tabebuia heterophylla*), yellow wiss (*Stigmaphyllon emarginatum*), butterfly pea (*Centrosema pubescens*), pistarckle bush (*Croton betulinus*), yellow maran (*C. flavens*), hay grass, *Rhynchospora* sp., beggar's ticks (*Desmodium incanum*), marsh mallow (*Waltheria indica*), donkey weed (Stylosanthes hamata), red sage (*Lantana camara*), inkberry (*Randia aculeata*), marble tree (*Cassine xylocarpa*), maidenberry (*Crossopetalum rhacoma*), princewood (*Exostema caribaeum*), pigeon berry (*Bourreria succulenta*), worry wine (*Stachytarpetha*

jamaicensis), worry-wine (*Stachytarpetha* sp.), jack switch (*Corchorus hirsutus*), bitter bush (*Rauvolfia viridis*), beach euphorbe (*Chamaesyce mesembrianthemifolia*), suckers (*Opuntia repens*), *Desmanthus virgatus*, limber caper (*Capparis flexuosa*), neem (*Azadirachta indica*), sticky cleome (*Cleome viscosa*), seagrape (*Coccoloba uvifera*), *Passiflora multiflora*, clashi mulat (purple *Convolvulus nodiflorus*), heliotropium (*Heliotropium* sp.), privet (*Clerodemdrum aculeatum*), purslane (*Portulaca oleracea*), goatweed (*Capraria biflora*), *Wedelia calycina*, *Melochia tomentosa*, *Chamaecrista glandulosa* var. *swartzii*, Prosopis (*Prosopis* sp.), and *Evolvulus filipes*.

Herbaceous layer: butterfly pea (*Centrosema pubescens*), marsh mallow (*Waltheria indica*), donkey weed (*Stylosanthes hamata*), sticky cleome (*Cleome viscosa*), worry wine (*Stachytarpetha jamaicensis*), worry-wine (*Stachytarpetha* sp.), beach euphorbe (*Chamaesyce mesembrianthemifolia*), suckers (*Opuntia repens*), *Passiflora multiflora*, heliotropium (*Heliotropium* sp.), purslane (*Portulaca oleracea*), goatweed (*Capraria biflora*), *Wedelia calycina*, *Chamaecrista glandulosa* var. *swartzii*, and *Evolvulus filipes*.

Coastal Hedge

Bluff Bay: Buttonwood (*Conocarpus erectus*), seaside mahoe (*Thespesia populnea*), *Acacia farnesiana*, white sage (*Lantana involucrata*), beach grass (*Sporobolus virginicus*), cough bush (*Ernodea littoralis)*, manchioneel (*Hippomane mancinella*), beach euphorbe (*Chamaesyce mesembrianthemifolia*), *Heteropteris purpurea*, sea purslane (*Sesuvium portulacastrum*), capers (*Capparis* spp.), black torchwood (*Erithalis fruticosa*), seagrape (*Coccoloba uvifera*), periwinkle (*Catharanthus roseus*), French grass (*Commelina erecta*), turpentine (*Bursera simaruba*), heliotropium (*Heliotropium angiospermum*), clashie-malashie (*Jacquemontia pentanthos*), tournefortia (*Tournefortia microphylla*), bitter bush (*Rauvolfia viridis*), maidenberry (*Crossopetalum rhacoma*), Acacia tortuosa, Turk's-cap (*Melocactus intortus*), pipe organ (*Pilosocereus royenii*), opuntias (*Opuntia* spp.), lucky nut (*Thespesia populnea*), mauby (*Colubrina arborescens*), princewood (*Exostema caribaeum*), ironwood (*Krugiodendon ferreum*), yellow box (*Schaefferia frutescens*), passiflora (*Passiflora multiflora*), pigeon berry (*Bourreria succulenta*), air plant (*Tillandsia utriculata*), sand bur (*Cenchrus* sp.), white cedar (*Tabebuia heterophylla*), grey nicker (*Caesalpinia bonduc*), yellow nicker (*C. ciliata*), jumbie-pepper (*Rivina humilis*), boxwood (*Sideroxylon* obovatum), crabwood (*Gymnanthes lucida*), water mampoo (*Pisonia subcordata*), wild frangipani (*Plumeria alba*), short-leaf fig (*Ficus citrifolia*), and blackberry (*Guettarda odorata*).

