An Environmental Profile of the Island of TORTOLA, British Virgin Islands

VOLUME 4 OF THE BRITISH VIRGIN ISLANDS ENVIRONMENTAL PROFILE SERIES

island resources FOUNDATION

J.A. WOOLLAM FOUNDATION

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http://j.mp/BVI_Tortola
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http://j.mp/BVI_JostVanDyke

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ACRONYMNS

ARK	Association of Reef Keepers (BVI)
BEST	Biodiversity and Ecosystem Services in Territories
BMPs	Best Management Practices
BVI	British Virgin Islands
BVIEC	British Virgin Islands Electricity Corporation
BVIHCCV	British Virgin Islands High Court Civil
BVIHCCVAP	British Virgin Islands High Court Civil Appeal
CBC	Convention on Biological Diversity
CCA	Climate Change Adaptation
CCAP	Climate Change Adaptation Policy
CCI	Caribbean Challenge Initiative
CDEMA	Caribbean Disaster Emergency Management Agency
CDM	Comprehensive Disaster Management
CGB	Cane Garden Bay (Tortola)
CITIES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CSO	Central Statistics Office (BVI)
CYEN-BVI	Caribbean Youth Environment Network of the BVI
DCF	Department of Conservation and Fisheries (BVI)
DDM	Department of Disaster Management (BVI)
DEFRA	Department for Environment, Food, Rural Affairs (UK)
DFID	Department for International Development (UK)
DOA	Department of Agriculture (BVI)
DPU	Development Planning Unit (BVI) (now Central Statistics Office)
DPW	Department of Public Works (BVI)
DTCP	Department of Town and Country Planning (BVI)
DWM	Department of Waste Management (BVI)
DWS	Department of Water and Sewerage (BVI)
ECACC	Enhancing Capacity for Adaptation to Climate Change
ECNAMP	Eastern Caribbean Natural Area Management Programme
EE/LL	East End/Long Look (Tortola)
EIA	Environmental Impact Assessment
EMT	Environmental Management Trust
EPA	Environmental Protection Area
ESHS	Elmore Stoutt High School (BVI)
EU	European Union
FAO	Food and Agriculture Organization (UN)
FATF	Financial Action Task Force
FCO	Foreign and Commonwealth Office (UK)
FEMA	Federal Emergency Management Agency (US)
FERA	Food and Environmental Research Agency (UK)
FPA	Fisheries Protected Area
GCCA	Global Climate Change Alliance
GDP	Gross Domestic Product
GIS	Geographic Information System
GoVI	Government of the (British) Virgin Islands
HLSCC	H. Lavity Stoutt Community College
HOA	House of Assembly (BVI)
IBA	Important Bird Area
IMPASSE	Management of Protected Areas to Support Sustainable Economics
IPCC	Intergovernmental Panel on Climate Change
IRF	Island Resources Foundation
IUCN	International Union for the Conservation of Nature
IWMP	Integrated Waste Management Plan
JVD	Jost Van Dyke
LFPR	Labour Force Participation Rate
LOS	Law of the Sea
MNRL	Ministry of Natural Resources and Labour (BVI)
MPA	Marine Protected Area
NCCC	National Climate Change Committee (BVI)
NDDP	National Disaster Development Plan
NEAP	National Environmental Action Plan
NGIS	National Geographic Information System
NGO	Nongovernmental Organisation
NIDP	National Integrated Development Plan
NIDS	National Integrated Development Strategy
NOAA	National Oceanic and Atmospheric Administration (US)
NPA	National Parks Act
NPDP	National Physical Development Plan
NPO	Non-profit Organisation
NPT	National Parks Trust of the Virgin Islands
OECS	Organisation of Eastern Caribbean States
OTEP	Overseas Territories Environment Programme (UK)
PA	Protected Area
PAHO	Pan American Health Organisation
PRSMP	Puerto Rico Strong Motion Programme
PS	Permanent Secretary
R3I	Regional Risk Reduction Initiative
RBG	Royal Botanic Gardens, Kew (UK)
RSPB	Royal Society for the Protection of Birds (UK)
SIDS	Small Island Developing States
SLM	Sustainable Land Management
STEP	Sustainable Tourism Environmental Programme
TB	Tourist Board (BVI)
TNC	The Nature Conservancy
UK	United Kingdom
UKOT	UK Overseas Territory
UKOTCF	UK Overseas Territory Conservation Forum
UNDP	United Nations Development Programme
UNFCC	United Nations Framework Convention on Climate Change
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
USVI	United States Virgin Islands
UVI	University of the Virgin Islands
VI	Virgin Islands
VIEC	Virgin Islands Environmental Council (BVI)
VISR	Virgin Islands Shipping Registry (BVI)
WI	West Indies/West Indian
YEP	Youth Empowerment Project (BVI)

ABBREVIATIONS

In this document measurements are first stated as metric measures followed by U.S. equivalents in parenthesis.

ac	acre	**m**	metre
cm	centimetre	**m²**	square metre
ft	foot	**m³**	cubic metre
ha	hectare	**mi**	mile
in	inch	**mm**	milimetre
kg	kilogram	**mph**	miles per hour
km	kilometre	**msw**	maximum sustainable winds
km²	square kilometre	**yd**	yard
lb	pound	**yd³**	cubic yard

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PREFACE AND ACKNOWLEDGEMENTS

When Island Resources Foundation (IRF) was founded in 1972, my late husband, Dr. Edward L. Towle, and I took as our operating credo an early-for-its-time, yet also forward-looking premise—namely, that islands are special places, that their environments are unique and vulnerable, and that the Foundation's mission would be to assist small islands (especially those in the Caribbean) to address environmental change, even as they simultaneously confronted the challenges of social, economic and institutional development.

One of Island Resources Foundation's earliest studies—carried out in 1976 in the British Virgin Islands for the Government of the Virgin Islands—was to develop and apply environmental guidelines designed specifically for ***island*** development. For its time, this work was innovative—in part because "environment" and "development" were not yet linked as they are today to small-island sustainability. It also was the beginning of a long relationship between Island Resources Foundation, based in nearby St. Thomas in the U.S. Virgin Islands, and our neighbours in the BVI, just a short distance away across the Sir Francis Drake Channel.

In the late 1990s, the Foundation launched a stronger presence in the British Virgins, first, with the establishment of an operational base, provided initially through the generous support of the H. Lavity Stoutt Community College, and then with the execution of several long-term programmes. In 1997, IRF donated its unique Caribbean-focused environmental library to the College, now housed at the College's Learning Resource Centre as a discreet collection named in memory of Dr. Edward L. Towle. That collection is now being digitized to ensure wider availability of these historical treasures that tell the story of the growth of the environment sector in the insular Caribbean during the final decades of the twentieth century.

The Foundation's final project in the BVI[✦] has been the Environmental Profile Programme for the British Virgin Islands. Based on the premise that knowledge is power, the Foundation, with a variety of partners, set out in 2008 to provide a current-state description and assessment of the environment of the four primary islands of the BVI, each profile to identify the major issues and opportunities related to the management of the territory's natural resources.

The *Tortola Environmental Profile* is the last in the series—following profiles for Jost Van Dyke in 2009, Virgin Gorda in 2012, and Anegada in 2013. As befits the island of its title, this Profile is big, sweeping in its narrative, and expansive in its viewpoint. It will be followed by several scientific addenda, similar to the earlier profiles, and, in this case, also a special companion document to focus on the natural history of Tortola's offshore sister islands.

Funding for the *Tortola Environmental Profile* has been forthcoming almost entirely from the private sector, with only the BVI Governor's office, through its Overseas Territories Programme Fund, providing a government grant. Primary funding was received from the J.A. Woollam Foundation in Lincoln, Nebraska (USA). IRF is deeply indebted to Trustee John A. Woollam for facilitating this substantial grant, without which this publication could not have been completed. Other donors include the Dave Hokin Foundation—which has long supported the Environmental Profile Programme—the Faile Foundation, Curt and Nancy Richardson, the Falconwood Foundation, the Nora Hazel Point Estate, Sir Richard Branson, TRS Services, Ltd. and members of Island Resources Foundation.

I am very grateful for the Herculean contributions of the Tortola Profile Project Team, most of whom have been with the project since the first profile was published in 2009—Jean-Pierre Bacle, Kevel Lindsay, Cynthia Rolli, Clive Petrovic, Dr. Michael Kent, Charlotte McDevitt and Rosemary Delaney-Smith. With the Tortola Profile, we added two new team members: Dr. Shannon Gore and Noni M. Georges, both of whom have complimented the excellence of their profile colleagues. With the publication of this the last of the four island profiles, I would be neglectful if I did not express special appreciation to deputy project leader, Jean-Pierre Bacle, who has been by my side throughout the tenure of this project with good cheer, good advice, and extraordinary labour. My appreciation also to Rosemary Delaney-Smith, who has served as the programme's community coordinator and local liaison. When Jean-Pierre or I could not be in the BVI to handle a particular task, solve a particular problem, or spread the "good news" about the Profile Programme, Rosemary was always on hand to assume these added responsibilities.

[✦] After more than four decades in the Caribbean, IRF will be sunsetting as an organisation in 2016.

And so, to our multiple donors over the course of producing the four Environmental Profiles, to those who researched and wrote the individual chapters of the Profiles, and to the many individuals who assisted us in the gathering of data or participated in profile-related meetings and interviews (those for the Tortola Profile are identified below), I extend my appreciation, even as Island Resources Foundation now dedicates this Profile and those that preceded it to the people of the British Virgin Islands. The environment of your Virgin Islands as articulated throughout these Environmental Profiles is in your hands to lovingly protect and wisely manage.

—Judith A. Towle (May, 2015)
Vice President of Island Resources Foundation
Project Director for the British Virgin Islands Environmental Profile Programme

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Island Resources Foundation extends its appreciation to each of the persons identified below for assisting us in the process of gathering data for the Tortola Environmental Profile.

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Taken from Tortola’s West End Peninsula, looking at Lower Belmont Bay, Belmont Point, and Belmont Pond.

1. INTRODUCTION TO TORTOLA[1]

> *Can you recall when whelks along the sea rocks were just there for the picking … and the joy of cooking a pot of them in sea water and when they were tender, easing them out of the shells, cleaning off their tails and making a meal of them? Have you any recollections of the 'fry-fry' cake or the romance of a moonlight walk to the seashore to see thousands of silvery fish glistening in a fisherman's crawl?*
>
> *… Do you remember when the hillside guts used to run with crystal water for washing and bathing? And when the same guts were lined with guavaberry trees bearing red and yellow berries, just there for the picking?*
>
> Verna Penn Moll, "This Land: A Trust from God"

Unlike these reminiscences of Virgin Islands author and educator Verna Penn Moll, the island of Tortola today displays a modern and well-developed landscape, the most cosmopolitan of the islands comprising the British Virgin Islands (BVI) (**Figure 1**). The capital of the territory, Road Town, lies within a sheltered harbour of the same name, Road Harbour, on the island's southern coast. Commerce and government are centred on the island as is the territory's only tertiary educational facility, the H. Lavity Stoutt Community College. The BVI's primary economic activity—the offshore financial services sector—is concentrated on Tortola, as well as key components of the territory's tourism sector—yachting and cruise ship tourism.

Because Tortola is the most populous and most developed of all of the islands comprising the British Virgin Islands, much of the environmental complexity of the territory and most environmental concerns can be found within Tortola's borders. The challenges Tortola confronts as it seeks to protect and manage its environment are generally those of the entire territory, and, as such, it has presented an outsized challenge to the writers of the BVI Environmental Profiles.

According to local tradition, the island of Tortola is thought to have been originally named "*land of the turtle dove*" by Christopher Columbus. One could assume that Columbus so named it because of the presence of a significant population of doves on the island, which might have reminded the explorer of the dove species in his home country. Later when the Dutch settled Tortola, they named it *Ter Tholen* after one of the small islands off the coast of The Netherlands. When the English reclaimed the island, they modified the name to its present-day *Tortola*. (See Section 1.2.2.2 for a fuller explanation of Tortola's naming.)

Beef Island is located just east of Tortola (**Figure 2**). For purposes of the *Tortola Environmental Profile*, Beef Island is considered part of Tortola. Today, a short, two-lane bridge (the Queen Elizabeth II Bridge) connects the two islands. Beef Island was likely given its name by ship captains as a signpost for provisions, and historical remnants of cattle activity are still present in the landscape.

A number of smaller islands and cays surround Tortola. Today they are generally referred to as "sister islands," although they were often known as "outer islands" in days gone by. Seventeen✦ of the small islands located offshore from Tortola have also been studied by researchers from Island Resources Foundation (IRF), and a summary of the landscape features, natural resources, and biodiversity of the sister islands are found in a companion document to the *Tortola Environmental Profile* entitled ***The Natural History of Tortola's Sister Islands***.

[1] The authors of Chapter One are: Jean-Pierre Bacle, Judith A. Towle, and Dr. Michael D. Kent; contributors: Dr. Katherine Smith (Box 1) and Rosemary Delaney-Smith (Box 2).

✦ Little Thatch Island, Great Thatch Island, Little Tobago Island, Great Tobago Island, Ginger Island, Carval Rock, Cooper Island, Salt Island, Dead Chest, Peter Island, Pelican Island, Norman Island, Guana Island, Little Camanoe Island, Great Camanoe Island, Scrub Island, and Marina Cay.

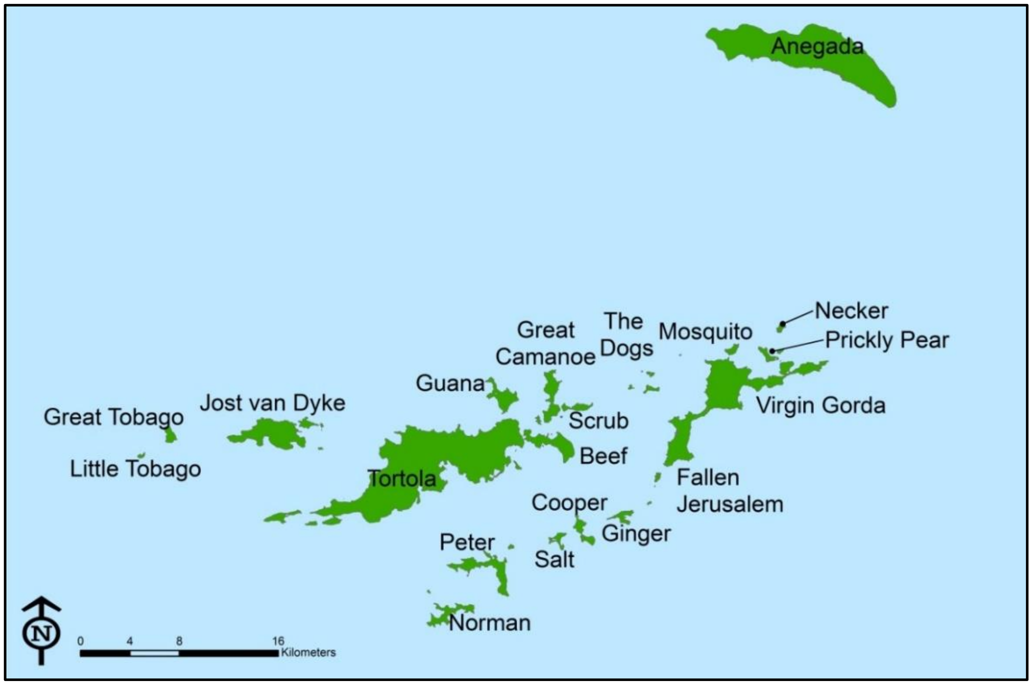


Figure 1.
Regional map of the British Virgin Islands.
(*Source*: adapted from the BVI National Geographic Information System, Department of Town and Country Planning.)

1.1 The Physical and Natural Setting

1.1.1 Tortola's Physical Geography

The Territory of the British Virgin Islands is comprised of approximately 50 islands, islets, and cays. Tortola is the largest island in the territory, and the third largest in the entire Virgin Islands archipelago, after St. Croix and St. Thomas in the US Virgin Islands. The island is about 5 km (3 mi) wide and 21.7 km (13.5 mi) long, and covers an area of 54 sq km (21 sq mi).

The island is marked by towering steep hills and deep valleys. The highest peak is Sage Mountain (also named Mount Sage), which reaches 543 m (1,781 ft). It stands as the highest peak in all the Virgin Islands including the US Virgin Islands. Most of the high peaks, including Sage Mountain, occur to the west of Road Town, the territory's capital city, with at least eight peaks above 350 m (1,150 ft). East of Road Town, Sabbath Hill at 385 m (1,263 ft) is the highest peak and the only one above 350 m (1,150 ft). Elevation lowers significantly eastward. **Figure 2** provides some geographic details of Tortola and Beef Island.

Beef Island, the sixth largest in the territory at 3.8 sq km (1.47 sq mi), stretches 4.5 km in length (2.8 mi), and is barely 0.5 km to 1 km in width (0.31 to 0.62 mi). It is situated immediately east of Tortola.

In contrast to Tortola, Beef Island is a sparsely populated island and is comprised of rolling lowlands with the exception of Little Mountain (73.7 m/242 ft) located west of the island's airport and the impressive Mount Alma (224 m/735 ft), which dominates the east end of the island. With its seven salt ponds and extensive fringing mangroves, Beef Island is a refuge for wildlife displaced from more developed areas of Tortola.

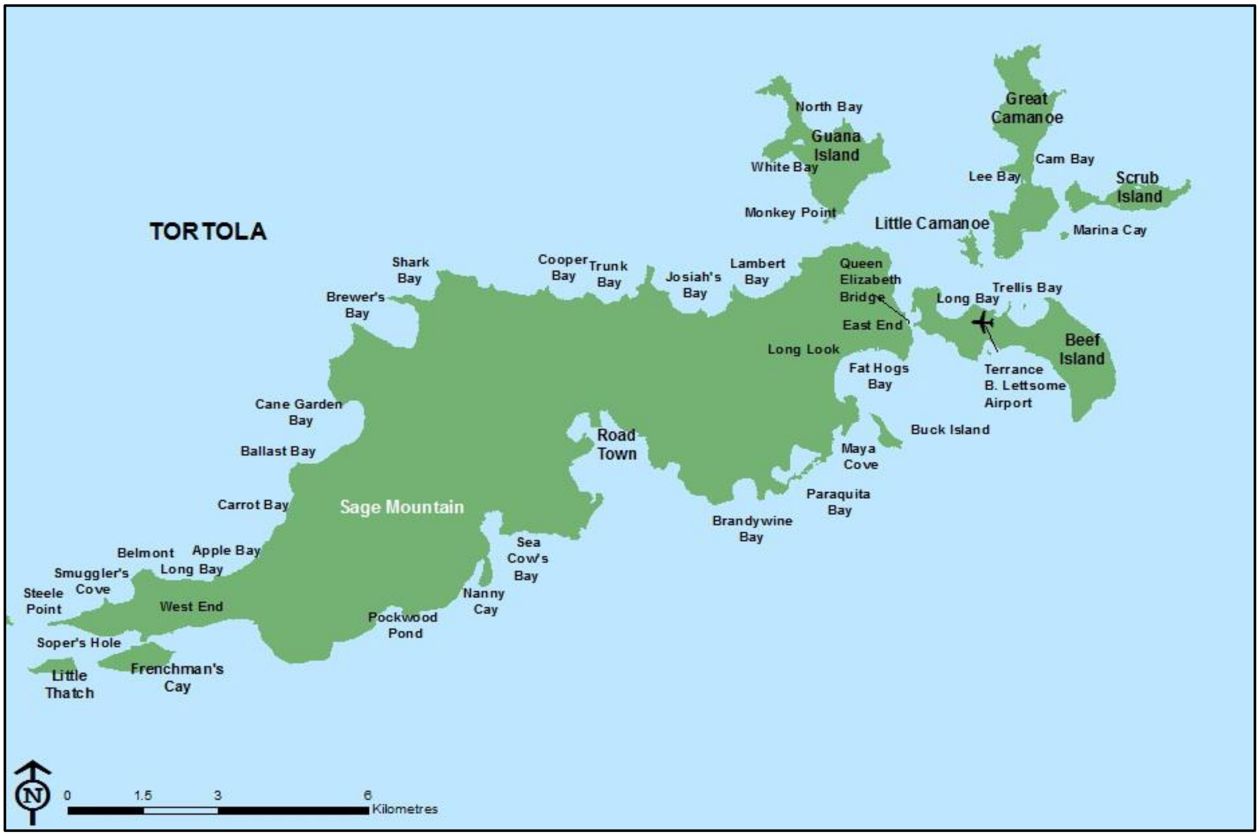


Figure 2.
General location map of Tortola, including Beef Island.
(*Source*: adapted from the BVI National Geographic Information System, Department of Town and Country Planning.)

1.1.2 Tortola's Geological History

The British Virgin Islands lies at the northeastern edge of the Puerto Rico/Virgin Islands micro-plate located within the northern boundary zone between the Caribbean and North American Tectonic Plates (Rankin, 2002). Beginning 80–100 million years ago during the Late Cretaceous period, a complex series of undersea mountain building, extreme volcanism, several major sea level changes, centuries of coral reef formation, and on-going erosional and depositional processes all contributed to the landscape seen today on the island of Tortola. Except for Anegada, all islands in the Virgin Islands archipelago are essentially volcanic.

The BVI—as well as St John, St. Thomas and Puerto Rico—are subaerial topographic highs on the Puerto Rican Bank, a submerged platform defined by the 183-metre depth contour (Rogers and Teytaud, 1988). Some 100,000 years ago, during the last ice age of the Pleistocene Epoch, a continuous subaerial landmass extended from Puerto Rico across the British Virgin Islands. About 15,000 years ago, continental glaciers began to melt; and as glaciers retreated, a rapid rise of sea level occurred and then tapered off about 10,000 years ago. A further slowing of sea level rise occurred about 3,000 years ago to near present-day levels. Most beaches, barrier reefs and coastal salt ponds were formed by that time.

The geology of the BVI is described in the studies of Helsley (1960), Donnelly (1966), Earle (2002), Rankin (2002), and in the more recent engineering geological studies by Joyce (2006). Being the largest island, Tortola has the most varied and complex geology (see **Figure 3**).

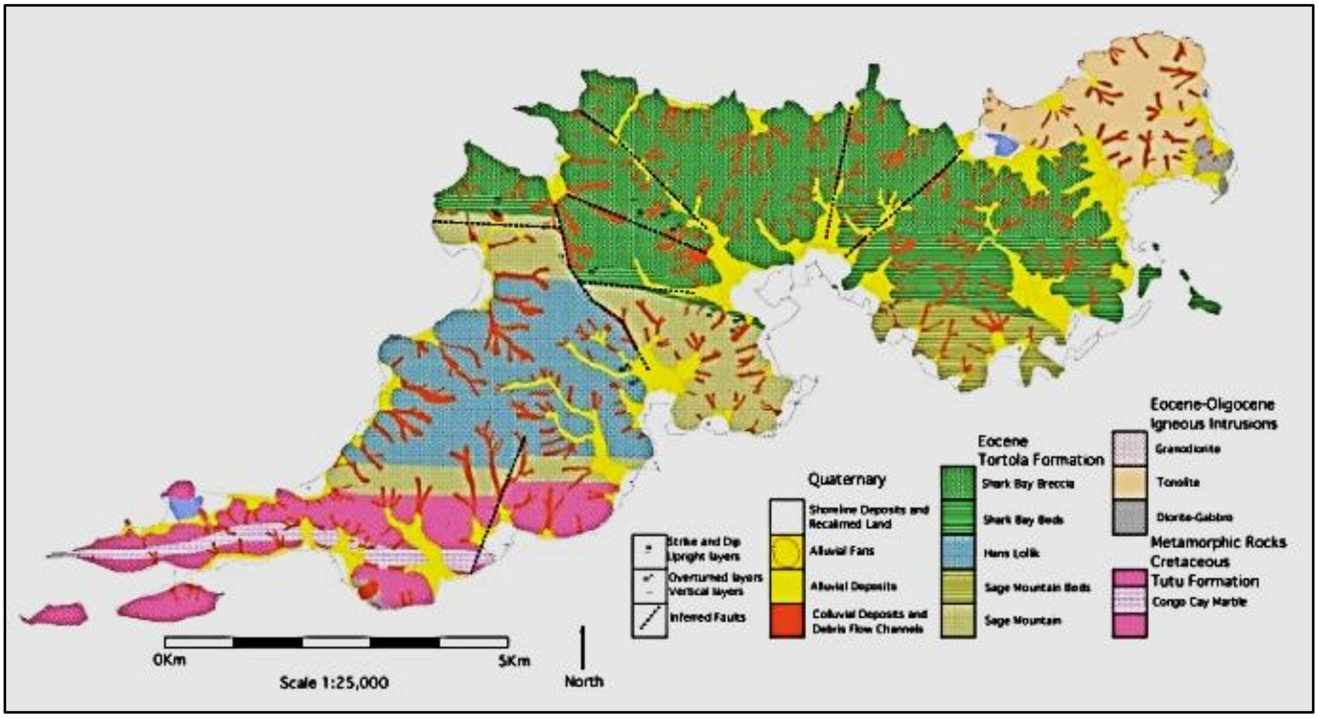


Figure 3.
The geology of Tortola (*source*: Joyce, 2006).