Banana Wharf: boxwood (*Sideroxylon obovatum*), bass an'boom (*Dendropemon caribaeus*), black torchwood (*Erithalis fruticosa*), yellow nicker (*Caesalpinia ciliata*), sea amyris (*Amyris elemifera*), maidenberry (*Crossopetalum rhacoma*), mauby

(*Colubrina arborescens*), buttonwood (*Conocarpus erecta*), marble tree (*Cassine xylocarpa*), blackberry (*Guettarda odorata*), wild frangipani (*Plumeria alba*), clashie-malashie (*Jacquemontia pentanthos*), morning glory (*Ipomoea* sp.), beach morning glory (*I. pes-caprae*), I. violacea, turpentine (*Bursera simaruba*), ground orchid (*Tetramicra caniculata*), butterfly orchid (*Psychilis macconnelliae*), yellow dancing lady (*Tolumnia prionochila*), black caper (*Capparis cynophallophora*), limber caper (*C. flexuosa*), cough bush (*Ernodea littoralis*), short-leaf fig (*Ficus citrifolia*), beach morninglory (*Canavalia rosea*).

Drought-deciduous Woodland

Emergents: white cedar (*Tabebuia heterophylla*), black mampoo (*Guapira fragrans*), water mampoo (*Pisonia subcordata*), fiddlewood (*Citharexylum fruticosum*), fishpoison (*Piscidia carthagenensis*), tamarind (*Tamarindus indica*), pigeon berry (*Bourreria succulenta*), turpentine (*Bursera simaruba*), marble tree (*Cassine xylocarpa*),

Canopy: white cedar (*Tabebuia heterophylla*), black mampoo (*Guapira fragrans*), water mampoo (*Pisonia subcordata*), fiddlewood (*Citharexylum fruticosum*), fishpoison (*Piscidia carthagenensis*), tamarind (*Tamarindus indica*), pigeon berry (*Bourreria succulenta*), turpentine (*Bursera simaruba*), marble tree (*Cassine xylocarpa*), (*Leucaena leucocephala*), black caper (*Capparis cynophallophora*), limber caper (*C. flexuosa*), white caper (*C. indica*), yellow box (*Schaefferia frutescens*), bitter bush (*Rauvolfia viridis*), sea amyris (*Amyris elemifera*), pipe organ (*Pilosocereus royenii*), inkberry (*Randia aculeata*), princewood (*Exostema caribaeum*), brisselet (*Erythroxylum brevipes*), bully mastic (*Sideroxylon foetidissimum*), fiddlewood (*Citharexylum fruticosum*), maran (*Croton astroites*), pistarckle bush (*C. betulinus*), *Galactia* sp., *Rynchosia minima*, *R. reticulata*, yellow wiss (*Stigmaphyllon emaginatum*), *Tournefortia microphylla*, basket wiss (*Serjania polyphylla*), cat's claw (*Macfadayena unguis-cati*), air plant (*Tillandsia utriculata*), and wild pineapple (*Bromelia pinguin*).

Shrub-layer: maran (*Croton astroites*), inkberry (*Randia aculeata*), black caper (*Capparis cynophallophora*), air plant (*Tillandsia utriculata*), eugenias (*Eugenia* spp.),

Ground-layer: agave (Agave missonium), orchids (*Tolumnia prionochila*), French grass (*Commelina erecta*), bamboo grass (*Lasiacis divaricata*), and guinea grass (*Panicum maximum*).

Mixed Dry Grassland/Pasture

Grasses and sedges: *Chloris barbata*, *Digitaria* sp., *Buteloua americana*, *Sporobolus indicus*, *Urocholoa fasciculatum*, *Echinochloa colona*, *Paspalum* spp., *Urocholoa* sp., *Panicum maximum*, *Distichlis spicata*, and *Fimbristylis* sp.

Herbaceous growth: butterfly pea (*Centrosema pubescens*), marsh mallow (*Waltheria indica*), donkey weed (Stylosanthes hamata), sticky cleome (*Cleome viscosa*), worry wine (*Stachytarpetha jamaicensis*), worry-wine (*Stachytarpetha* sp.), beach euphorbe (*Chamaesyce mesembrianthemifolia*), suckers (*Opuntia repens*), *Passiflora multiflora*, heliotropium (*Heliotropium* sp.), purslane (*Portulaca oleracea*), goatweed (*Capraria biflora*), *Wedelia calycina*, *Chamaecrista glandulosa* var. *swartzii*, and *Evolvulus filipes*.

Fresh Pond

Water lily (Nymphaea ampla), Mexican primrosewillow (Ludwigia octovalis), mannyflower (Hydrocotyle umbellata), common waterweed (*Egeria densa*), water hyacinth (Eichhornia crassipes), sesbania (Sesbania sericea), Cyperus (Cyperus lingularis, C. planifolius, C. polystachyos) and Fimbristylis cymosa.

Rock Pavement

Rock balm (*Siphonoglossa sessilis*), Christmas bush (*Comocladia dodonaea*), wild frangipani (*Plumeria alba*), wild allamanda (*Pentalinon luteum*), Turk's cap (*Melocactus intortus*), opuntia (*Opuntia* spp.), pipe organ (*Pilosocereus royenii*), capers (*Capparis* spp.), marble tree (*Cassine xylocarpa*), buttonwood (*C. erectus*), vines (*Ipomoea* spp.), clashi mulat (*Convolvulus nodiflorus*), *Evolvulus convolvuloides* and Matestelma *grisbachianum*.

Beach (sand, cobblestone, rubble/coral)

Sea purslane (*S. portulacastrum*), giant milkweed (*Calotropis procera*), sea rocket (*Cakile lanceolata*), opuntia (*Opuntia* spp.), seaside heliotrope (*Heliotropium curassavicum*), beach morning glory (*Ipomoea pes-caprae*), bay bean (*Canavalia rosea*), inkberry (*Scaevola plumieri*), seagrape (*Coccoloba uvifera*), cough bush (*Ernodea littoralis*), goatweed (*Capraria biflora*), bay cedar (*Suriana maritima*), sandburs (*Cenchrus* spp.), salt grass (*Sporobolous virginicus*), cordgrass (*Spartina patens*), and sedges (*Cyperus lingularis* & *C. planifolius*).

Cropland (one area of cultivated field south of the Trellis Bay area)

Cultivated Plants: squash (*Cucurbita* var.), pumpkin (Cucurbita var.), bitter melon (*Momordica charantia*), peanut (*Arachis hypogaea*), common peas (*Pisum* var.), black-eyed pea (*Vigna unguiculata*), beans (*Phaseolus* var.), okra (*Hibiscus esculentus*), West Indian sorrel (*H. sabdariffa*),sweet potato (*Ipomoea batatas*), eggplant (*Solanum melongena*), green pepper (*Capsicum* var.), seasoning pepper (*Capsicum* var.), cassava (*Manihot esculenta*), soursap (*Annona muricata*), and sugar apple (*A. squamosa*).

Weeds: sticky cleome (*Cleome viscosa*), beggar's ticks (*Desmodium* sp.), donkey weed (*Stylosanthes hamata*), wire weed (*Sida* sp.), inflammation bush (*Veronia cineria*), seed under leaf (*Phyllanthus amarus*), shak shak (*Crotalaria retusa*), hogweed (*Boerhavia erecta*), police macca (*Kallstroemia maxima*), croton (*Croton lobatus*), noyan vine (*Merremia dissecta*), heliotropium (*Heliotropium* sp.), goatweed (*Capraria biflora*), mil weed (Chamaesyce hirta), red milkweed (*Euphorbia heterophylla*), scarlet bean (*Macroptilium lathyroides*), French weed (*Commelina erecta*), cyperus (*Cyperus* spp.), crab grass (*Digitaria bicornis*), sandbur (*Cencrus* sp.), and guinea grass (*Panicum maximum*),

ANNEX E: BIRD OBSERVATIONS

Species	Feb. 27, 2005	April 5 – April 7, 2005	June 8 – June 20, 2005
Brown Booby	✓	✓	✓
Brown Pelican	✓	✓	✓
Magnificent Frigate Bird	✓	✓	✓
Laughing Gull		✓	✓
Royal Tern			✓
Least Tern			✓
Sandwich Tern			✓
Common Tern			✓
Roseate Tern			✓
Brown Noddy			✓
Little Blue Heron		✓	
Tricolored Heron		✓	?
Cattle Egret	✓	✓	✓
Snowy Egret			✓
Great Blue Heron	✓	✓	
Yellow-Crowned Night-Heron			✓
Green Heron			✓
Greater Flamingo			✓
Semipalmated Plover		✓	
Wilson's Plover		✓	✓
Black-Bellied Plover			✓
Semipalmated Sandpiper		✓	
Spotted Sandpiper		✓	
Willet			✓
Lesser Yellowlegs		✓	
Greater Yellowlegs		✓	
Black-Necked Stilt	✓	✓	✓
Common Moorhen			✓
White–Cheeked Pintail		✓	✓
American Kestrel	✓	✓	✓
Osprey	✓		
Scaly-Naped Pigeon	✓	✓	✓
White-Crowned Pigeon			✓
White-Winged Pigeon	✓	✓	✓
Turtle Collared-Dove			✓
Common Ground Dove	✓	✓	✓
Zenaida Dove	✓	✓	✓
Short-Eared Owl			✓
Mangrove Cuckoo	✓	✓	✓