Most of Tortola, especially the central portion, consists of the Tortola Formation, which includes three members:

(1) The Hans Lollick Member described as augite andesite breccias, tuffs and volcanic sandstone.

(2) The Sage Mountain Member described as massive-to-thin bedded andesite tuffs, lapilli tuffs and volcanic sandstone.

(3) The Shark Bay Member described as massive-to-thin bedded breccia, lapilli tuff and coarse tuff.

Elsewhere on Tortola, the Tutu Formation is found in the southwestern portion of the island (west of Nanny Cay). Here rocks have been highly metamorphosed in contact with an igneous intrusion of diorite. At the eastern end of the island (east of Josiah's Bay and Fat Hogs Bay), bedrock geology is dominated entirely by coarse-grained igneous intrusive rocks, mainly tonalite composition with some significant amounts of diorite and granodiorite (Joyce, 2006).

Beef Island's rock composition is similar to the eastern end of Tortola but is dominated by diorite (**Figure 4**). An interesting geological feature on Beef Island is the formation of boulder fields centred between Little Cay and Well Bay (**Photo 1**). This geological landscape is similar to that of The Baths on Virgin Gorda. The area, with its amazing pile of giant boulders reaching 35 m (116 ft) in elevation, is the result of geological and geomorphological processes that occurred millions years ago (see section 1.2.3.2. in *An Environmental Profile of the Island of Virgin Gorda*, IRF, 2012). Smaller outcrops of boulder fields occur elsewhere on Beef Island, especially northeast of Hans Creek.

Tortola continues to experience ongoing weathering and climatic processes. Increasing development and road cuts along the coast and inland have greatly increased rock and soil exposure. This in turn creates more susceptibility to erosion and slope instability. Shoreline erosion and accretion is a testament to the island's continuing adjustment to coastal dynamics, caused by normal climate fluctuations aided by anthropogenic activity.

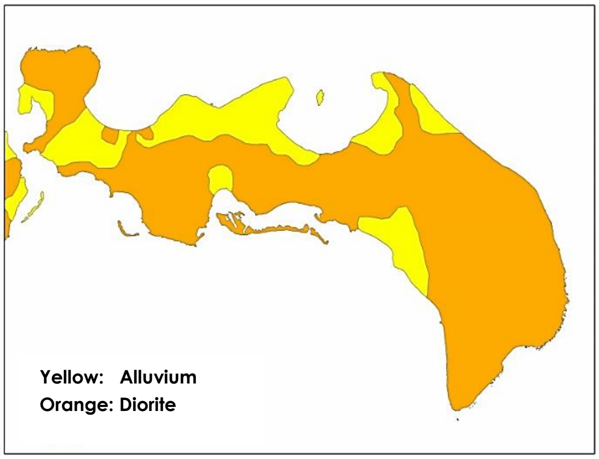


Figure 4.
The geology of Beef Island (source: Joyce, 2006).

Photo 1.
On top of the largest boulder formation on Beef Island, looking at the southern tip of Little Cay in the foreground and Mount Alma in the background.

1.1.3 Tortola's Physiographic Features

Tortola, including Beef Island, can be characterised as having six physiographic features:

1. Bedrock Uplands.
2. Lowland Plain.
3. Colluvial Deposits.
4. Alluvial Deposits.
5. Wetlands.
6. Beach Deposits.

(1) Bedrock Uplands

Most of Tortola and the eastern third of Beef Island fall into this category. The uplands are comprised of resistant volcanic rocks that give the island its dramatic and rugged topography. High elevation and steep slopes dominate throughout this type of landscape (**Photo 2**). Most upland areas consist of exposed bedrock and bedrock thinly veneered with soils. On more gentle slopes, thicker and more mature soils are found.

(2) Lowland Plain

This landscape feature has a flat-to-undulating topography and is seldom found on Tortola. The central part of Beef Island between Little Mount and Mount Alma is a good example. Here average elevation barely exceeds 20 m (65 ft) and consists of low-lying bedrock eroded through time. Many boulder fields are common throughout the landscape (**Photo 3**), with the most prominent one just east of Well Bay (**Photo 1**). At lower elevation, alluvium deposits are common, especially along the coast and surrounding the salt ponds. These deposits mostly consist of reworked marine sediments. The relatively flat and low-lying terrain in proximity to a coastal marine environment has allowed many salt ponds to develop over the last 3,000 years.

Photo 2.
The west end of Tortola viewed from Little Thatch Island. Soper's Hole is flanked by high steep hills in the foreground and massive Sage Mountain in the background.

Photo 3.
Beef Island's lowlands partially covered with boulder fields.
Photo taken southeast of Trellis Bay.

(3) Colluvial Deposits

Tortola's landscape is dissected by a multitude of ghuts caused by intense erosion along rock fissures and fault lines and along erodible rock formations. Within these ghuts and their tributaries, colluvial deposits are found. They are gravity induced and exhibit a wide range of unsorted heterogeneous particle sizes, ranging from clay to sand and gravel to boulders. Their composition largely reflects the nature of the original landmass that collapsed. These deposits typically cover steep valley walls and terminate at drainage channels.

Non-channelised colluvial deposits also occur. These deposits tend to form along and at the base of steep slopes and hillsides as a result of erosion, soil creep, landslides and debris flows (**Photo 4**).

Photo 4.
Gravity-induced landslide along Sir Francis Drake Highway west of Road Town. The failure was likely due to reduced plant cover from animal overgrazing.

(4) Alluvial Deposits

Alluvial deposits are found along low-lying coastal areas between the shoreline and at the base of large watersheds and large drainage ghuts. Deposits largely consist of reworked colluvium washed downslope from hillsides and drainage channels. Sediments tend to be finer and more sorted as they are transported further downslope.

Most large deposits are scattered along the south shore of Tortola. From west to east, the largest deposits are: Coxheath (**Photo 5**), Pockwood Pond, Pleasant Valley, Sea Cow's Bay, Lower Estate, Pasea, Baugher's Bay, Paraquita Bay, and Fat Hogs Bay. Along the north shore, the three largest deposits are: Josiah's Bay, Brewer's Bay and Cane Garden Bay. On Beef Island, the main deposits occur around Long Bay, Trellis Bay, and Bluff Bay. On Beef Island, alluvial deposits occur in association with the lowland plain and salt ponds.

Photo 5.
Extensive alluvial deposits along Coxheath Valley.
The area is primarily used for livestock farming and grazing.

(5) Wetlands

Salt ponds and coastal mangroves were once a common site, especially along the southern shores of Tortola. Today many of these important ecosystems have been partially or fully reclaimed by large-scale development projects, road construction, and private property encroachment. **Figure 5** shows the current distribution of mangrove wetlands on Tortola.

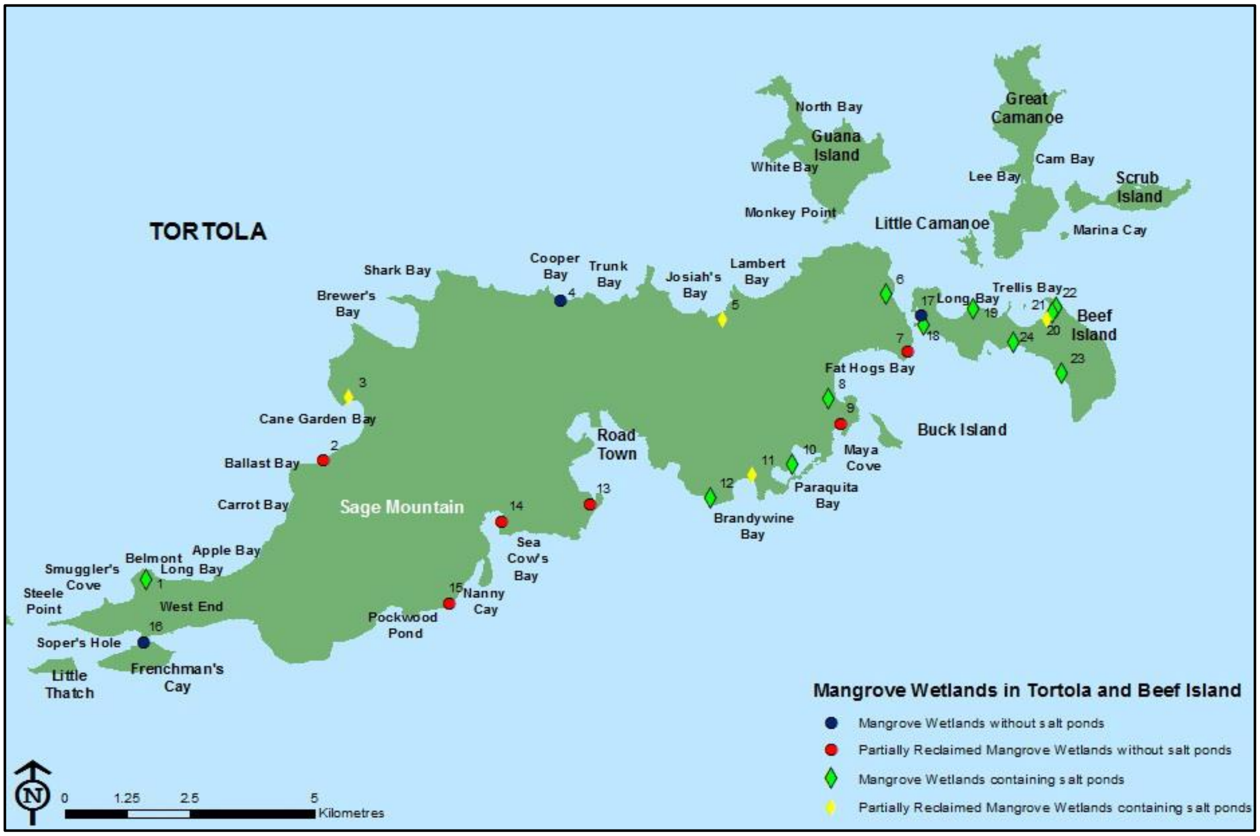


Figure 5.
Location of current mangrove wetlands on Tortola, including Beef Island.
See Table 1 for details. (*Source*: adapted from Jarecki, 2006.)

In a fairly recent study of historical wetland coverage of Tortola, based on 1950's aerial photographs, results showed that of the 33 wetlands that existed on Tortola in the 1950s, 17 were fully reclaimed, 9 were partially reclaimed, and only 7 suffered minor encroachment (Jarecki, 2006). This assessment indicates that at least 47 percent of the historical mangrove coverage on Tortola has been lost in the last five decades as a result of development.

On Beef Island, only one wetland has been partially reclaimed out of seven wetland sites in the 1950s. A few wetlands remain fairly intact due to difficult road access such as the Banana Wharf Salt Pond (**Photo 6**).

Table 1 provides a list of existing mangrove wetlands including those partially reclaimed. It is likely that increased wetland loss has occurred since the Jarecki study in 2006.

Photo 6.
Banana Wharf Salt Pond fringed by four species of mangroves, looking south toward Mount Alma on Beef Island.

Table 1.
Existing mangrove wetlands of Tortola and Beef Island, including those partially reclaimed.

Site #	Wetland	Location	Salt Pond Present?	Portion Reclaimed
1	Belmond Pond	Tortola	Yes	-
2	Cane Garden	Tortola	No	75%
3	Cane Garden (Sinky Pond)	Tortola	Yes	50%
4	Cooper's Bay	Tortola	No	-
5	Josiahs Bay	Tortola	Yes	25%
6	Harris Pond	Tortola	Yes	-
7	South of Bridge (East End)	Tortola	No	25%
8	Witches Brew	Tortola	Yes	-
9	Hodges Creek	Tortola	No	50%
10	Paraquita Bay	Tortola	Yes	-
11	Brandywine Bay	Tortola	Yes	75%
12	Sophie Bay	Tortola	Yes	-
13	Road Reef – Burt Point	Tortola	No	75%
14	Sea Cow's Bay	Tortola	No	50%
15	Havers	Tortola	No	50%
16	Frenchman's Cay	Tortola	No	-
17	Beef Island Channel	Beef Island	No	-
18	Long Bay Pond	Beef Island	Yes	-
19	Runway Pond	Beef Island	Yes	-
20	Trellis Bay Mangrove	Beef Island	Yes	50%
21	Central Beef Island Flats	Beef Island	Yes	-
22	Banana Wharf	Beef Island	Yes	-
23	Hans Creek	Beef Island	Yes	-
24	Bluff Bay	Beef Island	Yes	-

Source: adapted from Jarecki, 2006. Site numbers refer to Figure 5.

Note: Table 54 in Chapter 8 displays data for all wetlands in the Tortola Profile area, including those that have been *totally* reclaimed. The table above includes remaining wetlands, including those *partially* reclaimed.

Salt ponds are important and useful systems that act as sediment traps for sediment runoff. This provides a significant buffer for maintaining nearshore water quality and the marine ecosystem. Salt ponds also play a useful function in wildlife ecology as these habitats provide shelter, nesting and foraging opportunity for seabirds and shorebirds and other wildlife species. Precipitated sea salt is still traditionally collected at some ponds during the dry seasons by residents.

Freshwater wetlands are seldom found on Tortola, and those that exist are mostly irrigation ponds that are associated with small-scale farming and livestock. Natural freshwater wetlands fed by springs or seepage are few, usually small and in a precarious state due to land alteration.

On Beef Island, the redevelopment of the airport's storm water drainage system since 2000 has had the unintended consequence of creating new freshwater habitats. The irrigation channels and especially the settling ponds around the airport have gradually been transformed into freshwater wetlands attracting numerous freshwater aquatic plants and wildlife species (**Photo 7**).

Photo 7.
One of the many freshwater pond habitats formed within the airport's storm water drainage system.
Note the airport terminal in the background.

Photo 8.
A group of student and adult volunteers carefully inserting PVC pipes into bottom sediments and placing mangrove seedlings within the PVC pipe opening
(photo courtesy of the DCF).

To counter the loss of mangrove forests along the coast, a mangrove replanting programme for the BVI was initiated in 1999 (Burnett Penn, 2005). The concept originated with the current Minister of Natural Resources and Labour, Dr. The Honourable Kedrick Pickering, when he served on the board of the National Parks Trust (NPT) in 1999. As part of Arbour Day activities overseen by the NPT, Dr. Pickering suggested that mangroves seedlings be replanted to compensate for the loss of fringing mangroves along the shoreline.

The collaborative effort between the National Parks Trust and the Department of Conservation and Fisheries (DCF) was joined by local NGOs and carried out with the assistance of many volunteers from the community, especially students from primary and secondary schools (**Photo 8**). At least 12 volunteer organisations have been involved in the programme since its beginning; from 1999 to 2008, about 2,500 red mangrove seedlings were planted.

On Tortola, the replanting effort targeted at least nine sites mainly along the south shore where the loss of coastal mangroves was significant and where bottom sediment conditions were conducive to a successful replanting rate. The sites included Frenchman's Cay, Havers, Sea Cow's Bay, Slaney Point, Road Reef, Brandywine Bay, Paraquita Bay, Hodge's Creek, and Red Rock.

The Riley Encased Methodology using a PVC pipe system was utilised to enhance seedling survival by protecting plants from predation, intense storms, and debris. The programme includes regular monitoring to assess success rates. Similar approaches implemented in the US Virgin Islands reported seedling survival rates of over 83 percent. Growth rate monitoring at one of the BVI sites show that seedlings generally reach 1 m (3 ft) by the five-year point (Burnett Penn, 2005).

(6) Beach Deposits

Tortola's coastline is highly irregular, indented, and dominated by steep rocky cliffs. Other shoreline features include beaches, fringing mangroves, and anthropogenic structures such as marinas, ports, riprap, and bulkheads.

Beach deposits are numerous on Tortola and reflect some variability in form and texture, ranging from sandy to coral rubble (**Photos 9** and **10**). The sedimentary texture of beach deposits tends to reflect beach location, orientation, coastal dynamics (wind, waves, and currents), local geology, and the local terrestrial environment. A recent study on beach morphology identified and characterised 19 primary beaches on Tortola and five on Beef Island (Gore, *et al*., 2012). **Table 2** provides a summary of findings.

Photo 9.
Coralline sand beach at Belmont Bay, looking toward Belmont Point. The beach is backed by a well-developed elevated sand dune system.

Photo 10.
Coral cobble beach dominates the northwest shore of Beef Island along Banana Wharf and Mount Alma's shoreline. Note the old coral rubble wall along the tree line. The area is covered with remnant wall enclosures that at one time kept in livestock "beef," hence the island's name.

Table 2.
The morphology of Tortola and Beef Island beaches.

Beach Name	Island	Morphology Class	Morphology Subclass	Beach Texture
Smuggler's Cove	Tortola	Barrier	Embayed	Sandy
Long Bay – Belmont	Tortola	Mainland	Embayed	Sandy
Cappoon's Bay	Tortola	Mainland	Embayed	Sandy
Little Carrot Bay	Tortola	Mainland	Embayed	Sandy
Cane Garden Bay	Tortola	Barrier	Embayed	Sandy
Cane Garden East	Tortola	Barrier	Linear	Coral Rubble
Brewer's Bay	Tortola	Mainland	Embayed	Sandy
Larmer Bay	Tortola	Mainland	Embayed	Sandy
Cooper Bay	Tortola	Mainland	Embayed	Sandy
Trunk Bay	Tortola	Mainland	Embayed	Sandy
Rogues Bay	Tortola	Mainland	Embayed	Sandy
Cooten's Bay	Tortola	Mainland	Embayed	Coral Rubble
Josiah's Bay	Tortola	Barrier	Embayed	Sandy
Little Bay Lambert	Tortola	Mainland	Embayed	Sandy
Paraquita Bay	Tortola	Barrier	Linear	Coral Rubble
Burt Point	Tortola	Mainland	Linear	Coral rubble
Slaney	Tortola	Mainland	Linear	Coral rubble
Pockwood Pond	Tortola	Mainland	Embayed	Coral Rubble
Coxheath	Tortola	Mainland	Embayed	Coral Rubble
Long Bay	Beef Island	Barrier	Embayed	Sandy
East Trellis Bay	Beef Island	Barrier	Embayed	Sandy
Sprat Point	Beef Island	Spit	-	Sandy
Banana Warf	Beef Island	Barrier	Linear	Coral Rubble
Well Bay	Beef Island	Mainland	Cuspate	Sandy

Source: Adapted from Gore, *et al.*, 2012.

The study shows that most beaches on Tortola, including Beef Island, are sandy in texture. Seven (37 percent) of Tortola's beaches consist of coral rubble, while only one (20 percent) of the five primary beaches on Beef Island is so composed. Noteworthy is that sandy beaches are predominantly located within embayments along the Atlantic-facing coastline (north side), while coral rubble beaches are more common on the Caribbean-facing coastline (south side). See also Chapter 5, Section 5.1.2.2 for information on Tortola's beaches.

An uncommon feature associated with beach deposits is beach rock. Beach rock consists of a cemented accumulation of sand, pebbles, and cobbles formed at or below sea level (the intertidal zone). It is easily unnoticed until you walk on its hard abrasive surface. There are no studies that address the origin and distribution of beach rock in the BVI. The formation of beach rock is complex but is known to be linked to fluctuating sea level. Beach rock formation below low tide is an excellent indicator of former sea level still-stand.

1.1.4 Tortola's Soils

Information on Tortola's soils is scarce and limited to a few environmental studies covering site-specific areas usually associated with proposed development. Soil data for the island and the territory are therefore at a general level. Although there is no comprehensive soil survey for the BVI, it can be assumed that soil formation strongly reflects the underlying geology, topography, vegetation, microorganisms, climate, and land use activity. In his watershed studies, Alam (*circa* 1990) describes Tortola's soils as ranging from sandy clay to sandy clay loam. No information is available for Beef Island.

As expected, soils differ in texture and thickness depending on elevation and slope aspect. Soil formation tends to be thinner and less developed as elevation increases and slopes steepen. Thicker and more mature soils can generally be found on gentle slopes, within low-lying areas, or where terrain is flat to undulating. Geologically, alluvial deposits are where thicker soils will occur. Dense and mature vegetation cover contributes to soils having more organic matter.

Important factors contributing to soil loss include vegetation clearing for development (**Photo 11**), overgrazing of livestock, and trampling caused by free-roaming and feral livestock.

Photo 11.
Recently cleared land for development along the upper slopes of Sage Mountain. These rich soils are now exposed to direct precipitation and eventual erosion.

1.1.5 Tortola's Watersheds, Drainage and Hydrology

Tortola's topography is dominated by a pronounced central ridge oriented east-west. Elevation along the central ridge is relatively high (averaging above 300 m/1,000 ft) within a short distance from the shoreline, resulting in very steep average slopes. The north-facing slopes along the central ridge are generally steeper, and the distance from ridge to shoreline is shorter compared to south-facing slopes. The coastline is indented with numerous bays. Many bays include sandy beaches while the more sheltered ones support wetlands. Drainage ghuts are dry and only flow during heavy rainfall. Flooding is common along lower flat areas, shallow depressions, and salt ponds.

Literature on the watersheds of the BVI is scarce, with a single document by Abul Alam (*circa* 1990) providing most of the available information at an island-level scale. His report summarises the basic watershed characteristics of some 47 watersheds on Tortola. Although incomplete and outdated, the information is rather helpful in that it includes data on watershed size, major soil types, dominant slopes, existing land use, land capability for agriculture, and land ownership.

A recent watershed map generated from the BVI National Geographic Information System (which is managed by the Department of Town and Country Planning) included 115 watersheds for Tortola and 14 for Beef Island. Those units were deemed too numerous and small in size for use in the Environmental Profile and have therefore been consolidated to form 13 primary watersheds for Tortola and 3 for Beef Island (**Figure 6** and **Table 3**).

Most large watersheds occupy the south-facing slopes of Tortola, and many are drained by more than one main ghut. **Table 4** provides a list and characteristics of the 20 primary ghuts on Tortola. A different topographic landscape and smaller catchment basins on Beef Island have resulted in watersheds that are less defined, particularly in the central lowlands of the island. For this reason, there are very few developed drainage systems on Beef Island.