Species	Feb. 27, 2005	April 5 – April 7, 2005	June 8 – June 20, 2005
Smoothed-Billed Ani	✓	✓	✓
Antillean-Crested Hummingbird	✓	✓	✓
Green-Throated Carib	✓	✓	✓
Belted Kingfisher		✓	
Puerto Rican Flycatcher			?
Gray Kingbird	✓	✓	✓
Caribbean Elaenia	✓	✓	✓
Caribbean Martin		✓	✓
Northern Mockingbird		✓	✓
Pearly-Eyed Thrasher	✓	✓	✓
Black-Whiskered Vireo		✓	✓
Prairie Warbler		✓	
Yellow Warbler	✓	✓	✓
Bananaquit	✓	✓	✓
Black-Faced Grassquit	✓	✓	✓
House Sparrow		✓	✓

Observers:
J.P. Bacle (February 27, 2005),
K. Lindsay, B. Devine, J.P. Bacle (April 5 – 7, 2005)
K. Lindsay, J.P. Bacle, C. Petrovic (June 8 – 20, 2005)

ANNEX F: IUCN RED LIST SPECIES FOR THE BRITISH VIRGIN ISLANDS

SPECIES	COMMON NAME	CLASS
Acacia anegadensis	Pokemeboy	CR
Acropora cervicornis	Staghorn Coral	
Acropora palmata	Elkhorn Coral	
Aetobatus narinari	Spotted Eagle Ray	DD
Anolis roosevelti	Roosevelt's Giant Anole	CR
Balistes vetula	Queen Triggerfish	VU
Calyptranthes kiaerkovii	Kiaerskov's lidflower	CR
Carcharhinus leucas	Bull Shark	LR/nt
Carcharhinus limbatus	Blacktip Shark	LR/nt
Carcharhinus longimanus	Oceanic Whitetip Shark	LR/nt
Caretta carettta	Loggerhead	EN
Charadrius melodus	Pipping Plover	VU
Chelonia mydas	Green Turtle	EN
Cordia rupicola	Black Sage	CR
Cyclura pinguis	Anegada Rock Iguana	CR
Dendrocygna arborea	Black-billed Wood-duck	VU
Dermatolepis inermis	Marbled Grouper	VU
Dermochelys coriacea	Leatherback	CR
Epinephelus itajara	Jewfish	CR
Epinephelus striatus	Nassau Grouper	EN
Eretmochelys imbricata	Hawksbill Turtle	CR
Fulica Caribaea	Caribbean Coot	LR/nt
Galeocerdo cuvier	Tiger Shark	LR/nt
Globicephala macrorhynchus	Pacific Pilot Whale	LR/cd
Grampus griseus	Russo's Dolphin	DD
Guaiacum officinale	Lignum Vitae	EN
Isurus oxyrinchus	Shortfin Mako	LR/nt
Lachnolaimus maximus	Hogfish	VU
Lagenodelphis hosei	Fraser's Dolphin	DD
Leptocereus quadricostratus	Sebucan	CR
Lutjanus cysnopterus	Cubera Snapper	VU
Machaonia woodburyana		CR
Malpighia woodburyana		
Maytenus cymosa	Caribbean Mayten	EN
Metastelma anegandense	Wire Wist	CR
Negaprion brevirostris	Lemon Shark	LR/nt

Peltophryne lemur	Puerto Rican Crested Toad	VU
Prinace glauca	Blue Shark	LR/nt
Rhincodon typus	Whale Shark	VU
Scarus guacamaia	Rainbow Parrotfish	VU
Senna polyphylla		
Sphyrna lewini	Scalloped Hammerhead	LR/nt
Sphyrna mokarran	Great Hammerhead	DD
Sphyrna zygaena	Smooth Hammerhead	LR/nt
Steno bredanensis	Rough-toothed Dolphin	DD
Thunnus obesus	Bigeye Tuna	VU
Thunnus thynnus	Northern Bluefin Tuna	DD
Zanthoxylum thomasianum	St. Thomas Prickly-ash	EN