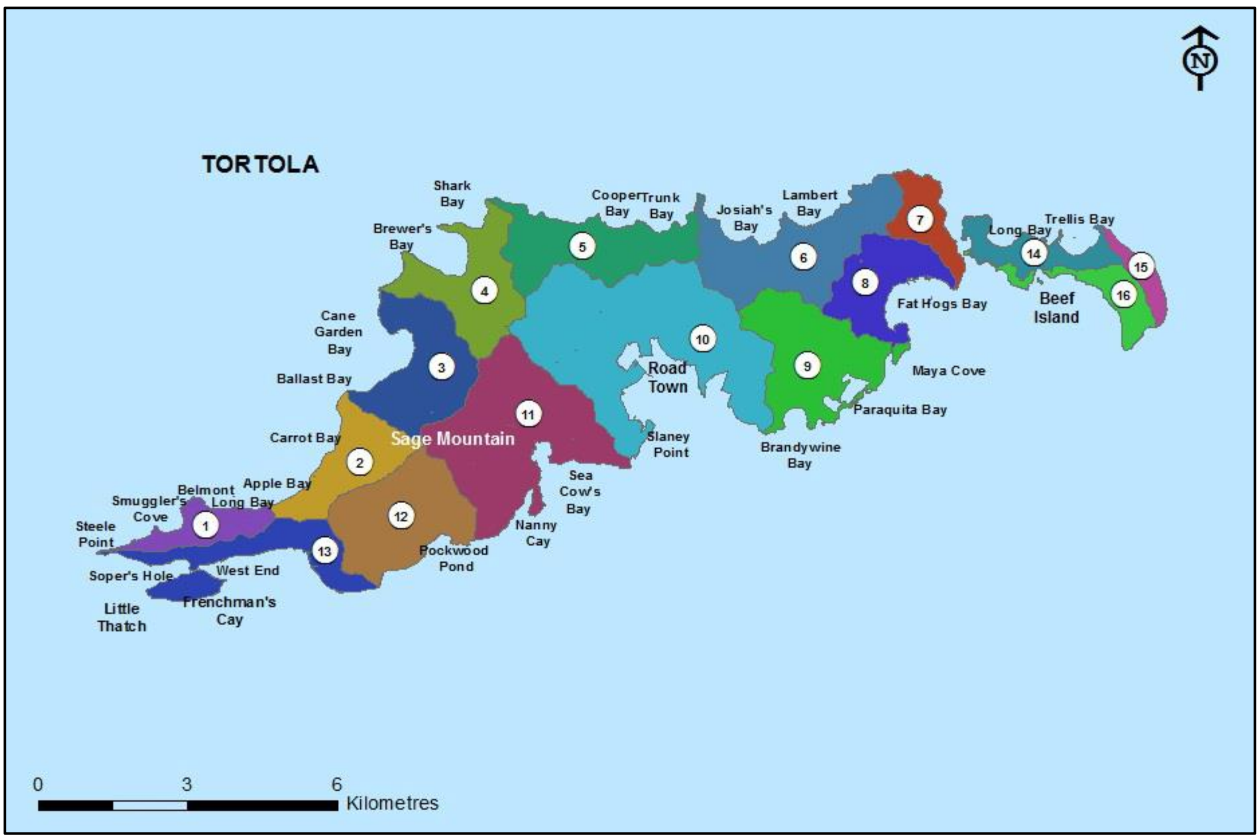


Figure 6.
The primary watersheds of Tortola and Beef Island.
See Table 3 for details.
(*Source*: adapted from the BVI National Geographic Information System, Department of Town and Country Planning.)

Table 3.
Size of the primary watersheds of Tortola and Beef Island.

#	Watershed Name	Island	Area (hectares)	Area (acres)
1	Belmont Pond	Tortola	157	388
2	Carrot Bay	Tortola	288	712
3	Cane Garden Bay	Tortola	403	997
4	Brewer's Bay	Tortola	368	909
5	Cooper Bay	Tortola	410	1,013
6	Josiah's Bay– Lambert Bay	Tortola	516	1,274
7	Lloyds	Tortola	157	389
8	Fat Hogs Bay	Tortola	291	718
9	Paraquita Bay	Tortola	476	1,175
10	Road Town	Tortola	1,062	2,625
11	Sea Cow's Bay	Tortola	800	1,978
12	Pockwood Pond	Tortola	473	1,168
13	West End	Tortola	304	750
14	Long Bay – Trellis Bay	Beef Island	167	412
15	Mount Alma	Beef Island	70	172
16	Hans Creek – Bluff Bay	Beef Island	14	36

Source: Adapted from the BVI NGIS, DTCP. Site numbers refer to Figure 6.

Table 4.
Primary drainage ghuts of Tortola.

Drainage "Ghuts"	Watershed	Direction	Length (metres)	Elevation (metres)	Slope (%)
Two Ghut	Pockwood Pond	NS	1,950	472	24
Buntin Ghut	Pockwood Pond	NS	1,830	502	27
Brown Ghut	Pockwood Pond	NS	1,830	472	26
Valley Ghut	Sea Cow's Bay	WE	3,050	521	17
Nibbs Ghut	Sea Cow's Bay	NS	2,680	459	17
Long Bush Ghut	Road Town	WE	2,440	379	16
Huntum's Ghut	Road Town	NS	2,680	374	14
Jackass Ghut	Road Town	NS	1,710	311	18
Johnson Ghut	Road Town	NS	1,580	311	20
James Ghut	Road Town	NS	1,580	332	21
Spring Ghut	Paraquita Bay	NS	2,800	385	14
Bomie Ghut	Fat Hogs Bay	NS	1,520	203	13
Grey Ghut	Josiah's Bay	SN	1,460	385	26
Thousand Ghut	Cooper Bay	SN	1,010	320	29
Johnny Cake	Cooper Bay	SN	1,950	374	19
River Ghut	Brewer's Bay	SN	1,710	407	24
Garden Ghut	Cane Garden Bay	EW	1,340	459	34
Shannon Ghut	Cane Garden Bay	EW	1,710	396	23
Old Ground Ghut	Carrot Bay	EW	1,340	513	38
Cappoon's Bay Ghut	Carrot Bay	EW	970	228	23

Source: Earle, 1997.

1.1.6 Tortola's Climate

Tortola enjoys a climate dominated by the Trade Winds Climate Zone. The climate is subtropical and characterised by fair weather, steady winds, and slight but regular annual, seasonal and diurnal temperature ranges.

As is the case elsewhere in the Eastern Caribbean, the easterly trade winds are the dominant weather feature. The average wind direction varies throughout the year according to the following general pattern:

- December to February: Winds blow from east-northeast (known locally as the "Christmas winds").
- March to May: Winds blow from easterly directions.
- June to August: Winds blow from east-southeast.
- September to November: Winds blow mainly from east and southeast.

Usually, except for tropical storms and hurricanes, the highest wind speeds normally occur from December to February and also from June and July. Average wind speeds for the months of June-July are around 12-30 km (7-12 mi) per hour, while in October average wind speeds can drop to 7 km (4 mi) per hour. Because of Tortola's steep topography and variable slope aspects, wind velocity is variable throughout the island, and there is little protection against the full force of the trade winds, especially along exposed upper elevations.

Tortola and its neighbours lie within the hurricane corridor. Most of these intense storms occur from August to October, with September being the most active month. Within recent years, several hurricanes passed sufficiently close to the BVI to cause moderate to significant damage (see **Table 5** and also Chapter 3, Section 3.1.3).

There is no systematic weather data collection system or data covering all of the BVI. Of the four major islands, Tortola is the only one with significant and reliable weather information. Temperature records from the Paraquita Bay Agricultural Station from 1971 to 1977 are summarised in **Table 6**. Although these records are more than three decades old, they represent the most current published data available and are consistent with more localised temperature reporting.

Records show that temperatures vary little throughout the year. The difference between the monthly mean temperatures of the coolest and warmest months is about five to seven degrees F with the highest temperatures in August or September and the lowest in January or February.

Table 5.
Recent storms and hurricanes affecting the BVI.

Date	Storm
1955 August	Hurricane Connie
1960 August	Hurricane Donna
1979 29 August	Hurricane David
1979 4 September	Hurricane Frederic
1984 November	Tropical Storm Klaus
1988 10 September	Tropical Storm Gilbert
1989 18 September	Hurricane Hugo
1995 19 August	Hurricane Iris
1995 6 September	Hurricane Luis
1995 15 September	Hurricane Marilyn
1996 8 July	Hurricane Bertha
1996 9 September	Tropical Storm Hortense
1998 21 September	Hurricane Georges
1999 21 October	Hurricane Jose
1999 17 November	Hurricane Lenny
2000 22 August	Hurricane Debby
2008 16 October	Hurricane Omar
2009 2 September	Tropical Storm Erika
2010 29 August	Hurricane Earl
2010 8 October	Hurricane Otto
2011 11 September	Tropical Storm Maria

Typical daily maxima are around 32 degrees C (89.6 degrees F) in the summer and 29 degrees C (84.2 degrees F) in winter. Typical daily minima are around 24 degrees C (75.2 degrees F) in the summer and 21 degrees C (69.8 degrees F) in the winter. Temperature and climate are moderated by near constant onshore breezes. Due to year-round high temperatures and nearly constant winds, the evaporation rate is generally high.

Rainfall records from the BVI Department of Water and Sewerage in Tortola show that annual rainfall in a 95-year span has ranged between 61.2 cm (24.1 in) and 239.5 cm (94.3 in), with a mean value of 127.3 cm (50.1 in). Rainfall amounts vary monthly and annually. Although there is no sharp distinction between the wet and dry seasons (**Table 7**), the wettest period typically is from September to November, which coincides with the hurricane season. The driest season on average is from January to August with May showing isolated rainy peaks. Major rainfall events are usually associated with major weather systems, especially during the passage of easterly tropical waves.

It is anticipated that under the territory's Climate Change Initiative, the collection and archiving of weather and climate data for the BVI will be upgraded within the Department of Disaster Management (see also Chapter 3, Section 3.1.9).

Table 6.
Temperature data from Paraquita Bay, Tortola (1971-1977)

Months	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
Maximum Temperature (F)	82°	82°	83°	84°	85°	85°	86°	87°	88°	87°	86°	83°	85°
Maximum Temperature (C)	28°	28°	28°	29°	29°	29°	30°	31°	31°	31°	30°	28°	29°
Minimum Temperature (F)	73°	72°	72°	73°	76°	77°	78°	76°	76°	76°	74°	72°	75°
Minimum Temperature (C)	23°	22°	22°	23	24°	25°	26°	24°	24°	24°	23°	22°	24°
Average Temperature (F)	77°	77°	77°	78°	80°	81°	82°	82°	82°	81°	80°	77°	80°
Average Temperature (C)	25°	25°	25°	26°	27°	27°	28°	28°	28°	27°	27°	25°	26°

Source: Earle, 1997.

Table 7.
Average monthly precipitation for Tortola.

Month	Precipitation (cm)	Precipitation (in)
January	6.5	2.56
February	6.25	2.46
March	4.62	1.82
April	9.58	3.77
May	12.88	5.07
June	7.0	2.75
July	8.33	3.28
August	11.56	4.55
September	12.85	5.06
October	16.36	6.44
November	16.69	6.57
December	14.68	5.78
Total	**127.30**	**50.11**

Source: Earle, 1997.

1.2 The Community Setting

If we look back only five decades to the early 1960s, Tortola was then described as essentially a classless society, with a homogenous black population and only a small number of expatriates (Bowen, 1976). The island was a highly mobile community with the movement of several hundred persons per week traveling between the British and US Virgin Islands, primarily BVIslanders seeking employment in the more developed USVI. Young people sent away for education often did not return, as reported in *The Torch* newspaper (Jan/Feb 1957):

> *Every year more and more of our young people are being sent away to be trained, but on returning so few of them have that love for Tortola that makes them want to remain and try to better the place.*

It was also a society with only a few members in the middle class, with "no local doctors, no lawyers, local or otherwise, no architects, and most of the top teachers and top civil servants were non-Tortolans, a large number from the Leeward Islands" (Bowen, 1976). Two sectors—farming and fishing—dominated the economy, and small-scale farmers and fishers accounted for much of work force.

It is difficult to compare this 1960 community with the Tortola that has emerged in the second decade of the twenty-first century. The island is now a cosmopolitan, multicultural community, with a strong middle class, and few farmers and fishers because BVIslanders now seek white collar professions. It is a well-educated society that has taken its place as a leader in the global financial community. However, there are now more expatriates on the island than BVIslanders, which has resulted in tensions among belongers and non-belongers that were not prevalent 50 years ago.

1.2.1 Population Characteristics

The BVI Census Report for 2010 was released in November of 2014. The population for Tortola is reported at 23,419 residents, with a total BVI population of 28,054, meaning that 83 percent of Virgin Islanders—the vast majority—live on the heavily populated island of Tortola (**Table 8**).

Table 8.
BVI population figures from 2010 Census.

Island	Population	% of Total
Tortola	23,419	83%
Virgin Gorda	3,930	14%
Anegada	285	1%
Jost Van Dyke	298	1%
Other Islands/Boaters	122	1%
TOTALS	28,054	100%

These figures may surprise many Virgin Islanders as there has been a generally widespread assumption in the territory that the BVI population has grown more substantially (at one time estimated to reach 30,000 by 2010). Tortola's population grew in the last decade (2004 to 2014) by approximately 15 percent, from a figure a little over 20,000 in 2004 to the 2014 figure of just over 23,000. The Central Statistics Office estimates that Tortola's population will increase to over 30,000 by end of the 2020 decade (CSO data, 2014).

What will also surprise BVIslanders, and undoubtedly will increase concerns within the local community, is the size of the **expatriate population**, *i.e.*, those not born in the BVI as a percentage of the overall population. The recently released 2010 census calculates that 61 percent of the territory's current population was born outside of the BVI. In Tortola, that figure holds true, with only 39 percent of Tortola's residents having been born in the Virgin Islands (see **Table 9**).

Nationals from over 113 countries reside in the British Virgin Islands. In Tortola, as is the case territory-wide, Guyana accounted for the largest portion (7 percent) of the island's population who were not born in the BVI.

Table 9.
Tortola's population by residents' country of origin.

Countries of Origin	#s	% (rounded)
Virgin Islands (UK)	9,204	39%
Guyana	1,720	7%
Jamaica	1,516	7%
St. Vincent & Grenadines	1,454	6%
Dominican Republic	1,326	6%
Virgin Islands (US)	1,306	6%
United States of America	1,294	6%
St. Kitts and Nevis	1,038	4%
Dominica	882	4%
United Kingdom	654	3%
Other Caribbean	586	3%
Puerto Rico	413	2%
Trinidad and Tobago	405	2%
Grenada	308	1%
St. Lucia	306	1%
Asia	250	1%
Overseas Territories	175	1%
Other Countries	150	1%
Europe	143	>1%
Africa	131	>1%
Latin America	85	>1%
Middle East	79	>1%
Not Stated	46	>1%
Pacific	20	>1%
TOTALS	**23,491**	**100%**

Source: Central Statics Office, 2014.

The next five countries with the highest percentage of citizens residing in Tortola (Jamaica, St. Vincent and the Grenadines, Dominican Republic, USVI, and the United States) comprise—with Guyana—38 percent of Tortola's population, a percentage figure almost equal to the number of BVI citizens residing on the island.

According to the 2010 census, 56 percent of Tortola's expatriates moved to Tortola for employment, while another 38 percent moved with family or a spouse. Only one percent immigrated to Tortola for educational opportunities.

The new census figures indicate that there is an almost equal **gender balance** for Tortola's population, with approximately the same number of men and women residing on the island (see **Table 10**). This approximately equal gender balance also holds for the territory as a whole.

Table 10.
Gender distribution for Tortola and the BVI from the 2010 Census.

Sex	Tortola	%	BVI	%
Male	11,468	49%	13,820	49%
Female	12,023	51%	14,234	51%
TOTALS	23,491	100%	28,054	100%

Tortola's **age demographics** (**Table 11**) from the 2010 census indicate that over 70 percent of the population falls within the age group 15 to 64 years of age, or, in other words, within the working age bracket. Twenty-two percent of those residing in Tortola were classified as young (up to 14 years old), and a mere six percent were noted as elderly (65 years and older). Thus, the proportion of elderly is very small while the proportion of the population falling within the working age group dominates. The latter, according to the Central Statistics Office, is a direct result of immigration (CSO, 2014).

Table 11.
Age distribution and dependency ratios for Tortola from the 2010 Census.

Age Group	#s	%	Dependency Ratio
0-14 (Young)	5,265	22%	31%
15-64 (Working Age)	16,797	72%	
65 plus (Elderly)	1,429	6%	9%
TOTALS	**23,491**	**100%**	**40%**

Dependency ratios indicate the extent to which there are young and elderly persons in the population in relation to working-age persons. The young and elderly segments of the population are considered "dependents," while the working-age segment constitutes persons who are "independents." The higher the proportion of independents (working age), the more potential support there can be for the dependents. A dependency ratio under 50 percent is considered good because it indicates there are more than two working-age persons for every dependent person (CSO, 2014).

In Tortola the total Dependency Ratio is below this 50 percent benchmark. The island's population yields a young dependency ratio of 31 percent and an old dependency ratio of 9 percent, resulting in a Total Dependency Ratio of 40 percent (**Table 11**). Again, the CSO attributes the low dependency ratios to the territory's high level of immigration.

Regarding the **ethnic origins** of Tortola's population, the vast majority of residents (77 percent) are of African descent (**Table 12**). The largest ethnic groups following African/Black are: Hispanics/Latino, White/Caucasian, and Mixed, but even taken as a whole, these three ethnic groups only represent 17 percent of Tortola's population. The census identified as many as 15 ethnic groups in Tortola, which means there is a richness of cultures and diversity present on the island but, conversely, the ethnic mix can and has led to cultural clashes, racism, language barriers, and social tensions (CSO, 2014).

Table 12.
Ethnic groupings for Tortola from the 2010 Census.

Ethnic Group	#s	% (rounded)
African/Black	17,852	77%
Hispanics/Latinos	1,355	6%
White/Caucasian	1,293	6%
Mixed	1,172	5%
Indian	495	2%
East Indian	392	2%
Not Stated	194	>1%
Philippinos	180	>1%
Other Ethnic Groups	129	>1%
Creole	114	>1%
Carib	86	>1%
Asian (Other)	73	>1%
Lebanese	44	>1%
Amerindian	41	>1%
Middle Eastern (Other)	40	>1%
Chinese	18	>1%
Syrian	13	>1%
TOTALS	**23,491**	**100%**

Source: Central Statics Office, 2014.

In its 2014 Census Report, the Central Statistics Office states that the level of **literacy** in the Virgin Islands is high but that this level is not entirely determined by the quality of the territory's educational system. Because of the high level of immigration, the level of literacy is, to a large extent, dependent on the education of the expatriate population.

Literacy is considered as the ability to read and write simple sentences and do simple numeracy, and it is expected that this level of achievement can be reached by persons receiving at least five years of formal education. Based on this criteria, the census reports that 97 percent of Tortola's population is literate.

Regarding the level of **education** attained by those residing on Tortola, the 2010 census reports the following:

- 17 percent of Tortolans had secured a primary school certificate;
- 32 percent had earned their high school diploma;
- 25 percent had completed some level of tertiary education;
- 25 percent had not achieved any of the above.

With respect to **employment**, the data from the 2010 census indicate that 13,954 persons (97 percent) were employed in Tortola and those unemployed stood at 3 percent (431 individuals), the highest unemployment rate in the territory. The Census Report noted that there is a higher rate of unemployment among young adults (persons aged 15-29 years of age). This unemployment figure was reported as 7.3 percent for the territory, and since Tortola has by far the largest population in the territory, it can be assumed that this relatively high rate of unemployment for the territory's young adults is also the approximate rate for Tortola.

The labour force participation rate (LFPR) shows the extent to which persons of working age (15-64 years of age) are either working or actively seeking employment. Typically, this rate lies between 60 and 75 percent for developed countries. In the BVI, the rate is considerably higher at 86 percent, which is also the LFPR for Tortola. The CSO has identified the territory's high immigration levels as the reason for this unusually high LFPR.

Relative to the type of occupations held by residents of Tortola, 69 percent of the island's workers held white collar positions, and 19 percent of Tortola's work force was employed in the public (government) sector. **Table 13** provides an overview of Tortola's workers by the sectors in which they are employed.

Table 13.
Tortola's work force by employment sector, from the 2010 Census.

Occupation Group	#s	% (rounded)
Public Administration and Defence, Compulsory Social Security	2,871	22%
Construction	1,617	13%
Wholesale/Retail Trade, Repair of Motor Vehicles	1,517	12%
Accommodation and Food Service	1,331	10%
Financial and Insurance	1,116	9%
Administrative and Support Services	982	8%
Transportation and Storage	590	5%
Professional, Scientific and Technical	540	4%
Other Service Activities	434	3%
Education	387	3%
Manufacturing	360	3%
Information and Communication	262	2%
Health and Social Work	239	2%
Activities of Households as Employers	194	2%
Arts, Entertainment and Recreation	153	1%
Agriculture, Forestry and Fishing	82	>1%
Real Estate	75	>1%
Water Supply, Sewage, Waste Management	29	>1%
Electricity, Gas, Steam and Air Conditioning Supply	15	>1%
Mining and Quarrying	13	>1%
TOTALS	**12,807**	**100%**

The overall average monthly **income** for workers on Tortola was USD$2,555, which is considerably higher than that of Virgin Gorda (USD$1,999), Jost Van Dyke (USD$1,750), and Anegada (USD$1,658).

The median income for the Virgin Islands (*i.e.*, half of the territory's workers have an income above that amount and half have an income below) is $1,734 per month. This figure is high per international standards, which considers anyone earning less than $1,400 per month to be a low-income earner. In the territory as a whole, 29 percent earned a relatively low income (below $1,400), while on Tortola, the figure was slightly lower at 28 percent.

Overall, perhaps the demographic issue that most challenges the island of Tortola—and indeed all of the BVI—is that of immigration. Indigenous Tortolans have now become a minority within their island, and their economy now depends on the labour of a disenfranchised group of non-citizens. Perhaps it is only a matter of time before the expatriate population will press for a larger claim in Tortola and the territory as a whole.

In the meantime, the tension between belongers and non-belongers remains a dominant feature in the life of Tortolans and all BVIslanders.

1.2.2 Historical Development of Tortola

1.2.2.1 Amerindian Settlement

The human history of Tortola begins with the pre-Colombian occupation which may stretch back to approximately 1000 BC (Drewett, 2003). Who these people were, where they came from and their eventual departure from the island is not recorded. Subsequent occupations culminated with the last wave of South American Indians to reach the BVI who belonged to the Ostionoid culture and whose roots may be traced to the Orinoco river valley in modern Venezuela. The Ostionoid occupation arrived in the Virgin Islands *ca.* 1300-1400.

Their distinctive incised clay pottery and introduction of ball courts to the Lesser Antilles identifies them. Evidence uncovered in the form of pottery at Belmont on Tortola, where a ball court has been excavated, validates their presence on the island that they populated substantially. Test pit excavations in 1994 revealed Ostionoid evidence at 33 different locations on Tortola (Drewett, 1994).

Why these Amerindians evacuated the island remains a mystery, but their absence may have something to do with the Spanish purge of the region which took place in the mid-sixteenth century. Certainly by the time the English first colonised Tortola in the late-seventeenth century, there were no Indians remaining (Suckling, 1780).

1.2.2.2 Early European Settlement

The early European settlement of Tortola was hampered by the contiguous proximity of Spanish Puerto Rico which jealously guarded its island possessions. Although Spanish power in the region was declining by the early-seventeenth century, they were not prepared for any occupation close to one of their pilot colonies, making the Virgin Islands a hazardous prospect for development. On three occasions in the 1640s, fleets dispatched from San Juan violently evicted English and French migrants who had attempted to colonise Tortola (Figueredo, 1993), thus providing a settlement precedence.

By the early 1650s, however, the region was becoming safer, encouraging a Dutch contingent from St. Eustatius under the command of Governor Abraham Adriansen to occupy the Virgin Islands and, in particular, the island the Spanish had called Santa Ana (Matthews, 1969). Based on the fact that many of the Dutch settlers had originated from the Zeeland Peninsula in modern day Holland, they began to name their new colonies after home towns and provinces, including Nieu Zeeland (New Zeeland) and Nieu Amsterdam (New York). A small island to the north of the Peninsula known as Tholen provided St. Eustatius with colonists who named their new Leeward possession Nieu-Ter-Tholen (New land of Tholen (CSP American and West Indies 1696-97, No. 382, Part 1).✦ Like many names in the Virgin Islands this was subsequently corrupted to Tertolen and, eventually, Tortola.

The series of three wars fought between the English and Dutch during the second half of the seventeenth century culminated with the Third Dutch War (1672-74), which directly affected the island of Tortola. At the beginning of hostilities, Sir William Stapleton, as Governor of the British Leeward Islands, issued Major William Burt of St. Kitts beating orders to raise 100 armed men (PRO CSP 1697-98, No. 220, Part II), who were then boarded on ships whose Commanders were given orders to attack the Dutch islands of Saba, St. Eustatius and Tortola.

There is no accurate census for the settlers on Tortola at the time of the attack in July of 1672, but a deposition from an ensign who took part states, "The fort and island surrendered, and … the fort was demolished, the cannon carried away and the whole island laid waste" (PRO CSP 1697-98, No. 220, Part I). Peter Balderick, the Governor of the island,

✦ Documentation of the early history of Tortola has been provided by historian Dr. Michael Kent and is the result of his extensive research at the National Archives in the UK. Full documentation can be found in the List of References at the end of the Profile; see entries for: National Archives, Colonial Office (Leeward Islands Original Correspondence and Virgin Islands Sessional Papers); Fortesque, J.W. and Headlam, C. (Calendar of State Papers, Colonial Series). We have not inserted a citation in the text for each particular document used by Dr. Kent, with the exception of the current footnote, quotations, and the citing of statistical data.

realising the futility of resistance, capitulated immediately, and from that moment the island has always remained British. The resident settlers at the time of the attack were subsequently evacuated to St. Kitts.

At the close of the Third Dutch War in 1674, the opposing governments concluded at the Treaty of Westphalia that a mutual restoration of all territories captured during the conflict would take place, but the Dutch, who were also at war with France until 1678, procrastinated the restoration of their Leeward Island possessions for fear of an immediate French attack. Sir William Stapleton was ordered in 1677 to continue possession of Tortola and the surrounding Virgin Islands, and by 1678 there were 15 white settlers on the island (PRO CSP 1677-80, No. 741).

When war was finally concluded between the Dutch and the French, the Dutch Ambassador petitioned Charles II, the British monarch, for the restitution of Tortola, but without success. The English retained the Virgin Islands even though in 1676 they had described Tortola of "no value at all" (PRO CSP 1675-76, No. 785) and had, in 1679, returned St. Eustatius and Saba to Dutch control.

1.2.2.3 British Control from 1762

The settlement of Tortola was hindered during the latter years of the seventeenth century by the uncertainty of sovereignty which had existed since the Treaty of Westphalia. English subjects were hesitant to invest in an island which might at any time be forfeited, and, as late as 1712, the Dutch were still prepared to bribe British officials in an effort to regain Tortola. This was, however, a period in the history of the West Indies when vast sums of money could be accumulated by any person prepared to settle and farm in a frontier Caribbean colony. The prospect of quick wealth blinded many to the dangers inherent in settling islands they were unable to defend. The premise was simple: if you wished to colonise an island, you had to be prepared to fight for it. This was amply illustrated on Tortola in April of 1686.

As early as 1683, a grant had been given by Sir William Stapleton to Thomas Bisse, an English subject, to plant and settle Tortola as the Lieutenant Governor on behalf of the British crown. Bisse had constructed what was possibly one of the first sugar works in the BVI and planted cane in an attempt to encourage other settlers to join him. Unfortunately, few arrived and the infant enterprise, through lack of fighting men and defences, lay dangerously at the mercy of any hostile naval force.

The lack of any effective defensive measures encouraged marauding pirates to attack Bisse's settlement, which inevitably took place in 1686. In describing the attack, Governor Bisse's son stated that:

> *On 14th April, fifty armed men from a Spanish ship landed in Tortola, beset my father's house and plundered it of everything. They stripped me and bound me, and carried me to a neighbouring plantation, where they took all the Negroes they could find, went thence to another plantation where they did likewise, and finally finding no Negroes barbarously beat and abused me. They then carried me aboard their ship where they kept me three days constantly threatening me, and threw a sixteen pound lead at me which struck me in the back, from which I doubt I will recover. They also tortured another inhabitant from Tortola. One of the prisoners discovered that they had determined to murder all the English and Dutch on the island, the ringleader being an English Doctor, who had formally belonged to Captain John Beare (PRO CSP 1685-88, No. 678, Part X)*

The attack which took place on Tortola in 1686 discouraged any further settlement, leaving the island abandoned until the early-eighteenth century. By this time adjacent Virgin Gorda had been settled and colonists were beginning to migrate over the Sir Francis Drake Channel to Tortola. The pattern of settlement suggests that the outer islands within sight or close to Virgin Gorda—like Beef, Camanoe and Guana—were initially occupied, then the east end of Tortola and the leeward southern shore was cleared for planting. The large leeward bays on the south side—such as Fat Hogs Bay, Road Harbour and Sea Cow's Bay—saw the first communities on Tortola, followed by the north shore in the mid-seventeenth century.

BOX 1

African Ethnic Origins in Early Tortolan History: The Plantation Era

Before the mid-eighteenth century, the earliest Africans who arrived, involuntarily, in Tortola were transported through the Dutch and Danish transatlantic slave trade. Later, from the 1750s onward, slave ships arrived directly to the island. An analysis of: (1) official correspondence; (2) Dutch participation in the slave trade, in particular; (3) certain cultural retention words found in the Virgin Islands; and (4) slave ship records is instructive in identifying the African ethnic origins of these early populations. Such analysis indicates that, despite an inevitable plethora of African ethnic groups present in Tortola's early slave population, it is possible to focus on at least two key ethnic groups: the *Akan* and the *Igbo*.

Akan Presence

In a letter dated 27 September 1695, Governor Christopher Codrington of the Leeward Islands wrote that in the Virgin Islands (specifically Tortola), the enslaved population was brought in through the trading port at St. Thomas in the Danish West Indies. Later, in a letter dated 15 May 1717, Governor Walter Hamilton, also governor of the Leeward Islands, referred to the *frequent* arrival in Tortola of slave ships from the island of St. Eustatia, a Dutch colony.

The Dutch connection is particularly instructive because, between 1676 and 1750, the Dutch drew their enslaved population from West Central Africa, the Bight of Benin on the western African coast, and the Gold Coast on the Gulf of Guinea, also in west Africa. In the latter case, these would be individuals from the *Akan* city-states. Between 1726 and 1750, the Dutch transported the greatest *majority* of their enslaved Africans from the Gold Coast, *i.e.*, from the *Akan* ethnic group.

This *Akan* presence is also indicated in the existence of certain cultural retention words, such as *Camfou* or *comfoo* dances, which also existed in early Virgin Islands history. *Twi* is one of the Akan languages, and the word *camfou* or *comfoo* is most likely derived from the *Twi* term o'*komfo*, meaning priest, diviner, soothsayer. The word *fungi* in Virgin Islands culture also carries great significance. It refers to traditional Virgin Islands music as well as to one portion of the territory's national dish—*fungi* and fish. The word *fungi* has also been linked to a *Twi* word, *fugyee,* meaning "soft meal of boiled yam." It has also been linked to the words *Kimbundu funzi (*meaning cassava mush), *Congo fundi (*meaning flour or porridge), and *Yoruba funje (*meaning "given to eat").

Although it has often been suggested that the word *obeah* originated from the Ashanti terms *obayifo* or *obeye* meaning wizard or witch or the spiritual beings who inhabit witches, it is important to note that after the *Akan* city-states were incorporated into the Ashanti Empire in the eighteenth century; the Ashanto Empire then protected its citizens from being extracted into the transatlantic slave trade. More recently, it has been argued the word *obeah* "probably derived from the *Igbo* or related language where the term *dibia* refers to a doctor or healer, and a related term, *abia [Ibibio]*, means practitioner, herbalist. This is very interesting in light of the fact that slave ship records indicate a preponderance of *Igbo* people in early Virgin Islands history.

Igbo Presence

By the 1740s, the island of Tortola was transitioning to a sugar island with corresponding demographic changes also apparent, such as an increase in Africans which, in the Caribbean, was normally associated with an increase in sugar production. We now have an important tool available to help us understand the origins of the enslaved Africans, this being *The Transatlantic Slave Trade: A Database on CD-ROM*. In the *Database*, the first voyage recorded occurred in 1748, the last in 1812.

According to the *Database*, the majority of Africans transported to Tortola—6,390 between the years of 1750 and 1812—came from the Bight of Biafra off the West African coast, in the easternmost part of the Gulf of Guinea. It is generally accepted that the greatest majority of Africans who came from the Bight of Biafra were *Igbos*. Secondly, between the years 1759 and 1803, 2,744 enslaved Africans arrived in Tortola from the Windward Coast of Africa. Between 1711 and 1808, 2,329 Africans were brought from West Central Africa to Tortola, which meant Angolans or Kimbundu-speakers and Congos or Kikongo-speakers.

In conclusion, we now know through an examination of official correspondence, along with certain cultural retention words, that it is highly probable there was an *Akan* presence in Tortola during its early history, with the *Akan* people entering the island via the early Dutch and Danish slave trade. Furthermore, an examination of slave ship records clearly shows that *Igbos* were represented, in even larger numbers, in Tortola.

Thomas Woolrich, a merchant living on Tortola between 1753-73, stated that when he first arrived "there were some cotton plantations in the poor and rocky parts of the island, but not above ten or a dozen sugar estates" (Woolrich, 1791). Woolrich later states that "about three or four years [after his arrival] some slave ships came down; and the planters, having bought slaves, turned out their cotton and planted canes, clearing out small parts of woodland from year to year to enlarge the old and make new sugar plantations." Woolrich is in fact describing the transitory phase of Tortola when the island changed from a small cotton-planting outpost to a significant sugar-producing colony.

During the early period of settlement, slaves were purchased from St. Thomas, where they could be bought for 40 percent less than they would cost in St. Kitts (Dookhan, 1975). Once a more regular pattern of settlement had been established, slaves were being imported directly into Tortola and the trend towards purchase was pursued at a rapid rate with a sharp rise in the enslaved population (see **Box 1**). In 1724, the enslaved population numbered 1,430 which by 1756 had increased to 6,121 (Dookhan, 1975). This demographic increase is also reflective of the economic growth taking place, which was catapulting the colony from a small inconsiderate outpost to a relevant sugar-producing entity.

Steady growth throughout the 1760s during the tenureship of Lieutenant Governor John Purcell created a halcyon period for Tortolan planters who accumulated considerable wealth and subsequently established a plantocracy similar to that which existed on other British West Indian islands. Continuous petitioning made the British Government take notice of the Virgin Islands which, in 1773, was finally granted the privilege of legislative government. In January of 1774, Ralph Payne (later to become Lord Lavington) arrived on Tortola and started to initiate the proceedings towards self-government.

Although the installation of legislative government and the profits from sugar were a positive growth indicator, the incessant conflicts which plagued the West Indies created enormous hardship and plunged islands like Tortola into economic recession. The Seven Years War (1756-63) seems to have bothered the BVI colonists very little, but later confrontations, most relevantly the American War of Independence (1775-83), had catastrophic implications for colonies which relied on trade with the American eastern seaboard. The subsequent Navigation Acts did little to revive trade with America, while the French and Napoleonic Wars (1792-1815) proved fatal for the West Indian trade.

Export figures for the Virgin Islands reflect this cancerous decline. In 1792, goods valued at £106,162 were exported to Britain, while just eight years later that figure had more than halved to £45,987 (Dookhan, 1973). Fluctuations in the market varied the value of exports from the colony until 1820, when a steady depreciation pattern emerged, reaching an all-time low in 1828 when just £20,934 worth of goods were exported to the mother country.

Nature contributed to the already dire situation when, between September 21 and 22 1819, a tremendous hurricane smashed into Tortola destroying what little remained on the island, leaving in its wake an estimated £302,669 worth of damage (Dookhan, 1973). By the early 1820s, the plantation system was collapsing in the Virgin Islands, encouraging the evacuation of the former white planter class. This, combined with the abolition of the slave trade in 1807 after which the importation of African slaves was forbidden, contributed to an irreversible demographic decline that remained consistent until modern times.

A visitor to Tortola in the latter half of the 1820s provided a bleak picture of the capital Road Harbour writing that:

> *The Town, if it might be so called, was the very epitome of misery and desolation; and the sample of its inhabitants, whom curiosity, rather than employment, had brought to the beach, appeared to have been trained up to support "the keeping" of the picture* (Wentworth, 1834).

1.2.2.4 Emancipation and Beyond

Thousands of miles away, social changes were taking place in Britain that were to finally break the stranglehold of the West India Lobby, which had politically supported planters' interests for over a century. After the Great Reform Act of 1832, the rampant parliamentary corruption—which had allowed West Indian nabobs to control the abolition process—collapsed, and within a year a bill had been passed to abolish slavery in all British colonies.

In the Virgin Islands, tradition states that the Emancipation Proclamation of 1834 was read at the Sunday Morning Well in Road Town which, in its present location, is probably incorrect. The original well was apparently closer to the modern bandstand until 1924, when water inundation and the subsequent pollution created by a hurricane made it necessary to move the well to its present location.

A period of apprenticeship—which many considered to be another form of slavery—emerged until 1838 when 5,115 apprentices achieved full freedom in the Virgin Islands (Dookhan, 1973). What followed was a period of confusion during which the population adapted from a plantation slavery economy to a free rural peasantry economy. The shift in taxation from the old planter class to the newly emancipated population left the colony in severe debt. In an attempt to alleviate the financial burden, new methods of taxation were introduced which were extremely unpopular with the population who in the past had not been subjected to taxation and now openly opposed to it.

One means by which the population actively opposed taxation was by smuggling with impunity their livestock and produce to adjacent St. Thomas and returning illicitly with provisions which were never declared before customs. This created a deficit in the treasury which directly affected the development of the colony. It has been suggested that "had smuggling been nonexistent, the revenues from customs duties would have been sufficient to meet expenditures, without the need to resort to extraordinary methods of raising the requisite amounts" (Dookhan, 1973).

One such extraordinary method was the cattle tax, which was first introduced in 1844. By 1853, the Road Town poorhouse had deteriorated to such a degree that the Legislature increased the existing cattle tax by 50 percent to raise revenue for building repairs (*St Croix Avis*, September 9, 1853). The rural population abjectly opposed any inflation of an already unaffordable tax, while the Council, with their customary lack of tact, decreed that it should be paid on the first of August, a day celebrated throughout the British Caribbean as Emancipation Day.

When the farming community descended from the hills into Road Town on August 1, 1853, it rapidly became clear that trouble was inevitable. Having vehemently refused to pay the tax increase, two men were arrested at the Treasury and then committed to the Road Town Gaol, which provoked the remaining antagonists into further action. Initially, President Chads was petitioned by the crowd at Government House to release the prisoners, but refused to do so on the grounds that interference with the judicial process was not within his gubernatorial mandate. Having promised to return the following day in greater numbers, the rural population retreated to their respective communities plotting insurgency.

The next morning, between 1,500 and 2,000 labourers (Dookhan, 1975) massed in Road Town and again petitioned President Chads, who promised to lay their grievances before the Legislature. Unsatisfied, the protesters charged the prison to release their compatriots where the Riot Act was read to them twice. Violence ensued, and any semblance of reconciliation disappeared when the mob began setting fire to their own capital.

The following three days of chaos and destruction retarded the colony's development for almost a century. All education was postponed for two years, while representative government was abolished for 97 years.

It was exactly to prevent such uprisings that an auxiliary military force had been created when slavery was still practised. However, in disbanding the militia just five years after emancipation, the colonial government critically underestimated the level of antipathy engrained within the recently freed population. In doing so, they compromised the internal security of the colony by rendering innocent bystanders defenceless against the depredations which took place between the 2nd and 5th of August, 1853. The constabulary formed in 1837 was no match for the infuriated mass of rural labourers, a situation that ultimately caused the evacuation of the white population with most never returning.

Many of the refugees from Tortola arrived at St. Thomas with desperate accounts of their escape, startling the Governor there to dispatch Baron Rosencrantz with 40 Danish troops on board the packet schooner *General Von Scholten* to assist President Chads (*St. Croix Avis*, September 9, 1853). Unfortunately, due to the lapse in time between the start of the riot and the arrival of the Danish troops some 36 hours later, most of Road Town was razed to the ground and the mob had dispersed into the country side where they destroyed many of the remaining estates. It was not until almost a week later that detachments of the 67th Regiment and the 2nd West India Regiment were dispatched.

The inevitable trials of the major antagonists resulted in both capital and custodial sentences while also providing the British Government with the impetus they required to finally dissolve the extant governmental system. That system had supported an Assembly and Council which had existed since 1774. On the basis that a lack of viable candidates for political office remained in the colony, the Constitutional Amendment Act was passed in August of 1854 providing for a Legislative Council only.

A cholera epidemic in late 1853 provided further distress to an already dire situation when 942 people or almost 14 percent of the population were wiped out in a matter of days (Dookhan, 1973). Only Beef Island and Salt Island escaped infection, probably because of a community-organised and enforced quarantine which denied access to anybody attempting to land on either of the two islands. The fear of infection led to special burial grounds being created, such as the plot behind the Methodist cemetery in Road Town, which is now commemorated by a plaque. The infection first appeared in Jost Van Dyke and the West End of Tortola where an epidemic cemetery was discovered in 2007during excavations at an Amerindian settlement in Belmont.

1.2.2.5 Period of Decline to the Modern Era

What followed is a period in Tortolan and Virgin Islands history about which little is recorded apart from melancholy official British records which document the colony's decline. It is a period which the Commissioner of the Virgin Islands, Robert S. Earle, described a half century later as "probably the three most hopeless decades in their history" (Fishlock, 1912).

Many of the former estates became what are now recognised as the modern communities that sprang up in areas where former slave families had remained following emancipation, such as the Fahies from Fahie Hill and the Nibbs from the Nibbs Estate. The original leeward shore settlements of East End, Road Harbour and Sea Cow's Bay contained the majority of Tortola's population, while the north shore settlements of Cane Garden Bay, Carrot Bay and Brewer's Bay for the most part retained their emancipated peasantry. Agricultural pursuits were supplemented by animal husbandry, charcoal burning, fishing, basket weaving, and regular temporary migrations to other islands such as St. Thomas and Santo Domingo where labour was in demand. Political representation was slowly constricted until on the 24th March, 1902, the Legislative Council held its last meeting and all power was invested in the Governor of the Leeward Islands in Antigua, some 212 miles away.

There were some glimmers of hope, however, most notably in the agriculture sector when:

> *In 1900 an Agriculture Department under the Imperial Department of Agriculture, was formed, and an Experiment Station was started about one mile from Road Town. The establishment of a Department of Agriculture and an Experiment Station may be regarded as a turning point in the history of the Presidency* (Fishlock, 1912).

The new Experiment Station, under the direction of Kew protégé Walter Charles Fishlock, began planting a variety of crops on a 160-acre former sugar estate. Plantings included limes, cacao, coffee, sugarcane, and pineapples, with land also reserved for sweet potatoes and cassava. By far the most profitable introduction was a new type of Sea Island cotton, which was first planted in 1903. Cotton had for a short period of time during the American Civil War (1861-65) been in great demand and grown on Tortola at a strong profit but had since declined until its re-introduction by Fishlock. In 1905, 1,250 pounds were produced with a value of £35, which by 1913 had increased to 52,000 pounds with a value of £3,300 (Fishlock, 2012). While primarily basing himself at the station in Road Harbour, Fishlock would also visit the outer islands where he provided advice to Virgin Islanders on new or emerging agricultural practices that could be to their economic advantage. Unfortunately, all of the progress achieved was abruptly obliterated on August 28, 1924, when a hurricane smashed into the island.

The "Gale of '24" as it later became known was the fourth hurricane that year and the last major hurricane to hit the islands until Hugo in 1989. Gusts and storm surge were particularly strong leaving a trail of devastation which essentially destroyed the progress instigated by the Experiment Station. The Administrator of the Virgin Islands, Otho Lewis Hancock, and his wife Agnes (both of whom later died aboard the *SS Kuala* when it was bombed by the Japanese during the evacuation of Singapore in 1942), were resident in Cameron Lodge, by then known as Government House, where Agnes wrote a detailed description of the storm. She described Road Town and Tortola the following day:

> *What had once been the town was ruin and wreckage, much like the pictures one saw of villages in France after being shelled. A house stood here and there, but most of them were just masses of wreckage, completely blocking the road and we had to climb over portions of roof etc., to get along at all. The sea did much of the damage in the town, as it came up and literally floated the wooden houses off of their wooden foundations.*
>
> *The far end of the town which is more sheltered did not suffer so badly, the church, thanks to a good roof, which was put on after the 1916 hurricane stood the storm and only inside damage was done. Also the school stood and is now full of refugees and lots of babies.*
>
> *As for the Wesleyan church, which is only a stone's throw from ours, it is like a pack of cards, completely razed to the ground. Their schoolroom, however, stood and is now a temporary hospital.*
>
> *We next heard terrible tales of dead and wounded. We have twenty nine dead and I believe between 70 and 80 wounded and most of the population homeless and destitute. Many people live in the mountains and I believe hardly a house remains. As for the wounds, some of them are terrible, ghastly deep gashes, many on the head, most of them septic as they could not get to town at once for treatment. It was particularly distressing to see small children with ghastly wounds. One small girl of three years has her skull exposed, her father, mother and five brothers and sisters were killed. Another baby aged about six months had its skull fractured and a ghastly septic wound; but mercifully it died after a week. Baughers Bay, where we used to go to bathe got terribly devastated, a man called Jennings had built a big new house there where many people rushed to for safety. Not a stick or stone of the house remains. Jennings died after a week, with broken limbs and terrible wounds. The Americans from St. Thomas sent us the first relief and a motor boat bought food and medical aid, tents and a Doctor and assistant, and took eleven of our worst cases to hospital in St. Thomas* (Hancock, 1924).

Yet again, the forces of nature plunged the colony into a state of economic and infrastructural depression. Lack of any political representation to request emergency funds made re-building a tediously slow and frustrating pursuit, provoking Virgin Islanders to re-evaluate their relationship with Great Britain. One individual in particular, Hope Stevens, began questioning the situation, and in 1939 he formed the Civil League, a group dedicated to politically empowering Virgin Islanders. The officers of the League included David Fonseca, Charlie Georges, J.R. O' Neal and H.R. Penn.

Unfortunately due to the intervention of World War II, they were essentially ignored by the British authorities who were more concerned with a potential German invasion. While the mother country and her allies fought the Axis powers, the Virgin Islands gently drifted through the Second World War with only the occasional U-boat sighting to remind them that it was even happening.

Subsequent to peace in 1945, the British position on her overseas colonies had softened, resulting in The British Nationalities Act of 1948. Coincidentally, just a year later, an Anegadian named Theodolph Faulkner came to Tortola with his wife who was expecting a baby. After arguing with the physician about British control, he went to the market square where he publicly protested against the government, expressing many of the social ills that were more widely felt. On November 24, 1949, 1,500 people gathered and marched through Road Town organised by Theodolph H. Faulkner, Isaac G. Fonseca and Carlton L. De Castro to protest against lack of political representation.