CR	Critically Endangered
EN	Endangered
VU	Vulnerable
NT	Near Threatened
LC	Least Concern
DD	Data Deficient
LR/nt	Lower risk / near threatened
LR/cd	Lower Risk / Conservation Dependent

ANNEX G: MARINE ASSESSMENT: LITTLE CAY-HANS CREEK

(Observations, April – June 2005)

MARINE PLANTS

Phylum Cyanophyta – Blue –green Algae

Fuzz Algae
Slime type Algae
Filamentous Algae

Phylum Rhodophyta – Red Algae

Fine Segmented Algae – *Jania sp.*
Reef Cement – *Porolithon pachydermum*
Lavender Crust Algae
Coraline Algae – *Gonolithion sp.*

Phylum Phaeophyta – Brown Algae

Sargassum – *Sargassum sp.*
Branched Algae – *Dictyota sp.*
White Scroll Alga – *Padina jamaicensis*
Saucer Leaf Alga – *Turbinaria tricostata*

Phylum Chlorophyta – Green Algae

Watercress Alga – *Halimeda opuntia*
Lettuce Leaf Alga – *Halimeda tuna*
Three finger Leaf Alga – *Halimeda incrassate*
Flat-top Bristle Brush – *Penicillus pyriformis*
Bristle Ball Brush – *Penicillus dumetosus*
Green Feather Alga – *Caulerpa sertulariodes*
Flat Green Feather Alga – *Caulerpa mexicana*
Oval-Blade Alga – *Caulerpa prolifera*
Green Grape Alga – *Caulerpa recemosa*
Fuzzy Finger Alga – *Dasycladus vermicularis*
Sea Pearl – *Ventricaria ventricosa*
Elongated Sea Pearls – *Valonia macrophysa*
Green Bubble Weed – *Dictyosphaeria cavernosa*
Network Alga – *Microdictyon marinum*
Blade Alga – *Avrainvillea sp.*
Mermaid's Fans – *Udotea sp.*
Mermaid's Tea Cup – *Udotea cyathiformis*

Class Angiospermae – Flowering Plants

Turtle Grass – *Thalassia testudinum*
Manatee Grass – *Syringodium filiforme*
Midrib Grass – *Halophila baillonis*

MARINE INVERTEBRATES

Phylum Porifera

Branching Vase Sponge – *Callyspongia vaginalis*
Brown Bowl Sponge – *Cribrochalina vasculum*
Black-Ball Sponge – *Ircinia strobilina*
Lumpy Overgrowing Sponge – *Holopsamma helwigi*
Fire Sponge – *Tedania ignis*
Touch-Me-Not Sponge – *Neofibularia nolitangere*
Orange Icing Sponge – *Mycale laevis*
Brown Variable Sponge – *Anthosigmella sp.*
Boring Sponge – *Cliona sp.*

Phylum Cnidaria

Feather Bush Hydroid – *Dentitheca dendritica*
Moon Jelly – *Aurelia aurita*
Mangrove Upsidedown Jelly – *Cassiopea xamachana*
Giant Anemone – *Condylactis gigantean*
Elegant Anemone – *Actinoporus elegans*
Corkscrew Anemone – *Bartholomea annulata*
Turtle Grass Anemone – *Viatrix globulifera*
Mat Zoanthid – *Zoanthus pulchellus*
White Encrusting Zoanthid – *Palythoa caribaeorum*
Branching Fire Coral – *Millepora alcicornis*
Blade Fire Coral – *Millepora complanata*
Black Sea Rod – *Plexaura homomalla*
Bent Sea Rod – *Plexaura flexuosa*
Shelf-Knob Sea Rod – *Eunicea succinea*
Sea Plumes – *Pseudopterogorgia sp.*
Sea Whip – *Pterogorgia sp.*
Common Sea Fan – *Gorgonia ventalina*
Venus Sea Fan – *Gorgonia flabellum*
Staghorn Coral – *Acropora cervicornis*
Elkhorn Coral – *Acropora palmate*
Finger Coral – *Porites porites*
Tube Coral – *Cladocora arbuscula*
Blushing Star Coral – *Stephanocoenia michilini*
Boulder Star Coral – *Montastrea annularis*
Golfball Coral – *Favia fragum*

Mustard Hill Coral – *Porites astreoides*
Lesser Starlet Coral – *Siderastrea radians*
Brain Coral – *Diploria sp.*
Maze Coral – *Meandrina meandrites*
Rose Coral – *Manicina areolata*

Phylum Ctenophora
Sea Walnut – *Mnemiopsis maccadyi*

Phylum Platyhelminthes
Flatworm – *Pseudoceros sp.*

Phylum Annelida
Bearded Fireworm – *Hermodice carunculata*
Southern Lugworm – *Arenicola cristata*
Magnificent Feather Duster – *Sabellastarte magnifica*
Variegated Feather Duster – *Bispira variegate*
Christmas Tree Worm – *Spirobranchus giganteus*
Medusa Worm – *Loimia medusa*

Phylum Arthropoda
Banded Coral Shrimp – *Stenopus hispidus*
Squat Anemone Shrimp – *Thor amboinensis*
Pederson Cleaner Shrimp – *Periclimenes pedersoni*
Spotted Cleaner Shrimp – *Periclimenes yucatanicus*
Red Snapping Shrimp – *Alpheaus armatus*
Spiny Lobster – *Panulirus argus*
Giant Hermit – *Petrochirus Diogenes*
White Speckled Hermit – *Paguristes punticeps*
Red Reef Hermit – *Paguristes cadenati*
Green Clinging Crab – *Mithrax sculptus*
Channel Clinging Crab – *Mithrax spinosissimus*
Nimble Spray Crab – Percnon gibbesi
Heart Urchin Pea Crab – *Dissodactylus primitivus*
Yellowline Arrow Crab – *Stenorhynchus seticornis*
Scaly-tailed Mantis – *Lysiosquilla scabricauda*
Dark Mantis – *Gonodactylus curacaoensis*
Soldierfish Isopod – *Anilocra laticaudata*
Mysid Shrimp – *Mysidium sp.*
Sessile Barnacles – Order Thoracica

Phylum Ectoprocta

Tubular-Horn Bryozoan – *Schizoporella violacea*

Phylum Mollusca

Queen Conch – *Strombus gigas*
Milk Conch – *Strombus costatus*
True Tulip – *Fasciolaria tulipa*
Netted Olive – *Oliva reticularis*
West Indian Star Snail – *Lithopoma tectum*
Stocky Cerith – *Cerithium litteratum*
Flamingo Tongue – *Cyphoma gibbosum*
Lettuce Sea Slug – *Tridachia crispate*
Brown Doris – *Discodoris evelinae*
Rough Fileclam – *Lima scabra*
Atlantic Pearl Oyster – *Pinctada radiate*
Amber Penshell – *Pinna carnea*
Sunrise Tellin – *Tellina radiate*
Fuzzy Chiton – *Acanthopleura granulate*
Caribbean Reef Squid – *Sepioteuthis sepioidea*
Caribbean Reef Octopus – *Octopus briareus*

Phylum Echinodermata

Cushion Sea Star – *Oreaster reticulatus*
Comet Star – *Ophidiaster guildingii*
Reticulated Brittle Star – *Ophionereis reticulate*
Blunt-Spined Brittle Star – *Ophiocoma echinata*
Banded-Arm Brittle Star – *Ophioderma appressum*
Long-Spined Urchin – *Diadema antillarum*
Rock-Boring Urchin – *Echinometra lucunter*
Variegated Urchin – *Lytechinus variegates*
Slate-Pencil Urchin – *Eucidaris tribuloides*
West Indian Sea Egg – *Tripneustes ventricosus*
Red Heart Urchin – *Meoma ventricosa*
Donkey Dung Sea Cucumber – *Holothuria Mexicans*

Phylum Chordata

Subphylum Urochordata

Giant Tunicate – *Polycarpa spongiabilis*
Black Sea Squirt

FISH

Key to Abundance:

S–	**Single**		**M–**	**Many:**	**10 – 100**
F–	**Few:**	**1 – 10**	**A–**	**Abundant:**	**Over 100**

Family Chaetodontidae

Banded Butterflyfish – *Chaetodon striatus*	*M*
Foureye Butterflyfish – *Chaetodon capistratus*	***A***

Family Pomacanthidae

Queen Angelfish – *Holocanthus ciliaris*	*F*
French Angelfish – *Pomacanthus paru*	*S*
Rock Beauty – *Holacanthus tricolor*	*M*