Just one year later in 1950, the Legislative Council was restored consisting of eight members including two ex-officio, two nominated and four elected. The British-appointed Commissioner served as the President. Property and literacy restrictions were imposed, and only British males over the age of 21 could vote. A new constitution was drafted for the first time in 48 years leading the Virgin Islands into the modern era.

1.2.3 Modern Development of Tortola

1.2.3.1 Tortola in the1960s

In her study of tourism and nationalism in the British Virgin Islands, writer Colleen Ballerino Cohen draws a sharp contrast between Road Town, the capital of the BVI, as illustrated in a 1960 photo and the same site captured later in 2008. She writes:

> [The 1960 photo] *shows a small seaside village around a perfect half moon harbor, with two small cays in the middle and a large cay to the west. The green hillsides sloping down to the harbor appear to be divided into agricultural plots, and the fields surrounding a concentration of red-roofed single-story buildings close to the shore appear to be surrounded by lush palm groves. The harbor itself, Road Harbour, is empty of any sea traffic, as is the channel outside the harbor* (Cohen, 2010).

In contrast, Cohen writes of the same landscape in 2008 (**Photo 12**):

> *In place of agricultural plots, houses and apartment houses dot the hillside running all the way from the harbor to the crest of the hills, and roads in different stages of construction crisscross the mountains that surround Road Town. To the west* [mid-right in front of the cruise ships in **Photo 12**], *the large cay has become part of the mainland, and is covered with buildings, the largest of which is four stories tall and houses the modern government administrative complex. At the tip of the reclaimed land on which the administrative complex sits is a large dock, with a cruise ship tied up. … Where the two small cays were, there is what appears to be a forest of sailboat masts* [mid-left in **Photo 12**], *and on the land across from this mast forest, every inch of space seems to be built on. The harbor itself is busy with sea traffic* (Cohen, 2010).

Photo 12.
Road Town, the capital of the British Virgin Islands, taken from the same perspective as Colleen Cohen's 2008 photo discussed in the text above (*source*: Government Information Service).

BOX 2

Agriculture in Tortola: An Historical Perspective

In his message on the occasion of the Centenary Celebration of the Department of Agricultre in 2002, the Acting Governor, M. Elton Georges, confidently stated, "Through most of the years of the 20th centruy—up to the 1960s—agriculture was the mainstay of the economy of these islands. Along with remittances from Virgin Islanders abroad, it was the surplus from agricultural produce that fed and clothed a large part of the population" (DOA, 2002). The picture painted by these words is a sharp contrast to present-day reality where agricultural surplus is a thing of the past and the territory is heavily dependent on agricultural imports from other countries. It is hard to remember that the BVI once produced sufficient crops and cattle to export to neighbouring islands. Elton Georges, in his same remarks in 2002, referred to his own boyhood memories from the 1950s when it was still common to use dipping mats for infested cattle and when the organised export of cattle to the French West Indies was not yet a thing of yesteryear.

Agriculture has played a key role in the development of Tortola and the BVI, as follows:

Subsistence and Survival: From the BVI's earliest history, agriculture contributed to basic survival, with subsistence agriculture a key to the survival of slaves during the plantocracy and of freed people after the abolition of slavery. The attachment of slaves to small cultivations was encouraged during slavery, and this pattern continued when the monocrop estates collapsed (Beckford, 2003). Subsistence agriculture has continued to the present with many Tortolans maintaining backyard gardens, a category still judged during the annual BVI Agricultural Fair.

Food Production for Local Market: The oral histories in Eugenia O'Neal's (1999) seminal work on BVI women farmers provide insight into the level of food production once achieved by local farmers. Interviewee Ilva Lettsome, who had been farming for over 65 years, recalled that her mother had over 500 sheep and over 60 cows and furnished assorted agricultural products— tomatoes, peas, cabbage, eggplant, potato, banana and eggs—throughout the Virgin Islands, including Guana Island, Road Town, Baugher's Bay and Freebottom. Other crops grown included collard greens, mustard, spinach, cassava, sweet potatoes, and fruits such as gooseberries and guava.

Export of Produce: Beckford (2003) reports that by the mid-1700s, the BVI had entered a period of unprecedented growth in agricultural production, with the colony serving as a major Caribbean supplier of cotton to England; sugar was also produced in abundance. In more recent times, in the early-to-mid decades of the twentieth century, the BVI was an exporter of produce to the neighbouring USVI. In her interview for O'Neal's oral history (1999), Ilva Lettsome recalls that her mother supplied St. John (USVI) with produce, with boats sailing every Saturday from St. John to stock up on provisions from her mother's produce in Tortola.

Export of Skilled Agricultural Labour: When hard economic times prevailed, many BVI agricultural workers found employment opportunities in other Caribbean Islands including the sugar cane fields of the Dominical Republic and Cuba.

Nevertheless, despite its noble role in the development of the BVI, the agriculture sector is now overshadowed by tourism and financial services, the territory's twin economic pillars. Despite its diminished status as a major contributor to the territory's economy, there is fundamental value to reviving agriculture in the BVI. Beckford (2003) argues that local food supplies benefit a country in three primary ways: (1) in times of crisis and uncertainty when externally imported food stuffs cannot be relied on; (2) in times of plenty to provide opportunities to stimulate local agri-businesses; (3) at all times by reducing "income leakages" that are paid to foreign food suppliers.

These arguments are powerful and may have contributed to Government's decision in 2009 to construct two green houses in the territory, the first at Paraquita Bay in Tortola. The Green House Project was designed to increase food production in the BVI to a level not possible using traditional agricultural methods alone (*pers. comm*., Permanent Secretary Ronald Berkeley Smith, MNRL, September 2014). The green houses have been promoted as facilities that will provide jobs for local farmers while also reducing the BVI's reliance on food imports and educating BVI youth about agriculture. Only the green house in Tortola was erected but stood empty and unused for several years, although Government is, as of this writing, entertaining bids for the operation of the facility, which is expected to be functional in 2015 (DOA, 2015).

However, a modern and productive agricultural system for Tortola will require more than a functional green house. A key factor in the sector's decline is the perception of agriculture, particularly by the island's youth. Children today have fewer opportunities to learn agrarian skills and knowledge from their parents and other elders, while, at the same time, the image of the traditional farmer who expends considerable energy and hard work to succeed at his/her profession cannot compete with the "more "glamorous" images of occupations in tourism and financial services. *(continued)*

A number of recommendations for enhancing the sector have been put forward over the years (O'Neal, 1999; DOA, 2002; Beckford, 2003), including: better integration of agriculture as a more central part of the school curriculum; infrastructure to provide more water for farmers; more assistance to young entrepreneurs wishing to pursue agrarian occupations; focused educational support for women farmers; encouragement for and financing of agricultural research; refurbishment of the Road Town marketplace; and exploration of non-traditional crops.

Early in 2014, Government announced that it was developing a new agricultural policy to regulate imports with international standards; dedicate more land to the practice of agriculture; and facilitate the development of farming as a viable industry (*www.bviplatinumnews.com*, 7 February 2014). In making the announcement, the Minister for Natural Resources and Labour also proposed that a national debate take place on the future of agriculture in the territory.

As part of the proposed debate, it should be recognised that those who work in agrarian occupations are highly skilled professionals who are knowledgeable about nature and human interactions with nature. In the past, traditional farmers in Tortola understood moon cycles and their impact on crop production, were familiar with a wide variety of crops, and knew how to use their crops to heal and sustain themselves. They possessed a rich understanding of herbal medicine and how to employ herbs and other plants as useful home remedies. Perhaps a paradigm shift is required before Tortola's contemporary society can once again appreciate the value of crop sustainability, food security, and the importance of this sector once so critical to the BVI but now overshadowed by new economic activities.

Dr. Cohen's pictorial depiction of Road Town in 1960 encapsulates the BVI that was just prior to the emergence of the territory's modern era. Communities, even Road Town, were small, primarily inhabited by small-scale farmers and fisherfolk. Agriculture (**Box 2**)—including livestock—and fishing, were the predominant occupations among BVIslanders, who also engaged in trading by inter-island sloops. And even the leading sectors—agriculture and fishing—were declining. In 1946, agriculture, forestry, fisheries, and hunting accounted for 72 percent of the male working population, but by 1960, this figure had decreased to 45 percent (Bowen, 1976).

During this period, BVIslanders found jobs and higher wages in the nearby American Virgin Islands, where, by the mid-1950s, the US territory was experiencing significant growth in its tourism sector, thereby offering a ready market for BVI labourers seeking employment. The population of the British Virgins was very mobile, with between 200 and 300 persons a week moving between the British and American Virgin Islands. By 1960, 10 percent of the BVI's 7,340-person population was in the USVI (Bowen, 1976). This transboundary movement was encouraged by a simplified US immigration procedure adopted in 1956 to accommodate temporary admission into the USVI, a procedure that was *only* applicable to BVIslanders (Howell, 1978).

The communities in which the population resided were scattered and relatively isolated as the British Virgin Islands entered the 1960s, with most travel between settlements, whether on another island or the same island, undertaken by sea. There were few roads, and these were more dirt paths than roads. There was electricity only in Road Town, limited to Government House, the Hospital and Administration Building. Telephone service in Road Town consisted of one switchboard with 20 lines; the communication link between the three sister islands and Road Town was via a radio-telephone system. There was no bank, and islanders sent their money to St. Thomas for deposit. School children met primarily in churches or parish rooms as there were only three designated school buildings (Bowen, 1976).

1.2.3.2 The Advent of Tourism

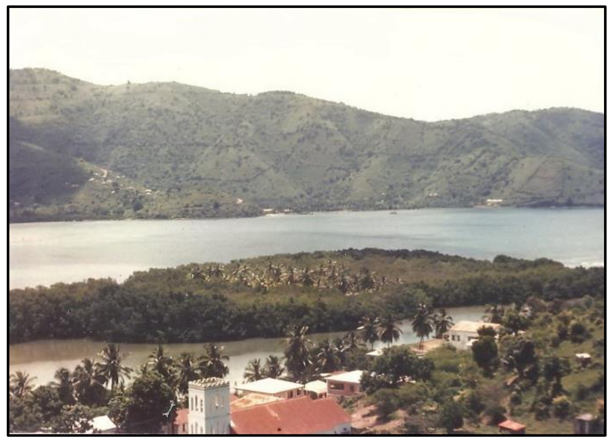
Given the lack of basic infrastructure, the colony (as it was then called) found that the initial impetus for modern development would come from the outside. In the beginning, this was the American entrepreneur Laurance Rockefeller and his development of the Little Dix Resort on Virgin Gorda in 1964. To this day, the BVI pinpoints the start of modern development in the territory to the establishment of Rockefeller's resort, which, because of the lack of basic infrastructure, was developed by Mr. Rockefeller as a self-contained unit. As one BVI scholar has noted, "The Rockefeller entrance into the British Virgin Islands was the most significant factor in its economic development" (Harrigan, 1969).

By 1967, Tortola offered a total of 106 guest rooms, scattered in 11 small facilities, the largest of which had 16 rooms—although room capacity would double in the next decade, largely as a result of the opening of the Prospect Reef hotel (Howell, 1978). But clearly, the island needed its own Rockefeller.

This came in the form of an Englishman named Kenneth Bates. In 1967, the Administrator of the BVI entered into an agreement with the British firm of Bates-Hill and its BVI subsidiary, the Tortola Development and Trust Company Ltd. The resulting Wickham's Cay Development Agreement was unprecedented in scale and ambition. It called for an extensive landfill project in Road Harbour, connecting the islet of Wickhams Cay✦ (**Photos 13**) to the mainland and thereby creating a prime development area of 28 ha (69 ac). The Agreement provided absolute ownership of the landfill area to the developer, Kenneth Bates, upon completion of the project (Howell, 1978; O'Neal, 2012).

Ultimately, the Government decided to rescind the Wickham's Cay Agreement and another Bates agreement for development of Anegada. Indicative of the concerns of Virgin Islanders was that expressed by J.R. O'Neal, a BVI businessman and statesman, who wrote that he visited the British Administrator, Martin Staveley, in order "to get some clarification about whether we would be allowed to even visit the development and I asked the Administrator if I would be allowed to approach the new Jerusalem." (O'Neal, 2004).

By 1968 a grassroots political action movement had emerged agitating for "Positive Action" (as the movement was to be called). Political strife, coupled with local concerns about uncontrolled development and development being taken over by foreigners, prompted the authorities to eventually cancel the two agreements. In 1971, the BVI Government acquired the interests of the Bates-Hill Corporation in both Tortola and Anegada for a sum of $5.8 million, which was supplied in the form of a loan from the British Government. The proposed development on Anegada was never achieved, but the Wickham's Cay project was completed in Tortola.



Photos 13.
Photos of Wickham's Cay taken before 1968 (pre-landfill project)
(source: first seen in Verna Penn Moll's *This Land: A Trust from God* (Moll, 2014).

There followed a period in which much of the infrastructure development on Tortola—initiated in the 1960s—was completed, an achievement that was offset by a downturn in Caribbean tourism and a more cautious attitude toward BVI investment by

✦ A prominent BVIslander from this period, J.R. O'Neal, has written, "Until 1967, Wickham's Cay was just a small cay, a mangrove-covered area with some coconut palms in the centre, a stone's throw away from Road Town (**Photo 13**). The original plan for the development of Wickham's Cay provided for a green belt which was to ***separate*** [emphasis added] old Road Town from the development. (The site of the green belt is demarcated by the present day eight-foot ditch which now runs through Road Town into the sea.)" (O'Neal, 2004).

foreign developers in light of Government's abrogation of the two Bates-Hill agreements (O'Neal, 2012; Howell, 1978). An FCO report in 1973 indicated:

> *Development slowed down considerably. …. The building of hotels and tourist enterprises was stopped. Money was in short supply, the cost of living rose and there was no longer full employment* (cited in Howell, 1978)

It was in the early 1970s that Tortola and the BVI began to develop yachting tourism as a prominent sub-sector of its overall tourism product. As Dr. Michael O'Neal has reported (O'Neal, 2012), a new tourism development strategy for Tortola, commissioned by the BVI Government and prepared by the British firm of Shankland Cox, recommended that emphasis be placed on promoting the territory's marine resources through development of charter-boat tourism. The Shankland Cox report advised the BVI to "strike a balance between the need to develop … tourist attractions for the benefit of the economy, without at the same time destroying what make them attractive in the first place" (Shankland Cox, 1972). Yachting tourism seemed to strike just such a balance, with the territory's subsequent charter boat fleet to be based on Tortola.

Cruise tourism also began in Tortola in the late 1970s, with regular alternating calls by two Cunard Ships, the *Princess* and the *Countess*. Initially, there was no cruise pier and the island's earliest cruise ships, which were relatively small in size, berthed at Road Town's cargo port, Port Purcell (Creque, 2014).

From these beginnings in the 1960s and 1970s, tourism would expand and develop on Tortola, although Virgin Gorda would largely remain the nub of BVI tourism, especially known for its upscale accommodations that have not been as extensively replicated on Tortola. Instead, in the 1980s, Tortola would move toward a new economic pillar, and it was this emerging sector which would stand as the primary foundation of the territory's subsequent quality-of-life and economic gains.

1.2.3.3 The Financial Services Sector

In 2014, the BVI celebrated the 30th anniversary of its financial services sector, marked by the 1984 enactment of the International Business Companies Act, (which was later repealed and replaced by the BVI Business Companies Act, 2004). As a result of the 1984 legislation, the territory would emerge in the following three decades as an international financial centre for global business; and, in the process, the BVI would enter a period of unprecedented economic expansion. The impact of this new economic sector—centred on the island of Tortola—cannot be underestimated, as was emphasised by the territory's Premier in a statement before the House of Assembly (HOA) in September of 2014. The Premier declared:

> *Without the economic prowess arising from enactment* [of the 1984 legislation] *and the resultant business development, we may have been but a mere group of beautiful sun kissed Caribbean islands* (The Honourable D. Orlando Smith, House of Assembly, 25 September 2014).

The strength of the BVI's financial services sector rests with the incorporation of foreign companies in the territory. The revenue from these foreign incorporations is derived principally from the annual government fees paid by active companies. It is an economic structure that does not require a great deal of infrastructure, nor does it require a large number of workers. In fact, while the sector is the largest contributor to the public treasury (approximately 60 percent), it does not significantly contribute to employment. Tourism, on the other hand, is not as great a generator of public revenues, but 80 percent of the territory's employment is derived directly or indirectly from tourism (*pers. com.*, Raymond Phillips, Director, DPU, 28 January 2014).

Incorporation numbers are viewed as a key measure of the health of the BVI's financial services industry. In his address to the HOA (25 September 2014), Premier Smith reported that there had been a noticeable decline of approximately nine percent in the number of new incorporations during the previous two years. This was in part the result of negative publicity from the international press and overseas activist groups targeting the BVI as a "tax haven." However, the Premier also reported that the BVI remains a significant leader in the incorporation of companies, with 454,000 active companies on its register, a figure that is five times more than its closest offshore competitor.

Despite external pressures and changes, it is clear that the British Virgin Islands remains dependent on its financial services sector to generate the public sector revenues upon which the quality of life for Virgin Islanders has become dependent.

1.2.3.4 Tortola in 2015

As Tortola moves forward, the subject of infrastructure repair and development on the island has become of increasing importance. Just as it was in the 1950s and early 1960s, the need to strengthen the island's infrastructural assets is seen by Government as imperative to Tortola's—and, indeed, the territory's—future growth and well-being.

In addition to extensive road repairs on Tortola, Government recently (April 2015) inaugurated an enhanced cruise ship pier in Road Town and is planning for an extension of the territory's primary airport located on the eastern end of Tortola. The cruise pier expansion includes extending, strengthening and widening the existing pier along with development of a boardwalk linked to Road Town, dredging and land reclamation, and a five-acre landside development with commercial, retail, entertainment and green spaces. The proposed extension of the island's major airstrip on Beef Island, first constructed as a small dirt strip by pioneering entrepreneur Wladek Wagner in the 1950s (**Box 3**), would extend the runway a proposed 2,500 feet.

Both of these capital development projects, designed to create new tourism infrastructure, are controversial. For example, instead of extending the airport runway, many in the community call for an upgrade in the sub-standard ferry service that currently links Tortola with St. Thomas, USVI, a major hub for connections with US airports and where most BVI-destined visitors now enter the Caribbean en route to the territory.

Whatever the outcome of these modern-day infrastructure developments, it is clear that Tortola will remain the most populated and developed of the BVI's major islands, the focus of business and commercial activities, the political centre of government, the base for the territory's yacht charter fleet, and the nexus of the territory's financial services industry that has brought renewed prosperity to Tortola and the British Virgin Islands.

BOX 3

The Wagner Family — Pioneers of Trellis Bay and Beef Island

Before Trellis Bay (Beef Island) on the eastern end of Tortola became a popular BVI anchorage for cruising yachties, there was the Wagner family who started it all. From 1949-1958, the Wagners—Mabel of Scottish birth, Wladek, a WW II Polish refugee, and their two children, born while the family resided at Trellis Bay—created a new world at this then-isolated, uninhabited bay (**Photo 14**). After sailing from the the British Isles to the Isles of the Caribbee on their 77-foot ketch, *Rubicon*, Captain Wagner, a reknowned Polish sailor, settled on Trellis Bay as the perfect anchorage for his pioneering dreams. The Wagners purchased ten acres from Haldane Davis of East End and using the *Rubicon* as their base, they carved a home and a series of guest houses out of the Beef Island wilderness; created Trellis Bay's first boatyard and marine railway, which initially attracted sailing yachts to the area; launched a clubhouse on nearby Bellamy Cay for visiting sailors; hosted a movie crew that included a young Sidney Poitier; and, on behalf of the Government, Captain Wagner constructed the BVI's first small airstrip on Beef Island. At the same time, the couple raised and schooled two children who spent their childhood at Trellis Bay.

Over 50 years later, Mabel Wagner has written a memoir of her family's life at Beef Island, *Lest I Forget* (Wagner, 2012), telling the story of their adventures and of the many enterprises—guided by her husband's ambitous dreams—they would create on Beef Island and which would ultimately provide the foundation for the Trellis Bay that can be seen today.

Photo 14.
Wladek, Michael, Mabel, and Suzanna Wagner.

2. THE INSTITUTIONAL ENVIRONMENT[2]

2.1 A Seven-year Perspective: What Has Changed?

As the British Virgin Islands entered the twenty-first century, the territory confronted fresh challenges relating to how it would balance economic growth and the sustainable use of its extant natural resources. The potential conflict inherent in this balancing act was well illustrated in the elections of 2007 when, for the first time in the BVI's electoral history, the issue of "growth vs. the environment" emerged as a key factor and seemed to dominate public discussion leading up to the elections. An issue of considerable controversy was the proposed development of a five-star resort development and golf course on Beef Island—connected by bridge to Tortola—in an existing fisheries protected area and proposed national park. The election served to focus attention on whether the natural environment was being put at risk in order to accommodate compelling economic growth interests.

The election—and the ensuing legal battle that grew out of the development project proposed for Beef Island[✦]—did not resolve the larger issue of growth vs. the environment, nor whether the two are necessarily in conflict. But it did set in motion a period when the Virgin Islands began to confront these issues with a greater understanding and broader awareness of the need to achieve a healthier balance between economic development and environmental sustainability.

As British Governor W. Boyd McCleary stated at the end of his four-year tenure in the territory (2010-2014), "There has been a noticeable shift during my years in the BVI as the environment and concerns about the sustainability of the environment have become more mainstream" (*pers. comm*., meeting with Judith Towle, 29 January 2014). The Governor noted that the territory's government will never be committed to promoting the environment "at all costs" and there will undoubtedly still be times when government action, or inaction, might result in damage to the environment.

But what is different now is an awareness of environmental risks associated with development actions and the need to diminish environmental degradation when pursuing development goals. What is new is the integration of the environment in discussions of economic growth and the increasing recognition of the importance of the environment in development planning.

Island Resources Foundation's Environmental Profile Programme for the British Virgin Islands was launched in 2008, shortly after the election of 2007. With each passing year that marked publication of a new profile—Jost Van Dyke in 2009, Virgin Gorda in 2012, and Anegada in 2013—this chapter on the institutional framework for the environment in the BVI has expanded and has included new legislative and policy initiatives, as well as recognition of a broader and more secure structure within which the BVI public sector manages, promotes, and protects the natural environment.

This chapter of the *Tortola Environmental Profile* will update these initiatives, which—taken in their entirety— provide ample evidence of the desire of successive BVI governments to modernise environmental policy, update environmental laws, and support established environmental mandates. While more can be done (see for example the Issues Table at the end of this chapter), a substantial institutional infrastructure for managing and protecting the environment is already in place.

However, it is now the responsibility of current and future governments to exercise greater clarity of intent, steadiness of purpose, and consistency of application when employing available institutional tools, particularly those that support a cohesion of economic growth and environmental sustainability.

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[2] The author of Chapter Two is Judith A. Towle.

✦ See Chapter 8, Box 10 for details on the court case resulting from the proposed Beef Island Development project and its potential impact on a designated protected area.

2.2 The Public Sector

2.2.1 Government Structure

The British have maintained sovereignty in the BVI since 1672, although initially the colony was not one of Great Britain's more profitable overseas enterprises. As a British colony, the BVI was administered as part of the Leeward Islands Colony from 1872 to 1956, at which time British colonial rule in the Caribbean began to break up and the Leeward Islands Colony was dissolved.

Constitutional reform in 1967 established the BVI as a British Dependent Territory (now named Overseas Territory), with a locally elected legislature and chief minister. The US dollar was also established as the official tender.

As a British Territory, the BVI Head of State is the British Monarch, represented locally by a Crown-appointed Governor who is responsible for external affairs, internal security, defence, the public service and administration of the courts. The BVI also enjoys a high level of self-governance that is based on the Westminster Parliamentary model of government. A new Constitution Order (2007) further defined the political relationship between the United Kingdom and the BVI.

Photo 15.
Government Administration Building, Road Town.

The legislative functions of Government reside in a 13-member, elected House of Assembly (replacing the Legislative Council in 2007). The Cabinet (replacing the Executive Council in 2007) is charged with the general management of Government and the formulation and implementation of policy. It is collectively responsible to the House of Assembly. The Premier (replacing the office of Chief Minister in 2007) and four other ministers of Government are appointed by the Governor upon recommendation from the elected representatives. The Attorney General is an ex-officio member of Cabinet.

There are at present six ministries, or portfolios: Office of the Premier, Finance, Natural Resources and Labour, Health and Social Development, Communications and Works, and Education and Culture.

2.2.2 Environmental Units of Government

That the "environment," broadly speaking, is government's responsibility is not disputed in the small islands of the Eastern Caribbean, including the British Virgin Islands. Government control of public health, ports, harbours, and aspects of forestry and fishing, for example, is generally recognised.

While the idea of government as guardian of selected environmental resources is not new, what is new is the idea of government coordinating various units of government into a coherent resource management strategy *and* system designed to improve efficiencies, reduce risks, and minimise adverse impacts on the environment.

How these new directions and responsibilities are being executed in the British Virgin Islands is the subject of this chapter of the Environmental Profile. While overall responsibility for the environment resides within the **MINISTRY OF NATURAL RESOURCES AND LABOUR** (MNRL), there are other units of Government that also have responsibilities related to the environment. **Table 14** provides a summary of BVI public agencies currently charged with managing and protecting the environment.

Table 14.
The agencies of the BVI Government with environmental responsibilities.

UNIT OF GOVERNMENT	ENVIRONMENTAL RESPONSIBILITIES
MINISTRY OF NATURAL RESOURCES AND LABOUR	• Environmental policy and international environment agreements. • Management of Crown Lands and the seabed. • Climate change. • Alternative energy.
DEPARTMENT OF CONSERVATION AND FISHERIES ***(Ministry of Natural Resources and Labour)***	• Wildlife protection. • Water quality monitoring of inshore waters. • Inventory and monitoring of beaches, coral reefs, mangroves, seagrass beds, including resource mapping. • Beach maintenance (especially heavily used beaches) and beach surveillance (to prevent sand removal). • Biodiversity conservation and research. • Management of designated Fisheries Protected Areas. • Promotion of fisheries development. • Promotion of environmental education and public awareness programmes.
NATIONAL PARKS TRUST ***(Ministry of Natural Resources and Labour)***	• Management of designated parks and protected areas. • Implementation of the BVI's Protected Areas System Plan. • Leadership for identifying and incorporating new sites within the BVI's Protected Areas System. • Biodiversity conservation and research within protected areas under its jurisdiction. • Management of a system of moorings for the protection of coral reefs. • Promotion of environmental education and public awareness programmes.
DEPARTMENT OF AGRICULTURE ***(Ministry of Natural Resources and Labour)***	• Responsible for designating and managing areas to protect watersheds and water resources and prevention of deforestation. • One protected Forestry Area and six protected Water Areas have been designated, in 1955 and 1963, respectively, under DOA responsibility.
DEPARTMENT OF TOWN AND COUNTRY PLANNING ***(Office of the Premier)***	• Responsible for physical development planning and for preparation of national physical development plans. • Authority to designate Environmental Protection Areas in development plans. • Screening and review of environmental impact assessments for proposed development projects. • Compilation of a list of buildings or sites in the territory that are of special interest, for the purpose of determining buildings that should be preserved or protected. • Issuance of Plant Preservation Orders for the purpose of protecting plants or plant species designated for preservation. • Preparation of area development plans. • Coordination of the Territory's National Geographic Information System.
DEPARTMENT OF DISASTER MANAGEMENT ***(Office of the Deputy Governor)***	• Coordinating agency for the territory to prepare for, respond to, and recover from natural and other disasters.
DEPARTMENT OF WASTE MANAGEMENT ***(Ministry of Health and Social Development)***	• Responsibility for the management of solid waste.
DIVISION OF ENVIRONMENTAL HEALTH ***(Ministry of Health and Social Development)***	• Responsibility for environmental pollution control under the Public Health Ordinance.

UNIT OF GOVERNMENT	ENVIRONMENTAL RESPONSIBILITIES
TOURIST BOARD *(Office of the Premier)*	• Responsibility for development and marketing of tourism, including promotion of the BVI's landscape features, environmental amenities, and parks and protected areas.
MINISTRY OF COMMUNICATIONS AND WORKS	• Responsible for implementation of the BVI's Energy Conservation and Renewable Energy Strategy.

Within the Ministry, three agencies execute primary responsibility for the management and protection of the environment:

1. **DEPARTMENT OF CONSERVATION AND FISHERIES.**
2. **NATIONAL PARKS TRUST.**
3. **DEPARTMENT OF AGRICULTURE.**

These key agencies of Government and others are summarised in Table 14 and discussed in more detail in the sub-sections that follow.

2.2.2.1 Department of Conservation and Fisheries (DCF)

The Department of Conservation and Fisheries was created in 1991 from the merging of a recently created Conservation Office (1989) with the established Fisheries Division to create a new department within the Ministry of Natural Resources and Labour. The Department's broadly based mandate is to manage the natural resources of the territory in a sustainable manner.

At present, the Department carries out its responsibilities within five functional divisions (see *www.bvidef.org*):

- Administration and Human Resources;
- Coastal Zone Management;
- Policy and Planning;
- Environmental Information; and
- Fisheries Management.

Many current activities of the Department concentrate on environmental education; environmental information management (including resource mapping); and environmental monitoring (although much of the latter, such as monitoring pollution in BVI coastal waters, is in response to site-specific problems or incidences rather than as a part of a standardised, continuous monitoring regime).

As structured, the Department has a strong *resource* ***conservation*** *mandate* to protect the natural resources of the BVI. For example, at present, the DCF manages all of the territory's Fisheries Protected Areas (Gardner, L., *et al*., 2008), ten of which are included in this study of Tortola and its surrounding cays (see also Section 8.3.1 Chapter 8,).

The Department carries out an equally compelling *resource* ***development*** *mandate* in the area of fisheries development. Recent annual reports from the BVI Fishing Complex state that Government's role in achieving a unified fishing industry with the support and cooperation of local fishermen requires that more attention be placed on developing the industry's infrastructure and uniting local fishermen.

Much of the DCF's focus has traditionally been on the coastal and marine environment. In 2008, the Department published the first edition of its *Marine Awareness Guide*, with a second edition released three years later. Through photos and documentation, the publications brought to life a marine world with which many residents and visitors were not familiar. It focuses on the species and habitats of the marine environment and on safety issues for resource users, plus conservation concerns and existing laws (Gore, 2008 and 2011).

With the exception of the Fisheries Act (1997) (see Section 2.2.3.1), the department's legislative mandate has been relatively weak for several decades as many of the laws supporting its regulatory and resource protection functions were outdated (*e.g.*, the Wild Birds Protection Ordinance of 1954, the Turtles Ordinance of 1959, and the Beach Protection Act of 1985). Legislation on endangered flora and fauna mostly comprises species lists related to trade, possession, and removal, not biodiversity conservation and habitat protection. Additionally, environmental standards, such as those for water quality monitoring, have not been formalised in law and therefore are only informally administered. Fortunately, many of these gaps in legislative mandate and environmental policy are currently under review by Government and are likely to be included in the revised Environmental Management and Conservation of Biodiversity Bill (see below, Section 2.2.3.6).

2.2.2.2 National Parks Trust (NPT)

Unlike the DCF, the Trust is a statutory body, established by legislative authority in 1961 and governed by a minister-appointed board. The Trust's long-standing mission has been to preserve and manage designated natural and cultural areas in the BVI. In 2011, the NTP celebrated its 50th Anniversary, an impressive record for a small territory (see also Section 8.5.1, Chapter 8).

The National Parks Trust is currently responsible for implementing the Territory's Protected Areas System Plan (Gardner, L., *et al.*, 2008) and managing the 21 sites falling under its jurisdiction. Ten of the 21 sites are included in this Profile (see Section 8.3.1, Chapter 8,). In the Government-approved System Plan, the Trust has also designated areas of national significance that are proposed for incorporation within the protected areas system (see Table 51, Chapter 8 for identification of proposed sites for Tortola and its surrounding environs).

The protected areas of the BVI encompass a wide variety of sites, many of which were designated under legislation other than the National Parks Act, *e.g.*, the Wild Birds Protection Ordinance (1954), the Protection of Trees and Conservation of Soil and Water Ordinance (1954), and the Fisheries Act (1997). The overlapping jurisdictions are discussed in more detail in the BVI Protected Areas System Plan 2007-2017 (*www.bvinationalparkstrust.org/downloads/NPT_Protected-Area-System-Plan-2008.pdf*).

Given the geographical distance separating park sites, including large expanses of open sea, the NPT's responsibilities for existing protected areas are substantial, particularly when juxtaposed with the limited resources available to the park system and its diverse, even conflicting mandates, to:

- manage and protect sites;
- preserve biodiversity;
- provide recreational opportunities;
- enforce rules and regulations;
- administer a publically accessible, territory-wide mooring system; and
- self-fund its activities since the Government's annual subvention to the Trust is likely to end in the near-term.

Since 2004, the BVI Government has pursued a policy to reduce direct budgetary support to the NPT. Initiatives designed to expand the Trust's financial self-sustainability include:

1. Expansion of fees collected by the Trust for moorings. The Trust has long maintained a system of moorings for daytime recreational users as part of its Reef Protection Programme. Fees collected from these moorings have provided significant revenues for the Trust (just under $950,000 in 2013).

   In 2012, fee collection for *all* BVI moorings (commercial and private) was turned over to the Trust by Government (these fees were previously collected by the MNRL), and the NPT has been collecting these additional revenues since 2013 (approximately $140,000 in 2013).✦

2. Initiation in 2004 of a user fee system for entrance to selected national park sites. At present, fees can be collected at three sites, two

✦ The NPT is currently mapping all BVI moorings to determine placement, whether private or commercial, legal or illegal, and other pertinent data (*pers. comm.*, Joseph Smith Abbott, then NPT Director, meeting with IRF profile team, 5 February 2014).

of which are located in Tortola (Sage Mountain and the Botanic Gardens in Road Town).

3. Identification of park sites where concessionary licences can be issued and revenues generated (only one such concession has been permitted, for Prickly Pear in Virgin Gorda).

Photo 16.
J. R. O'Neal Botanic Gardens, Road Town.

The Department does not have staff dedicated to the management of its protected areas, which means responsibility for water conservation, biodiversity, forestry management, and enforcement, are not being adequately addressed by officials and staff within the Department.

Despite these revenue streams, and grant funding from external donors, the then director of the NPT, Joseph Smith Abbott, told the Standing Finance Committee in March 2014 that it will be a "few more years" before the NPT will be self-financing without need for a Government subvention.

2.2.2.3 Department of Agriculture (DOA)

In addition to its primary mission to develop the agricultural sector, the Department is also mandated to designate and manage areas for the protection of watersheds and water sources and prevention of deforestation. Seven such protected areas are currently under the authority of the department, all on the island of Tortola. They include one forestry area (Sage Mountain) and six water protected areas. The six water areas, all designated in 1963, are (see also Section 8.3.2.4, Chapter 8):

- Belle Vue Water Area
- Morning Rose Spring Water Area
- Purcell Water Area
- Harrigan and Long Bush Water Area
- Great Mountain and Gordon Water Area
- Joe's Hill, Albion and Nibbs Estates, and Sea Cow's Bay.

2.2.2.4 Department of Town and Country Planning (DTCP)

Although external to the Ministry of Natural Resources and Labour, the Department of Town and Country Planning (within the Office of the Premier) exercises considerable responsibility for the environment, including: physical planning, land use planning, environmental impact assessment (EIA), protection of critical natural and historical resources through designation of Environmental Protection Areas (EPAs), and coordination of the National Geographic Information System (NGIS).

In 2012, a partnership between DTCP and the Caribbean Disaster Emergency Management Agency, via the local Department of Disaster Management, provided the necessary funding to create a new planning database. The database provides for the collection and monitoring of all development applications by linking government departments involved in the review of development proposals, while also allowing developers and individual applicants to track their proposals in real time.

The DTCP manages the initial screening and review of applications for development as part of an overall planning process before they are forwarded to the Planning Authority for a final decision.✦ Part of the screening process is to determine whether a proposed development will require an environmental impact assessment. Applications requiring an

✦ The MNRL provides preliminary approval when Crown Lands are part of a proposed development. Application is made to the Ministry, which will generally require inclusion of an environmental assessment. An *ad hoc* Technical Review Committee assists the Ministry in reviewing applications. Such approval is distinct from development approval by the Planning Authority, a process which is also required for Crown Lands.

EIA go through a more detailed approval process, including development of an environmental management plan to guide oversight and monitoring of approved projects. Both processes—EIAs and environmental monitoring—are the responsibility of the Department.

The **Planning Authority** (preceded by the Development Control Authority) is a statutory body within the Premier's Office established by the Physical Planning Act (2004). It comprises representatives from several government agencies (including the Chief Planner, Chief Conservation and Fisheries Officer, and the directors of Public Works and Disaster Management) and appointed stakeholders from the private sector with knowledge and experience relevant to physical planning. It is the final authority for approval of development applications, with the exception of certain public sector infrastructural projects, agricultural development, and tourism projects valued at over ten million dollars, in which case the Premier has the ultimate authority.

The BVI's development control process is now regulated under the Physical Planning Act (2004) (see Section 2.2.3.2). This legislation also provides provisions related to the protection of environmental, historic, and cultural values and resources. As such, the DTCP works collaboratively with other government sectors such as the DCF, the NPT, and the DDM.

Provisions of the Act also provide for the designation of Environmental Protection Areas (EPAs) by the Planning Authority. The DTCP does not currently have a process in place for designating EPAs, although this will be included in pending regulations to the Act (see Section 2.2.3.2 below and Section 8.6.2.4, Chapter 8).

The Department is responsible for physical planning for the territory as a whole. The most recent national Physical Development Plan was drafted by the DTCP in 2006, but, like its predecessors, it was never formally adopted by Government. In 2013, Government announced that a new National Physical Development Plan would be prepared for the territory by Town and Country Planning, with projected finalisation and completion of a 15-year plan in 2015 (see also Section 2.2.4.5).

The Department has also drafted a number of area development plans for the BVI, including Tortola, most of which have not moved beyond a detailed, final-draft phase. An exception is the Carrot Bay Community Development Plan (see **Box 4**).

The Department is currently working on a plan for Road Town, which area is also the focus of a planning initiative by the Ministry of Communications and Works (see Section 2.2.2.8 below). Two other Tortola-based area plans are currently in train—for Brandywine Bay and Smuggler's Cove/Belmont Pond—although neither was initiated by the Department of Town and Country Planning.

1. **Brandywine Bay**. The overall goal of this planning effort, being steered by the MNRL, is to commercialise the beach at Brandywine Bay on Tortola's southern shore, to the east of Road Town. At present, the plan is largely a "road plan," calling for realignment of the road that runs parallel to the beachfront, with a new public highway to be moved behind the existing road. The current road would then serve as a transportation link tied to development of the beach as an entertainment and recreational area. The proposed realignment requires purchase of private lands to accommodate the new public highway.

2. **Smuggler's Cove/Belmont Pond**. In 2005, the DTCP prepared a draft management strategy for the Smuggler's Cove/Belmont Pond area on the northwestern end of Tortola, an area with important historical artifacts and designated for future park status under the Protected Areas System Plan. However, in 2006 Smuggler's Cove became the focus of a government-approved resort development project, which ultimately failed. Government has now reacquired the land sold for development and has moved forward to reconstitute the area as a national park with beach amenities and provisions for vendors. The MNRL is spearheading planning for the site, but a development scheme presented to the public in 2013 was generally thought to be excessive and was sent back for revision and further communication, given strong public preference for minimal development of the area.

BOX 4

Carrot Bay Community Development Plan, 2010-2020

[*see also Section 8.5.2, Chapter 8*]

Carrot Bay is a coastal village with a strong tradition of agriculture located on the northwestern coast of Tortola, beneath the slopes of Sage Mountain National Park. Town and Country Planning's decision in 2010 to prepare a plan for the Carrot Bay watershed was predicated in part on the increasing volume of applications received by TCP from land owners in the watershed seeking to subdivide their plots. Such schemes however had the potential to encroach on areas long considered the Park's natural buffer zones or were located on unstable, environmentally sensitive or inaccessible land (*pers. comm*., Gregory Adams, Chief Physical Planner, DTCP, meeting with Judith Towle, 4 February 2014).

Carrot Bay is TCP's pilot community development plan (see also Section 8.5.2, Chapter 8) and is considered a template that can be used as a model for other communities, for example, at Cane Garden Bay, a village on Tortola's north side which has already initiated its own planning process (*pers. comm*., Dylan Penn, Deputy Chief Physical Planner, DTCP, 21 May 2014).

In the Carrot Bay Plan, a series of options for the future development of the area have been identified and evaluated, with existing and proposed land uses compared and major projects selected as priorities for design, costing and implementation. It is an ambitious scheme which required numerous community consultations and incorporation of community recommendations into the overall planning framework.

The Carrot Bay Community Development Plan (DTCP, 2012) has been approved by the Planning Authority and can therefore be used by the DTCP for planning purposes, although, to be binding, it requires Cabinet approval. The latter may not be forthcoming until remaining issues with landowners on steeper lands have been resolved (*pers. comm*., Dylan Penn, Deputy Chief Physical Planner, DTCP, 21 May 2014).

At stake is the difficulty of balancing the issue of development control, the issue of land ownership and property rights, and the issue of environmental impacts and risks. Some may feel the issues are too difficult to ever be fully resolved (short of Government purchase of private land holdings for incorporation into the Sage Mountain National Park). Nevertheless, the Community Development Plan is an excellent beginning and will provide a key reference point for evaluating subdivision applications and future development options for the Carrot Bay community.

What is notable about these two plans is that the point of origin is not the territory's planning agency (although the DTCP did play a role in their development). Planning initiatives such as these, which take place external to the framework of the planning process, have the potential to blur and even distort lines of communication and cooperation within the public sector, perhaps to the long-term disadvantage of plan development and plan implementation.

2.2.2.5 Department of Disaster Management (DDM)

The Department of Disaster Management originated under the legal authority of the Deputy Governor's Office in 1983 and became an independent department in 1990. It serves as the coordinating agency to mobilise the territory—including all sectors of government and civil society—in planning for and responding to hazards of all kinds. The Department seeks to ensure that adequate preparedness planning, mitigation measures, and response-and-recovery mechanisms are in place to counteract the impact of natural and technological hazards (*www.bviddm.com*).

The Governor of the BVI, who has overall responsibility for disaster management, serves as Chair of the **National Disaster Management Council** and has primary responsibility for pre-disaster and disaster-response activities. The Premier serves as Deputy Chair of the Council and is primarily responsible for recovery activities.

A National Disaster Development Plan (NDDP) was initially approved by the Executive Council (renamed Cabinet) in 1997. It was updated and approved in 2009, and now includes hazard indices and a new disaster organisational structure. A Comprehensive Disaster Management Strategy and Programming Framework, 2014-2018, has been approved by Cabinet (see Section 2.2.4.8).

Additionally, assessing hazard potential has been incorporated by the DDM into the development review process, but such assessments, coupled with the identification of vulnerability reduction strategies, are usually only carried out for private sector development projects.

The legislative authority for the Department is the Disaster Management Act (2003), which was revised and updated in 2011 and is currently before the House of Assembly for approval. Regulations in support of the Act have been completed and will be sent to Cabinet upon passage of the revised Act. The new legislation provides for streamlining comprehensive disaster management in the territory, improved emergency response by government, and enhanced governance (*pers. comm.*, Sharleen DaBreo, Director of Disaster Management, 11 October 2012).

2.2.2.6 Ministry of Health and Social Development

Two units of government within the Ministry of Health and Social Development have environment-related responsibilities: the **Department of Waste Management** (formerly the Department of Solid Waste) with responsibility for solid waste (see Chapter 7, Section 7.1.2.2 for details on the DWM) and the **Division of Environmental Health** with responsibility for environmental pollution control as related to public health.

Under the Public Health Ordinance (1967), regulations were authorised to prevent, abate, and control environmental pollution. However, the Division of Environmental Health is hindered in addressing these issues because this ordinance is so outdated, while the regulations authorised in the legislation were never prepared.

This means that major environmental health issues such as groundwater pollution, the disposal of hazardous materials, the discharge of untreated sewage into coastal waters, or harmful waste management practices cannot at the present time be fully regulated. Like the Department of Conservation and Fisheries, which is hampered in effectively monitoring coastal waters because of the lack of approved water quality standards, the Division of Environmental Health is also obstructed by the lack of legislated environmental health standards. The Division's recent Annual Reports indicate that it has long relied on the employment of contract officers and that this will continue until greater proficiency in recruiting and training BVI nationals in the field of environmental health is achieved.

2.2.2.7 Tourist Board (TB)

The mandate of the Tourist Board is laid out in the BVI Tourist Board Ordinance (1969), which divides the Board's role into two functional areas: (1) marketing and (2) product development and quality assurance. According to the most recent Tourism Development Strategy, 1996-2005 (Coopers & Lybrand, 1996), marketing has been the dominant activity of the Board, taking precedence over other functions. An updated national tourism strategy is currently being developed by the Premier's Office, whose Minister serves as Minister of Tourism.

"Green tourism" is providing a new marketing platform for the BVI, and a position for an environmental officer was recently created at the TB to assist with this commitment. Green tourism initiatives currently fall under the Tourist Board's Sustainable Tourism Environmental Programme (STEP).

Among other strategies, this programme promotes the environmental certification of hotel properties in the BVI under the Green Globe international certification standard. Of three BVI pilot properties certified under Green Globe (two in Tortola and one in Virgin Gorda), one property has renewed its certification, one has indicated its intention to do so, and a third has opted out of the programme (*pers. comm.*, Victorene Creque, Product Development Manager, TB, 5 February 2014).

There are presently no plans to extend the STEP pilot programme to other properties (*ibid*., Victorene Creque), although there are hotels and resorts striving to maintain the Green Globe standards even though they are not formally certified. Properties such as the Peter Island Resort & Spa and the Cooper Island Beach Club have adopted significant environmentally friendly operational practices but have not been formally certified.

The Tourist Board also actively encourages and supports clean-up events and activities throughout the territory, in part, in response to the blight of unsightly litter and illegal waste dumping that is obvious in all of the major islands, but in particular in Tortola. Many such clean-up campaigns are sponsored or co-sponsored by the Tourist Board, which also maintains a calendar of such events.

The BVI Protected Areas System Plan, 2007-2017 (see Section 2.2.4.6) calls for a more structured relationship and lines of coordination between the development of tourism (via the Tourist Board) and the promotion of parks and other protected areas (via the National Parks Trust). Since approval of the System Plan in 2008, a more formal approach to promoting protected areas in tourism planning has not yet been put in place, although the appointment of a TB environmental officer is designed to improve coordination between the Tourist Board and the environmental agencies of government. A marine recreational officer has also been appointed to liaise between the TB and the territory's marine recreation sector.

A 2013 study authorised by the Ministry of Natural Resources and Labour and carried out by a team of Dutch researchers highlighted the value of the environment to the Territory's tourism industry. Researchers reported that BVI ecosystems generate at least $194 million per year in tourism revenues (Sipos, *et al*., 2014). These academic findings reinforce the need for a coordinated and collaborative approach to tourism and the environment in the BVI; they also substantiate an idiom often put forward by the territory's current Minister of Natural Resources, the Honourable Dr. Kedrick Pickering, namely, that there is no tourism without the environment.