Family Acanthuridae

Blue Tang – *Acanthurus coeruleus*	*A*
Ocean Surgeonfish – *Acanthurus bahianus*	*A*

Family Carangidae

Bar Jack – *Caranx ruber*	*A*
Horse-Eye Jack – *Caranx latus*	*F*
Palometa – *Trachinotus goodie*	*F*

Family Scombridae

Cero – *Scomberomorus regalis*	*F*

Family Belonidae

Flat Needlefish – *Ablennes hians*	*M*
Houndfish – *Tylosurus crocodiles*	*S*

Family Sphyraenidae

Great Barracuda – *Sphyraena barracuda*	*M*

Family Albulidae

Bonefish – *Albula vulpes*	*S*

Family Sparidae

Sea Bream – *Archosargus rhomboidalis*	*F*
Saucereye Porgy – *Calamus calamus*	*M*

Family Gerreidae

Yellowfin Mojarra – *Gerres cinereus*	*A*

Family Elopidae	
Tarpon – *Megalops atlanticus*	*F*
Family Atherinidae	
Silversides	A
Family Haemulidae	
French Grunt – *Haemulon flavolineatum*	*A*
Striped Grunt – *Haemulon striatum*	*A*
White Grunt – *Haemulon plumieri*	*A*
Bluestriped Grunt – *Haemulon sciurus*	*A*
Caesar Grunt – *Haemulon carbonarium*	*F*
Tomtate – *Haemulon aurolineatum*	*A*
Margate – *Haemulon album*	*S*
Family Lutjanidae	
Mutton Snapper – *Lutjanus analis*	*F*
Gray Snapper – *Lutjanus griseus*	*A*
Dog Snapper – *Lutjanus jocu*	*S*
Schoolmaster – *Lutjanus apodus*	*A*
Lane Snapper – *Lutjanus synagris*	*M*
Yellowtail Snapper – *Ocyurus chrysurus*	*A*
Family Pomacentridae	
Longfin Damselfish – *Stegastes diencaeus*	*M*
Dusky Damselfish – *Stegastes fuscus*	*A*
Threespot Damselfish – *Stegastes planifrons*	*A*
Cocoa Damselfish – *Stegastes variabilis*	*F*
Beaugregory – *Stegastes leucostictus*	*A*
Yellowtail Damselfish–*Microspathodon chrysurus*	*A*
Sergeant Major – *Abudefduf saxalis*	*A*
Blue Chromis – *Chromis cyanea*	*A*
Brown Chromis – *Chromis multilineata*	*A*
Family Serranidae	
Butter Hamlet – *Hypoplectrus unicolor*	*F*
Barred Hamlet – *Hypoplectrus puella*	*M*
Yellowbelly Hamlet – *Hypoplectrus aberrans*	*S*
Yellowtail Hamlet – *Hypoplectrus chlorurus*	*M*
Black Hamlet – *Hypoplectrus nigricans*	*F*
Mutton Hamlet – *Alphestes afer*	*F*
Graysby – *Epinephelus cruentatus*	*seven seen*

Red Hind – *Epinephelus guttatus*	*two seen*
Coney – *Epinephelus fulvus*	*twelve seen*
Harlequin Bass – *Serranus tigrinus*	*M*
Lantern Bass – *Serranus baldwini*	*F*
Tobaccofish – *Serranus tabacarius*	*F*
Chalk Bass – *Serranus tortugarum*	*M*
Family Grammatidae	
Fairy Basslet – *Gramma loreto*	*F*
Family Scaridae	
Queen Parrotfish – *Scarus vetula*	*M*
Stoplight Parrotfish – *Sparisoma viride*	*A*
Princess Parrotfish – *Scarus taeniopterus*	*A*
Striped Parrotfish – *Scarus croicensis*	*A*
Redband Parrotfish – *Sparisoma aurofrenatum*	*A*
Redtail Parrotfish – *Sparisoma chrysopterum*	*M*
Redfin Parrotfish – *Sparisoma rubripinne*	*F*
Greenblotch Parrotfish – *Sparisoma atomarium*	*F*
Bucktooth Parrotfish – Sparisoma radians	S
Family Labridae	
Spanish Hogfish – *Bodianus rufus*	*S*
Puddingwife – *Halichoeres radiatus*	*M*
Yellowhead Wrasse – *Halichoeres garnoti*	*A*
Bluehead – *Thalassoma bifasciatum*	*A*
Slippery Dick – *Halichoeres bivittatus*	*A*
Blackear Wrasse – *Halichoeres poeyi*	*F*
Rosy Razorfish – *Hemipteronotus martinicensis*	*F*
Family Holocentridae	
Squirrelfish – *Holocentrus adscensionis*	*A*
Longspine Squirrelfish – *Holocentrus rufus*	*M*
Reef Squirrelfish – *Holocentrus coruscum*	*M*
Blackbar Soldierfish – *Myripristis jacobus*	*A*
Family Priacanthidae	
Glasseye Snapper – *Priacanthus cruentatus*	*F*
Family Apogonidae	
Barred Cardinalfish – *Apogon binotatus*	*F*
Flamefish – *Apogon maculates*	*F*
Bridle Cardinalfish – *Apogon aurolineatus*	*M*