2.2.2.8 Ministry of Communications and Works (MCW)

The **BVI Electricity Corporation (BVIEC)** is a statutory body under the Ministry of Communications and Works charged with the exclusive right to generate electrical power in the territory. The Electricity Corporation Ordinance of 1978 has for many years been the target of efforts to effect its revision and encourage the development of renewable energy in the Virgin Islands. A virtual monopoly on the production of energy was granted under the Ordinance to the Electricity Corporation and has prevented the provision of renewable energy as a primary power source in areas serviced by the BVIEC. A number of private businesses and resorts have experimented with non-fossil-fuel sources of energy such as solar and wind, but only as a backup or secondary source to electrical power provided by the Electricity Corporation.

This has been a case of legislative authority not keeping pace with technological advances, primarily because the generation and supply of renewable energy sources has not been supported under the law. Only recently, in March of 2015, has Government responded by amending the Electricity Corporation Ordinance (see Section 2.2.3.5).

Although revision of the outdated legislation has been slow, the BVI Government has recognised the need to encourage development of alternative energy approaches. To this end, Government has adopted an Energy Conservation and Renewable Energy Strategy which seeks to ensure that by 2023 the territory will supply almost half of its energy needs from renewable sources (see Section 2.2.4.11).

The **Department of Water and Sewerage (DWS)** also falls under the portfolio of the Ministry of Communications and Works. Consideration has been given to a merger of the BVI Electricity Corporation and the DWS, using a model established in the neighbouring US Virgin Islands where an independent body, the Water and Power Authority, has long managed both water and power supplies in the US territory. However, according to the Ministry, a proposed merger in the BVI is no longer under discussion as studies have found it is not a viable financial model (*pers. comm*., Anthony McMaster, Permanent Secretary, MCW, 23 May 2014).

Currently 80 percent of the potable water in the BVI is subsidised by Government through the operation of desalination plants, the highest such subsidy level in the Caribbean (*ibid*., Anthony McMaster). In an effort to improve the increasingly inadequate supply of water in the territory, in 2010 the BVI Government signed a contract with a UK-based company, Biwater, in which Biwater agreed to provide 2.3 million imperial gallons of potable water for the Virgin Islands and to rehabilitate the territory's dilapidated sewerage system.

Biwater fell behind its contractual schedule when it could not locate water sources it had assumed were available in wells at Paraquita Bay, and the company needed to pursue an alternative plan to source water directly from the sea at Paraquita Bay. In addition to the plant at Paraquita Bay, there is a Government plant at Baugher's Bay on Tortola and three privately operated desalination plants at Bar Bay, Cappoon's Bay, and Sea Cow's Bay (*pers. comm*., Devlon Joseph, Department of Water and Sewerage, 26 February 2015).

The Ministry is also spearheading a Main Street Improvement and Historic Restoration Project which focuses on the territory's capital city, Road Town. The project is designed to promote the historic importance of Main Street (**Photo 17**) and revitalise the environment for business in Road Town through a series of improvements to infrastructure and amenities. A **Road Town Development and Management Committee** was established at the end of 2013 to work with the Ministry and consultants, with the intent that when enabling legislation has been enacted, the Committee will evolve into a statutory board to support the Road Town City Manager.

Photo 17.
Main Street, Road Town, Tortola
(*Source*: *www.bvitourism.com/activity/main-street*).

2.2.2.9 Development Planning Unit (DPU)

The DPU was created in 1974 under the Ministry of Finance. The Unit was directed to provide statistical information, economic analysis and recommendations to the public sector to facilitate strategic planning and policy formulation. In 1999, the Unit drafted a National Integrated Development Plan, the first formal attempt at national integrated planning in the Virgin Islands (see also Section 2.2.4.3).

The DPU was initially a data collection unit but assumed a broader development planning function when reorganised in 1974. However, as a result of a Cabinet decision in 2012, the planning function of the DPU has been separated from its statistical data collection function, reassigning the planning function to the Ministry of Finance and reconstituting the DPU as the **Central Statistics Office** (CSO) in 2014.

One of CSO's primary responsibilities is the national census, which is carried out once every ten years. The timely assemblage of data for the 2010 census was hampered by human resource constraints and lack of data automation within the unit, according to the DPU's annual reporting to the HOA.

At the present time, no statistical data are collected on numbers of visitors to national parks and other natural amenities. While exit surveys have attempted to compile tourism data, they have focused on tourism expenditures rather than amenities visited (pers. comm., Raymond Phillips, DPU Director, 28 January 2014). A 2012 survey executed by the Tourist Board did not include data on visitation to national parks or environmental amenities. Only one question in the survey focused on the environment, and this was a general question related to the interviewee's perception of the environmental quality and cleanliness of the BVI (*pers. comm*., Victorene Creque, Product Development Manager, Tourist Board, 5 February 2014).

2.2.3 Environmental Legislation

Every person has the right to an environment that is generally not harmful to his or her health or well-being and to have the environment protected, for the benefit of present and future generations, through such laws as may be enacted by the Legislature including laws to (a) prevent pollution and ecological degradation; (b) promote conservation; and (c) secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.

Virgin Islands Constitution Order, 2007

A number of BVI legal and regulatory instruments are related to the protection and management of the environment. These are outlined in **Table 15** along with certain global treaties and regional agreements that pertain to the BVI. Key national laws are reviewed in the following sub-sections along with pending legislative initiatives related to the environment.

2.2.3.1 Fisheries Act (1997) and Regulations (2003)

The purpose of this legislation is to make provision for the promotion, management and conservation of fisheries resources in the territory. The Department of Conservation and Fisheries within the Ministry of Natural Resources and Labour (see Section 2.2.2.1) is the principal agency responsible for implementation of the Act.

The legislation authorises actions with respect to the conservation of fish and protection of the marine environment. Under the Act, the Minister may establish marine protection zones, and, pursuant to the Act, 14 Fisheries Protected Areas have been declared under the 2003 Regulations.

In August 2011, a ruling by the Court of Appeal of the Eastern Caribbean Supreme Court effectively invalidated the fisheries protected areas system established under the Fisheries Act and the Regulations thereto. In the case of Quorum Island (BVI) Limited and the Virgin Islands Environmental Council and the Minister of Planning (HCVAP 2009/021), it was found that protected areas established under the Fisheries Regulations (2003) had not been correctly declared. Following the ruling, the claimant in the court case, the Virgin Islands Environmental Council, lamented that "the ruling undermines confidence in legislation for environmental protection in the BVI" (*www.bviplatinum.com*, 17 August 2011). See also Chapter 8, Box10.

Since the ruling, all marine protected areas have now been correctly gazetted. According to an environment officer within the MNRL (*pers. comm.*, Tessa Smith-Claxon, 3 February 2014), the problem occurred because the sites were originally listed in a Schedule to the Regulations and then gazetted, rather than issued as Orders and then gazetted.

Under the Fisheries Act, the Minister also has broad authority to take measures to prevent, reduce and control pollution of fishery waters and the marine environment from any source, including measures to minimise the release of toxic, harmful or noxious substances from land-based sources.

The Act also authorises the Minister to declare by Order any type of fish as a "protected species," for a defined period of time or a specific protected area. Pursuant to this authority, the Fisheries Regulations prohibit disturbing or interfering with turtle eggs, turtle nests, and any turtle that is nesting.

In May of 2014, Cabinet approved the Shark Sanctuary Fisheries (Protected Species) Order. It prohibits fishing for sharks and rays within territorial waters as well as the sale and trade of shark and ray species.

2.2.3.2 Physical Planning Act (2004)

The Physical Planning Act, No. 15 of 2004 (enacted in March 2005), provides for the orderly development of land in the territory. The responsible minister is the minister for physical planning, currently the Premier, under whose portfolio the Department of Town and Country Planning is assigned (see Section 2.2.2.4).

Table 15.
BVI legal and regulatory instruments related to the environment.

NATIONAL LEGISLATION		
PLANNING AND DEVELOPMENT CONTROL	***Physical Planning Act*** (2004) (Regulations currently being drafted)	See Section 2.2.4.2 for details.
COASTAL RESOURCES	***Fisheries Act*** (1997) ***Fisheries Regulations*** (2003)	See Section 2.2.4.1 for details. See Section 2.2.4.1 for details.
	Beach Protection Act (1985)	The Act requires a permit for dumping on and removal of material from the foreshore and removing any natural barriers against the sea. It is outdated and does not provide regulations or a policy framework for beach management.
AGRICULTURE	***Protection of Trees and Conservation of Soil and Water Ordinance*** (1954/1965)	Authorises designation of protected forest areas, protected water areas and protected trees. Seven protected areas have been established under this Ordinance, all on Tortola.
PROTECTED AREAS	***National Parks Act*** (2006) ***National Parks Regulations*** (2008)	See Section 2.2.4.3 for details. See Section 2.2.4.3 for details.
WILDLIFE	***Wild Birds Protection Ordinance*** (1954)	The law protects listed birds, their eggs, nests, and young throughout the territory. Bird Sanctuaries Orders in 1959 and 1977 designated 20 bird sanctuaries in the territory, seven of which are located on cays surrounding Tortola.
	Turtles Ordinance (1959)	The Ordinance protects turtles from being disturbed or taken during nesting periods and prohibits the taking of turtle eggs, but does not address general protection of habitat for turtle nesting or feeding grounds.
	Protection of Endangered Animals, Plants, and Articles (Removal and Possession) Ordinance (1981)	This law was enacted to prohibit removal of listed corals without a license; it does not address protection of coral reefs *in-situ*. Needs updating to conform to species on IUCN's Red List and with CITES; needs to add locally important species.
POLLUTION CONTROL	***Public Health Ordinance*** (1967)	Authorises regulations to prevent, abate, and control environmental pollution. Environmental pollution is not defined, and regulations providing environmental standards have not been enacted.
	Litter Abatement Act (1987) (amended in 2004 and 2009)	Authorises appointment of litter wardens to issue warnings and tickets to violators of the litter law.
NATURAL HAZARDS	***Disaster Management Act*** (2003) (*updated bill, 2011, pending in the HOA*)	Provides legislative authority for disaster management in the territory.

NATIONAL POLICY AGREEMENTS		
ENVIRONMENTAL SUSTAINABILITY	***St. George's Declaration of Principles for Environmental Sustainability in the OECS*** (July 25, 2001)	The Declaration was signed by the Chief Minister, on behalf of the Government, in 2001. The document contains 21 Principles and recognises, among other things, the need for an integrated approach to managing land and marine areas as a single unit. (See also Section 2.2.4.1.)
ENVIRONMENTAL SUSTAINABILITY	***British Virgin Islands Environment Charter*** Signed by UK and BVI Governments (September 26, 2001)	Guiding principles for the UK and BVI Governments, and commitments by both governments (Section 2.2.4.2).
REGIONAL TREATIES		
MARINE ENVIRONMENT	***Cartagena Convention***, commonly known as the **Caribbean Regional Seas Agreement**, came into force in 1986 and was extended to the BVI in 1987 Two protocols adopted under the Convention define further obligations of the Contracting Parties:	The Convention encourages Contracting Parties to undertake agreements and protocols for the protection of the marine environment in the region.
	1) ***Protocol Concerning Specially Protected Areas and Wildlife*** (commonly known as ***SPAW***)	Creates a general obligation to protect, preserve and manage threatened or endangered species of flora and fauna in a sustainable way. Requires Parties to take actions to prevent species from becoming endangered or threatened.
	2) ***Protocol Concerning Pollution from Land-based Sources and Activities*** (commonly known as ***LBS Protocol***)	"Land-based sources and activities" are defined to include pollution from coastal disposal or discharges emanating from coastal establishments and outfall structures. Parties to the Convention have a general obligation to prevent, reduce and control pollution from land-based sources and activities using the best practical means and in accordance with capabilities.
GLOBAL TREATIES		
BIODIVERSITY	***Convention on Biological Diversity*** (1992), extended to the BVI in 1994	The Convention contains a series of far-reaching obligations related to the conservation of biological diversity and the sustainable use of its components.
WETLANDS	***Convention on Wetlands of International Importance especially for Waterfowl Habitat*** (1971), also known as **Ramsar**	This international Convention was extended to the BVI in 1999 with the acceptance by the Ramsar Secretariat of the BVI's application to list the Western Salt Ponds of Anegada as a "wetland of international importance especially for waterfowl." One of the obligations triggered by the Convention is that the BVI promote wise use of all wetlands within the territory.

MIGRATORY SPECIES	***Convention on Migratory Species*** (1983), also known as the **Bonn Convention**, extended to the BVI in 1985	The Parties to the Convention acknowledge the importance of migratory species being conserved and the need to take action to avoid any migratory species becoming endangered.
LAW OF THE SEA	***United Nations Convention on the Law of the Sea*** (1982) Convention came into force in 1994, was ratified by the UK and extended to the BVI in 1997	Part XII of the Convention ("Protection and Preservation of the Marine Environment") sets out a fundamental obligation for the BVI to protect and preserve its marine environment, and to take all measures necessary to prevent, reduce, and control pollution of the marine environment from any source.
TRADE IN ENDANGERED SPECIES	***Convention on International Trade in Endangered Species of Wild Fauna and Flora* (CITES)** Convention entered into force in 1975 Extended to BVI in 1976	An international agreement to protect endangered species from exploitation due to trade. The Convention requires national legislation as it is not self-executing. The BVI's *Protection of Endangered Animals, Plants, and Articles Ordinance is outdated* and does not fully comply as CITES legislation. The BVI is currently developing new legislation on trade in endangered species to comply with CITES.

The Act calls for the establishment of a statutory body, the Planning Authority. This body has the ultimate authority to approve development projects with the exception of tourism projects valued at over ten million dollars, in which case the minister's decision shall prevail.

The Physical Planning Act governs the environmental impact assessment (EIA) process for development activities in the territory. Schedule 3 outlines the circumstances that will require an EIA, and, pursuant to the Act, the DTCP has designed an Environmental Screening Form to be submitted with development applications. The form requires sufficient information for the department to determine if an EIA will be required and, if so, what level of EIA is necessary. A Hazard Vulnerability Assessment is also required. Additionally, the department has developed a matrix outlining the development application process with step-by-step procedures and a timeline.

At present, no Regulations to the Act have been issued, although these uniform controls and regulatory procedures are necessary to guide all parties—public and private—when taking action under the Act. In 2011, Government committed to strengthening the Act by introducing requisite regulations to replace the Land Development Control Guidelines (1972) and to address procedures for environmental impact assessments, the regulation of land sub-division, and the preservation of buildings and other important sites. An initial contract for drafting regulations was issued in 2012 with funding provided by the Department of Disaster Management. At this writing, it is anticipated that complete draft Regulations will be ready in the near-term for consideration by Government.

One area that needs to be reinforced in the Regulations is the applicability of the EIA requirement for government-sponsored projects as well as those in the private sector. The Act binds the Crown and therefore, intrinsically, all development activity—whether public or private—is subject to the same requirements.

Like most small places, the BVI cannot afford the consequences and costs associated with inopportune planning decisions and the failure to assert sound development control. It can be argued that the importance of planning decisions is inversely related to a country's size—primarily because there is so little margin for error (Towle, 1991). This is why the promulgation and timely implementation of Regulations to the BVI's Physical Planning Act are critical to full and effective execution of the Act.

2.2.3.3 National Parks Act (2006) and Regulations (2008)

The BVI's new National Parks Act and Regulations provide a forward-looking framework for protected area management in the territory. The new legislation updated the original National Parks Act of 1961, which established the National Parks Trust as a statutory body to manage parks and protected areas in the BVI (see Section 2.2.2.2).

The legislation incorporates modern concepts of protected area management, including an internationally recognised system of categories for designating protected areas (see Chapter 8, Table 46). The Act also incorporates provisions of international conventions to which the BVI is a party, such as the Convention on Biological Diversity (see Table 15).

The Act strengthens enforcement provisions and updates penalties. It also promotes environmental assessments of proposed development activities that occur outside designated parks but may impact the parks, especially in areas adjacent to a protected area, so-called "buffer zones."

The Act also includes provision for the management of historical sites by the NPT, provides guidance on management planning for protected areas, and specifically requires the preparation of a protected areas system plan, which was prepared by the Trust in 2007 and approved by Cabinet in 2008 (see Section 2.2.4.6).

2.2.3.4 Climate Change Trust Fund Act (2015)

As part of implementation of the territory's Climate Change Adaptation Policy (see Section 2.2.4.9) Government drafted legislation for a Climate Change Trust Fund in 2014 to provide a framework for funding activities that confront the impacts of climate change. The bill was enacted in March 2015, making the BVI the first Caribbean territory to establish a policy and financing framework for addressing the causes and impacts of climate change.

The Act calls for the establishment of a Trust Fund to raise annual funds through a variety of internal fees and taxes and external funding sources. The Board of Trustees of the Trust Fund will be responsible for managing the funds and for awarding grants, guided by recommendations from a Review Committee and based on priorities set by the Climate Change Committee (see Section 2.2.4.9).

While in draft form, the Act was the subject of a series of stakeholder consultations both within and external to Government. Major issues arising were focused on revenue sources, particularly the imposition of new taxes and fees (some of which will fall on visitors to the BVI), and on the level of government involvement in the management of the Trust Fund. Steps are being taken to ensure broad non-government participation in the management of the Trust Fund (*pers. comm*., Tessa Smith-Claxton, Environment Officer, MNRL, 20 May 2014).

When the Trust Fund Act is fully implemented, the BVI will find itself considerably ahead of many small island developing states in providing a mechanism to fund and address the impacts of climate change, according to officials from the Caribbean Community Climate Change Centre (*www.bvibeacon.com*, 8 May 2014).

2.2.3.5 BVI Electricity Corporation Ordinance Amendment (2015)

Recognising the BVI's dependency on imported fossil fuels—with primarily diesel and gasoline supplying approximately 99 percent of total energy needs— in mid-2013 Government reported that it was drafting new energy legislation that would open the BVI to renewable energy sources for the first time in its history. Without a legislative change, BVI businesses and residents have not been able to take advantage of contemporary alternative energy sources, and the monopoly enjoyed by the BVI Electricity Corporation as the sole source of energy in the territory has remain unchanged since the 1970s. For several decades, BVIslanders have been able to implement renewable energy strategies such as the use of solar water heaters or LED lighting, but the use of solar or other alternative energy sources could not be employed as a power source.

The March 2015 amendment to the Electricity Corporation Ordinance now allows individuals and companies to generate energy from nine designated sources: wind, solar, hydro, biomass, bio-fuel, landfill gas, sewage gas, geothermal energy, and ocean energy. Prior to the amendment, only the BVIEC was authorised to produce energy for the territory's electrical grid. Now, licensed consumers, generating power with renewable energy, will be able to sell their excess energy back to the BVIEC.

2.2.3.6 Environmental Management and Conservation of Biodiversity Bill

Since early in this century, Government has considered a more comprehensive approach to environmental protection and management. In 2008, and arising in part from the UK Government's concern that its Overseas Territories were not in compliance with the provisions of CITES (see Table 15), the BVI Law Reform Commission drafted a framework for environmental management in the BVI. The Commission's report (titled *Environmental Management and Conservation of Biodiversity Reform*) was submitted to Cabinet, but no further action was taken.

A proposed new law, also drafted in 2008, intended to bring together many public sector environmental responsibilities—particularly those identified with the DCF and the NPT—under a single new management authority, tentatively called the Environmental Management Trust (EMT). This agency would have replaced both the Department of Conservation and Fisheries and the National Parks Trust.

Moreover, the current Chief Conservation and Fisheries Officer would become the first director of Conservation and Fisheries within the Environmental Management Trust, and the current director of the National Parks Trust would become the first Director of National Parks within the EMT, while the current board of the NPT would become the first board of the EMT. The provisions of the Fisheries Act and Regulations and the National Parks Act and Regulations were to be retained.

However, more recent thinking within Government precludes the management structure proposed in 2008, primarily because of the human resource difficulties inherent in the merging of an independent statutory body (the NPT) with a line department of the central government (the DCF) (*pers. comm.*, Ronald Smith Berkeley, Permanent Secretary, MNRL, 6 February 2014).

The 2008 draft legislation called for the territory to deal more effectively with the conservation of biodiversity as well as BVI obligations under multilateral environmental agreements (see Table 15). The use of "biodiversity" in the bill's title was somewhat misleading for the Environmental Management and Conservation of Biodiversity Bill, 2008 addressed a wide range of environmental management and environmental protection issues, including pollution control and coastal zone management.

The need for a comprehensive change in the way the BVI's environment is managed—as first envisioned in 2008—reemerged in 2014-2015, and Government is once more drafting legislation to enable holistic environmental management in the territory. At this writing, Government anticipates completing draft legislation by mid-2015. Funding for the redrafting is being provided under the Global Climate Change Alliance (GCCA) Project on Climate Change Adaptation and Sustainable Land Management in the Eastern Caribbean (*pers. comm.*, Angela Burnett Penn, Environment Officer, DCF, 19 March 2015).

2.2.3.7 Other Legislative Initiatives

Although important legal tools for environmental management have been established in the BVI, many challenges remain. For example:

- The Physical Planning Act requires regulations, which are now being drafted; until these are approved ***and implemented***, much of the law will operate as legislated guidelines rather than as enforceable policy.
- The area of pollution control needs to be strengthened, particularly critical given the BVI's rapid-paced development and

geographical and geological challenges for pollution control.

- There is limited legal authority for protecting wildlife, critical ecosystems or habitats outside of formally protected areas.
- No comprehensive policy, authority, or legal framework exists for the management of the coastal zone.

Many of these gaps in the legislative framework may well be addressed in forthcoming environmental management legislation (Section 2.2.3.6).

2.2.4 Environmental Policy

In addition to the units of Government tasked with primary environmental responsibilities and the legal framework comprising the territory's extant environmental legislation, a number of national policy agreements and planning documents are available to strengthen the objectives of environmental protection and resource sustainability.

Primary among these are the following, which are reviewed in more detail in the sections that follow:

1. **ST. GEORGE'S DECLARATION OF PRINCIPLES FOR ENVIRONMENTAL SUSTAINABILITY IN THE OECS**
2. **BRITISH VIRGIN ISLANDS ENVIRONMENT CHARTER**
3. **NATIONAL INTEGRATED DEVELOPMENT PLAN**
4. **NATIONAL ENVIRONMENTAL ACTION PLAN**
5. **NATIONAL PHYSICAL DEVELOPMENT PLAN**
6. **PROTECTED AREAS SYSTEM PLAN**
7. **NATIONAL TOURISM DEVELOPMENT STRATEGY**
8. **COMPREHENSIVE DISASTER MANAGEMENT POLICY**
9. **CLIMATE CHANGE ADAPTATION POLICY**
10. **BEACH MANAGEMENT FRAMEWORK**
11. **ENERGY CONSERVATION AND RENEWABLE ENERGY STRATEGY**
12. **SOLID WASTE MANAGEMENT STRATEGY**
13. **CARIBBEAN CHALLENGE INITIATIVE**

2.2.4.1 St. George's Declaration

On 25 July, 2001, the BVI Chief Minister signed the St. George's Declaration of Principles for Environmental Sustainability in the OECS (OECS, revised 2006). This document contains 21 Principles which, among other things, recognise the need for an integrated approach to managing land and marine areas as a single unit.

The St. George's Declaration also supports:

(1) The Rio Declaration on Environment and Development, adopted at the UN Conference on Environment and Development in Rio de Janeiro in June of 1992.

(2) The decisions in the Barbados Declaration adopted at the UN Global Conference on the Sustainable Development of Small Island Developing States held in Barbados in 1994.

By virtue of the BVI Government having signed the St. George's Declaration, the territory is also bound by the principles stated therein.

2.2.4.2 British Virgin Islands Environment Charter

A second policy agreement—the BVI Environment Charter—was signed in 2001 by the BVI Government and the UK Government and provides guiding principles in the area of the environment. It is a document that denotes the shared environmental responsibilities of the two governments.