Dusky Cardinalfish – *Phaeoptyx pigmentaria*	*F*
Conchfish – *Astrapogon stellatus*	*S*
Family Gobiidae	
Sharknose Goby – *Gobiosoma evelynae*	*M*
Shortstripe Goby – *Gobiosoma chancei*	*F*
Goldspot Goby – *Gnatholepis thompsoni*	*M*
Colon Goby – *Coryphopterus dicrus*	*S*
Pallid Goby – *Coryphopterus eidolon*	*F*
Bridled Goby – *Coryphopterus glaucofraenum*	*A*
Glass Goby – *Coryphopterus hyalinus*	*A*
Family Clinidae	
Hairy Blenny – *Labrisomus nuchipinnis*	*S*
Saddled Blenny – *Malacoctenus triangulates*	*M*
Dusky Blenny – *Malacoctenus gilli*	*M*
Rosy Blenny – *Malacoctenus macropus*	*A*
Spinyhead Blenny – *Acanthemblemaria spinosa*	*S*
Family Blenniidae	
Seaweed Blenny – *Parablennius marmoreus*	*F*
Redlip Blenny – Ophioblennius atlanticus	M
Family Opistognathidae	
Yellowhead Jawfish – *Opistognathus aurifrons*	*M*
Family Bothidae	
Peacock Flounder – *Bothus lunatus*	*S*
Family Scorpaenidae	
Spotted Scorpionfish – *Scorpaena plumiei*	*S*
Family Synodontidae	
Sand Diver – *Synodus intermedius*	*M*
Family Cirrhitidae	
Redspotted Hawkfish – *Amblycirrhitus pinos*	*S*
Family Aulostomidae	
Trumpetfish – *Aulostomus maculates*	*F*
Family Malacanthidae	
Sand Tilefish – *Malacanthus plumieri*	*F*

Family Tetraodontidae

Bandtail Puffer – *Sphoerides spengleri*	*S*
Sharpnose Puffer - *Canthigaster rostrata*	*M*
Porcupinefish – *Diodon hystrix*	*S*

Family Ostraciidae

Scrawled Cowfish – *Lactophrys quadricornis*	*S*
Smooth Trunkfish – *Lactophrys triqueter*	*F*

Family Balistidae

Queen Triggerfish – *Balistes vetula*	*F*
Scrawled Filefish – *Aluterus scriptus*	*F*
Orangespotted Filefish – *Cantherhines pullus*	*M*
Whitespotted Filefish - *Cantherhines macrocerus*	*F*

Family Mullidae

Spotted Goatfish – *Pseudupeneus maculates*	*A*
Yellow Goatfish – *Mulloidichthys martinicus*	*A*

Family Sciaenidae

Spotted Drum – *Equetus punctatus*	*S*
Highhat – *Equetus acuminatus*	*M*

Family Muraenidae

Green Moray – *Gymnothorax funebris*	*F*
Spotted Moray – *Gymnothorax moringa*	*F*
Purplemouth Moray – *Gymnothorax vicinus*	*S*

Family Ophichthidae

Sharptail Eel – *Myrichthys breviceps*	*S*

Family Rhincodontidae

Nurse Shark – *Ginglymostoma cirratum*	*S*

Family Dasyatidae

Southern Stingray – *Dasyatis Americana*	*F*

Family Myliobatidae

Spotted Eagle Ray – *Aetobatus narinari*	*S*

MARINE REPTILES

Marine Turtles

Hawksbill – *Eretmochelys imbricata*	*F*
Green Turtle – *Chelonia mydas*	*S*