Ten principles are set out in the Environment Charter and have been agreed to by the UK and BVI Governments, including:

- To use the natural resources of the BVI wisely, being fair to present and future generations (#2).
- To identify environmental opportunities, costs and risks in all policies and strategies (#3).

- To aim for solutions that will benefit both the environment and development (#5).
- To safeguard and restore native species, habitats and landscape features, and control or eradicate invasive species (#7).
- To encourage activities and technologies that will benefit the environment (#8).
- To control pollution, with the polluter paying for prevention or remedies (#9).

Additionally, the BVI Government has committed to eleven specific actions under the Charter, including:

- To ensure the protection and restoration of key habitats, species and landscape features through legislation and appropriate management structures and mechanisms (#2).
- To ensure that environmental considerations are integrated within social and economic planning processes (#3).
- To ensure that environmental impact assessments are undertaken before approving major projects (#4).
- To commit to open and consultative decision-making on developments and plans which may affect the environment, and to ensure that environmental impact assessments include consultation with stakeholders (#5).
- To implement effectively obligations under the Multilateral Environmental Agreements already extended to the British Virgin Islands (#6).
- To review the range, quality and availability of baseline data for natural resources and biodiversity (#7).
- To ensure that legislation and policies reflect the principle that the polluter should pay for prevention or remedies and establish effective monitoring and enforcement mechanisms (#8).

We do not know the extent to which the Environment Charter—to which the two Governments have committed—has been actively consulted in executing policy or legislation or other environmental decisions in the BVI. We do know, however, that in a 2010 case from the Eastern Caribbean Supreme Court (*Webster et al v. Attorney General [Anguilla] and Dolphin Discovery*✦), the Court found that the commitments included in the Environment Charter are legal obligations. As more recently stated by the Ombudsman for Bermuda, "… the Charter constitutes Government policy … [and] the public has a legitimate—legal—expectation that Government will implement its own policy."♦ In other words, the Environment Charter has been found to constitute a binding agreement in the UK Overseas Territories.

Nevertheless, it has been over a decade since the Charter was signed by the BVI and the UK, and in the interim, according to former BVI Governor W. Boyd McCleary, the Charter may no longer be the primary document for coordinating UK/BVI environmental action (*pers. comm*., 29 January 2014). Rather, the Governor anticipates that Communiqués from the Overseas Territories Joint Ministerial Council will provide more up to date guidance, although it is noted that the Communiqué of 26 November 2013, which focused in part on green energy and the environment, did also reaffirm the Council's commitment to implementing the Environment Charters. According to Governor McCleary, the environment chapter in the 2012 Overseas Territories White Paper (UK FCO, 2012) will also be utilised as a primary document for cooperation between the UK and the OTs.

Of even more importance perhaps is an Environmental Audit Committee Report from the House of Commons (dated 8 January 2014), which found that the United Kingdom needed to do more to protect the biodiversity of its Overseas Territories. Glaringly, the 16 Members of Parliament who comprise the Committee stated that the UK Government "is prepared to exercise hard and soft power in relation to financial matters in the UKOTs, but it is apparently not prepared to exercise those powers to protect

✦ *http://www.danielbrantley.com/files/DD%20caribbean%20judgment.pdf*

♦ *http://www.ombudsman.bm/images/pdfs/press_releases/Press%20Release%20May%202013%20UK%20Environ%20Charter.pdf* biodiversity and to promote environmental sustainability" (UK House of Commons, 2014).

Furthermore, the report found that while the Environment Charters were a key development resulting from a 1999 White Paper defining the UK's relationship with its OTs, a subsequent White Paper in June 2012 (UK CFO, 2012) missed an opportunity to include policy detail on the environment of the OTs. This despite the fact that the UK had failed to ensure accurate monitoring of biodiversity in the Overseas Territories or to effectively include OTs in reporting under the Convention on Biological Diversity (CBD)♦ in the 13 years between the two White Papers. It is estimated that the OTs contain approximately 90 percent of all of the UK's biodiversity.

The Audit Committee report calls on the UK to fulfill its core environmental obligations to the UN under the CBD "in order to maintain its international reputation as an environmentally responsible nation state." Presumably, many of the recommendations contained within this report will constitute a framework for the ongoing environmental responsibilities of both the UK and the BVI Governments.

2.2.4.3 National Integrated Development Plan, 1999-2003 (NIDP)

The National Integrated Development Strategy (NIDS) was adopted by Government to promote the sustainable development of the territory; it covered the five-year period from 1999-2003. The National Integrated Development Plan (NIDP) was a major output of the NIDS and was prepared by the Development Planning Unit (DPU) of Government in 1999. Since the BVI does not have a national development plan, the NIDP provides many of the elements of such a planning instrument. It represents the first formal attempt at national integrated planning for the Virgin Islands.

Although it prepared the NIDP, the DPU had no coordinating role in implementation, and individual ministries and departments were responsible for implementing the strategies incorporated in the report. It was to have been a "living document" that would be updated every five years. While the NIDP was approved by Government, it was never fully executed; and because there were no reporting requirements by the departments and agencies of government, it became impossible to know what progress was being made in implementation (*pers. comm.*, DPU Director Raymond Phillips, meeting with Judith Towle, 28 January 2014).

In the intervening years, successive governments have not followed up the longer-term, more strategic approach to development planning that was represented by the NIDP. Instead, shorter-term development strategies linked to shorter-term budgeting cycles have been adopted. These, in part, reflect political manifestos that are not necessarily focused on longer-term, integrated national planning. It is noted that national development planning as a function of government has recently been moved from the Development Planning Unit to the Ministry of Finance and the DPU has been refashioned as a Central Statistics Unit (see also Section 2.2.2.9).

2.2.4.4 National Environmental Action Plan (NEAP)

The BVI developed a National Environmental Action Plan (NEAP) in 2004 as an attempt to provide a rational framework within which the environment of the territory could be managed in a responsible and sustainable manner (DCF, *et al*., 2004). The Plan was the product of a collaboration of a number of government agencies and others external to the public sector, coordinated by the Department of Conservation and Fisheries with the technical support of the Department of Town and Country Planning and two consulting companies.

The process was funded by the UK Foreign and Commonwealth Office (Department for International Development) and was prepared—according to the Plan's authors—as "part and parcel" of the National Physical Development Plan and National Integrated Development Strategy, in order to

♦ When the CBD was ratified by the UK in 1994, ratification was extended to three UKOTs, including the British Virgin Islands. Since that time, no UKOT has completed the necessary preparations to join the CBD, including the British Virgin Islands (UK House of Commons, 2014).

ensure the integration of environmental concerns in the national development planning process.

The NEAP was not approved by Cabinet, and its objectives and recommendations exist now primarily as a guide and planning tool for environmental action. Since there has been no formal implementation or follow-up, as time passes and particularly as the Climate Change Adaptation Policy moves to the forefront (see Section 2.2.4.9), the decade-old NEAP is likely to be less and less relevant.

2.2.4.5 National Physical Development Plan (NPDP)

National physical development planning has long been a responsibility of the Department of Town and Country Planning. Over time, the Department has prepared several National Physical Development Plans (NPDPs) to guide land use planning and development control in the territory.

The most recent drafts were prepared by DTCP in 1996 and 2006. Although no plan has been formally adopted by Government to date, the NPDP is used as a framework for area development planning by the department and a guide for development control decision-making in the territory.

In mid-2013, Government announced its intention to prepare a new National Physical Development Plan to guide the territory's development until 2030. The Plan is to be completed under the direction of Town and Country Planning, with a projected completion date in 2015. The Department will not increase in-house staff to take on this major assignment but will award a consultancy for external planners to undertake the work, assisted by a technical advisory committee comprised of representatives from across government agencies. Oversight monitoring and guidance will be provided by a public-private sector steering committee (*pers. comm*., Gregory Adams, Chief Physical Planner, 4 February 2014).

The new NPDP will build on the earlier 2006 effort, which means that a baseline of information is already available. The Plan will be policy-oriented, comprising a series of planning scenarios that reflect a good deal of fluidity and are dependent on circumstances that evolve over the 15-year life of the Plan (*pers. comm*., Dylan Penn, Deputy Director, DTCP, 21 May 2014).

The Chief Physical Planner stated in November of 2014 that the BVI confronts two primary planning challenges: the lack of a comprehensive land use plan and illegal development throughout the territory. As a result, planning decisions continue to be made on an *ad hoc* basis or based on traditional land use patterns (Gregory Adams quoted in Government press release, 3 November 2014).

2.2.4.6 Protected Areas System Plan, 2007-2017

The Protected Areas System Plan 2007-2017 was approved by Cabinet in 2008 and integrates in one plan all protected areas in the BVI, regardless of whether such areas are a part of the national park system. As such, the Plan provides an overall policy framework for the development and management of protected areas and sites in the Virgin Islands. (See also Section 8.2.4(1), Chapter 8.)

The first System Plan was prepared in 1981 with the assistance of the Eastern Caribbean Natural Areas Management Programme (ECNAMP); it was subsequently revised in 1986. The current System Plan (Gardner, *et al*., 2008) was prepared by the NPT in 2007 with the assistance of Island Resources Foundation under a grant from Laurance S. Rockefeller for the Sandy Cay Development Programme. It was approved by Cabinet in 2008.

The National Parks Trust is responsible for preparing and updating the System Plan as per the provisions of the National Parks Act (2006). The current System Plan includes, among other things, a statement of priorities for protected areas management during the ten-year period covered by the Plan and a process for evaluating progress in the development of the protected areas system.

2.2.4.7 National Tourism Development Strategy, 1996-2005

With an opening reference to the fact that "tourism has come of age in the BVI," the National Tourism Development Strategy, 1996-2005 (prepared by

Coopers & Lybrand Consulting in 1996) identified five guiding principles upon which the BVI's vision for tourism development would be built. The first of these is "the environment," which, according to the strategy, is essential in order:

> *... to develop and manage the tourism sector in harmony with the physical environment and in accordance with the principles of the carrying capacity of the environment.*

The statement recognises the dependency of the BVI tourism sector on the well-being and healthy state of the territory's physical attributes and natural environment. The strategy states unequivocally that the environment is the single most important element of the BVI Tourism Development Strategy.

Additionally, the tourism strategy identifies the need for comprehensive development planning to ensure sustainable tourism development. But whether tourism planning and national development planning are sufficiently coordinated and harmonised is not always evident in actual implementation.

The National Tourism Development Strategy identifies four "zones" for national tourism planning and ranks environmental carrying capacity for each zone. It suggests that this kind of assessment and ranking should be incorporated in national physical development planning, as carried out by Town and Country Planning, and should also be taken into consideration in development control decision making.

A new National Tourism Development Strategy is currently being prepared by the Premier's Office (the Premier serves as Minister of Tourism).

2.2.4.8 Comprehensive Disaster Management (CDM) Strategy and Programme Framework, 2014-2018

The BVI Government, through its Department of Disaster Management (DDM), has adopted a Comprehensive Disaster Management (CDM) approach for the territory. As such, the department's strategy for the management of disasters has evolved from one principally concerned with guiding government responses to events to one based on disaster risk reduction through greater attention to mitigation, preparedness and recovery.

Development of an updated CDM strategy began in 2013, and followed on CDMs prepared for 2003-2008 and 2009-2013. The 2014-2018 Comprehensive Disaster Management Strategy and Programme Framework (DDM, 2014) has now been approved by Cabinet. It seeks to further institutionalise an integrated approach to disaster management in the BVI and outlines how a comprehensive, all-hazards, all-agencies approach will be applied in the BVI—within Government, the private sector, communities, and non-governmental and voluntary organisations.

With the updating of the CDM Strategy and Programming Framework, the next step in territorial planning for disaster management is enactment of a new Act to revise and update the 2003 Disaster Management Act. A Disaster Management Bill is currently before the House of Assembly.

> *In 1961, at the request of the Deputy Governor, Rowan Roy and Arthur Swain met with the USVI Civil Defense to discuss BVI/USVI emergency communications and related disaster preparedness issues. This resulted in the installation of an Amateur Radio Station in the Telecommunications Centre and daily schedules were established with radio operators in St. Thomas.* ***This was the real dawning of Disaster Preparedness in the British Virgin Islands.***
>
> *— From Arthur Swain, 40 Years of BVI Telecommunications*

2.2.4.9 Climate Change Adaptation Policy (CCAP)

From 2007-2012, the BVI Government supported a climate change initiative under a project entitled Enhancing Capacity for Adaptation to Climate Change in the Caribbean UK Overseas Territories (ECACC). The project was funded by the UK Department for International Development and managed by the Caribbean Community Climate Change Centre headquartered in Belize.

ECACC funding was provided for the following activities (*pers. comm.*, Angela Burnett Penn, Environment Officer for Climate Change, DCF, 7 February 2012):

- Establishing a long-term institutional mechanism in the BVI to address climate change;
- implementing climate change educational activities;
- establishing ecosystem and climate monitoring;
- carrying out vulnerability and capacity assessments; and
- preparing a climate change adaptation policy paper for the British Virgin Islands.

A Virgin Islands Climate Change Green Paper was prepared in 2010 (Burnett Penn, 2010), which was further developed into a draft Climate Change Adaptation Policy (CCAP) in 2011. Following extensive public consultations, the policy paper was approved by an inter-departmental Climate Change Committee in 2011, and approved by Cabinet in 2012 under title of The Virgin Islands Climate Change Adaptation Policy: Achieving Low-Carbon, Climate-Resilient Development (DCF, 2012).

While the Virgin Islands is not a large contributor to climate change (*e.g.*, on a global scale, the territory's greenhouse gas emissions are small), the adverse effects of climate change on the BVI and other small oceanic islands will likely be widespread and felt more acutely than in larger continental countries that are more responsible for human-induced global warming. The BVI's Climate Change Adaptation Policy is designed to ensure that the local impacts of climate change are minimised and that climate change adaptation is fully integrated into all levels and sectors of territorial planning and policies.

The Policy reviews existing and potential impacts of climate change, many of which are significant for the BVI's tourism-dependent economy. The Policy also commits the Virgin Islands to specific adaptation actions (interventions) to minimise the impacts of climate change in the territory, with many of the actions to be undertaken within a short timeframe.

The Government has also committed to establishing a Climate Change Trust Fund to support implementation of the Climate Change Adaptation Policy. The Climate Change Trust Fund Act was drafted in 2014 and approved in early 2015 (see Section 2.2.3.4). The Fund will be administered by an independent Board of Trustees (**Figure 7**) charged with mobilising revenues from a variety of possible local and external sources, which might include a carbon levy on hotel and yacht tourists.

Implementation of the Climate Change Adaptation Policy has been vested with a National Climate Change Committee (NCCC), comprised of multiple government agencies and chaired by the Permanent Secretary in the Ministry of Natural Resources and Labour, who is also the National Climate

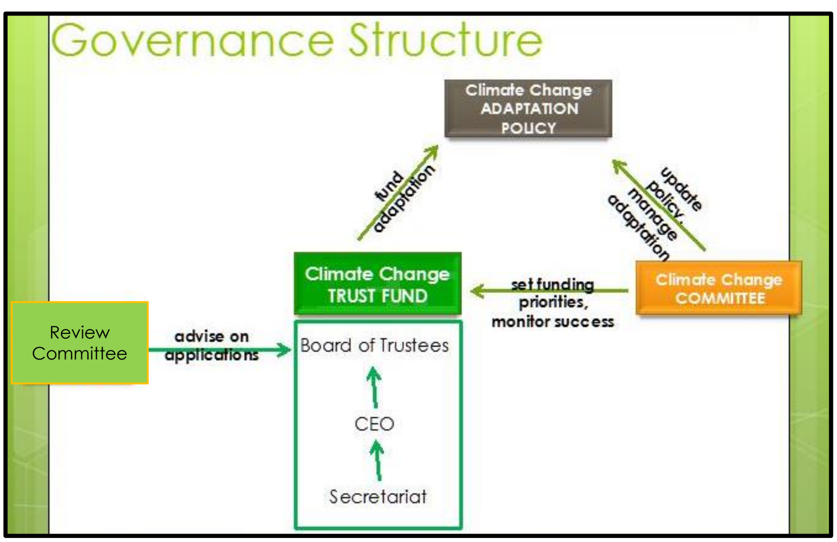


Figure 7.
Governance structure for implementing the BVI's Climate Change Adaptation Policy (source: Ministry of Natural Resources and Labour).

Change Focal Point. The PS in the Premier's Office is the co-chair. There is significant overlap between the membership of the Climate Change Committee and the membership of the pre-existing Planning Authority and Technical Review Committee, which, together, are responsible for the review and approval of all development applications (see Section 2.2.2.4 above). As such, the opportunity to integrate climate change adaptation measures as part of the planning process will be strengthened.

The BVI continues to participate in a number of regional climate change projects as a part of the territory's strategy to implement its CCAP. The most recent such involvement has been in the Global Climate Change Alliance (GCCA) project on Climate Change Adaptation (CCA) and Sustainable Land Management (SLM) in the Eastern Caribbean, which is managed by the Organisation of Eastern Caribbean States with funding from the European Union.

The BVI's component of the regional project was launched in June of 2014. The project aims to improve land management in OECS member states and strengthen the resilience of the region's natural resources to the impact of climate change. Importantly, the project will result in the implementation of at least one pilot climate change adaptation project in each participating state as well as initiatives to strengthen the policy and institutional environment for sustainable land management.

For some countries, the OECS's GCCA officer explained when visiting the BVI in 2014, SLM might mean rewriting development laws, while for others it might mean setting aside protected areas (*BVI Beacon*, 5 June 2014). The programme will also focus on education, which will be directed in the BVI by the Ministry of Natural Resources under its climate change awareness campaign.

2.2.4.10 Beach Management Framework

Gore (2012a) points out that the period between the advent of tourism in the early 1960s and the present witnessed a paradigm shift from preserving natural resources for local subsistence to exploiting natural resources for economic gain. Beaches are no exception to this shift; yet, the changes in how beaches are now used in the BVI have not produced balancing changes in how beaches are managed and protected.

Under the leadership of the Department of Conservation and Fisheries, an initiative to review beach management policy and legislation in the Virgin Islands was initiated in late 2011. The emerging framework (Gore, 2013a and b) is intended to provide background and direction for a fresh look at beach management issues in the territory.

As part of the current initiative, Government will be considering the following: a beach policy to provide a more comprehensive approach to beach management and protection; beach legislation to replace the outdated Beach Protection Ordinance of 1985; and a beach management framework to address issues such as beach carrying capacity, marine zoning, beachfront zoning, beach vendor licensing standards, and other related issues.

Although not finalised or formally approved, Government has also drafted a management plan and national policy for wetlands, encompassing salt ponds and mangrove ecosystems (DTCP, 2005). Current thinking within Government is that a comprehensive Natural Resource and Ecosystem Management Policy, including coverage on beaches, wetlands and other ecosystems, will be developed to support forthcoming comprehensive environmental management legislation (*pers. comm.*, Angela Burnett Penn, Environment Officer, DCF, 19 March 2015).

2.2.4.11 Energy Conservation and Renewable Energy Strategy

In 2013, Government developed a new energy strategy aimed at enhancing energy conservation, promoting renewable energy, and reducing the territory's dependence on imported fossil fuels. The Strategy represents a commitment by Government to ensure that within ten years, by 2023, 30 percent of the territory's energy will be produced from renewable energy sources.

To strengthen that commitment, the BVI signed a pact with other Caribbean countries in February of 2014 to explore alternative forms of renewable energy and to demonstrate renewable solutions in their schools, hospitals, public transport, and tourism industries. The pact grew out of a meeting of Caribbean political and business leaders who had gathered in the BVI at Sir Richard Branson's privately owned Mosquito Island. Signatories agreed to work with Branson's nonprofit group, the Carbon War Room, in transitioning to clean energy and in becoming as "carbon neutral" as possible (*Virgin Islands Daily News*, 7 February 2014; www.caribbean360.com 7 February 2014).

Four primary programme elements support the territory's Energy Strategy, while the amended Electricity Corporation Act (see Section 2.2.3.5) represents the legislative component of the Energy Strategy. The four supporting programme elements are (see www.bviplatinum.com, 4 December 2013):

1. Energy conservation.
2. Energy generation using alternative energy elements.
3. Energy efficiency.
4. Recycling.

Wind-derived energy sources based on the island of Anegada are the primary focus of the BVI's current renewable energy thrust (*pers. comm*., Anthony McMaster, Permanent Secretary, MCW, 23 May 2014), although the territory is also considering solar energy, energy from waste, and energy derived from wave or sea currents.

2.2.4.12 Solid Waste Management Strategy

In 2013 the Trinidadian firm of Egarr & Associates was engaged by the BVI Government to produce a comprehensive Solid Waste Management Strategy for the territory. In 2014, the resulting report was tabled in the House of Assembly, thereby making it a public document.

The Strategy recommends several proposed actions, including (see also Section 7.1.2.5, Chapter 7):

- A facility for waste recycling and reuse.
- More composting in the community.
- A public education programme.
- A legislative framework.
- Further study for waste-to-energy strategies.

The report also recommends the creation of a new statutory body, the Solid Waste Management Authority, to oversee waste facilities and improve collection, storage and disposal of waste, particularly through cost-recovery methods (*e.g*., fees like an environmental levy, household levy, tipping fee and other revenue-generating measures). The Authority would supervise the development of new landfill facilities, thus enabling current dumpsites—including illegal sites—to be closed.

The report concludes that the lack of comprehensive solid waste legislation will be detrimental to establishing a long-term framework for the management of solid waste.

2.2.4.13 Caribbean Challenge Initiative (CCI)

The Caribbean Challenge Initiative was launched in 2008 by The Nature Conservancy, a US NGO, and Caribbean government partners as an effort to chart a new course for protecting and sustainably managing marine and coastal environments across the insular Caribbean. Eight Caribbean countries were part of the initial partnership (Antigua and Barbuda, Bahamas, Dominican Republic, Grenada, Jamaica, St. Kitts and Nevis, St. Lucia, and St. Vincent and the Grenadines). The British Virgin Islands and Puerto Rico were added in 2013.

By virtue of becoming a participating partner of the CCI, the BVI has committed to protecting a minimum of 20 percent of its nearshore marine and coastal environment by 2020✦ and to establishing a sustainable financing mechanism to generate long-term funding for its Protected Areas System Plan. According to the Ministry of Natural Resources and Labour (*pers. comm*. Ronald Smith Berkeley, Permanent Secretary, MNRL, , 6 February 2014), the CCI is providing an opportunity for the BVI to showcase implementation of its Protected Areas System Plan (see Section 2.24.6).

✦ The BVI's Protected Areas System Plan (see Section 2.2.4.6) states that the target cover for protection of nearshore ecosystems and habitats is at least 30 percent.

The second phase of the CCI (2013-2018) was launched at Necker Island, BVI, in May of 2013 and was co-hosted by the heads of government of Grenada and the BVI and Sir Richard Branson, Founder of the Virgin Group. It was attended by 15 Caribbean states and 17 private companies, at which time a series of commitments were made to preserve and protect the region's marine and coastal environment and accelerate efforts to transition to renewable energy (see also Section 2.2.4.11).

2.3 The Private Sector

2.3.1 BVI Non-profit Organisations and the Legal Framework

Prior to 2012, the legal framework in the BVI supporting the non-profit sector was very weak. It basically provided only for registration of non-profit organisations under the territory's Companies Act or earlier Friendly Societies laws. The Financial Services Commission, which oversees registration of companies in the BVI—including not-for-profit organisations—provided no further oversight or support for the sector once registration had been completed.

This *laissez-faire* approach to the sector changed in 2012 with enactment of the Non-Profit Organisations Act. The immediate incentive for the legislation came from the territory's powerful financial services sector, which confronted a 2012 deadline to comply with global standards related to money laundering and the financing of drug and terrorist activities. Since the international Financial Action Task Force (FATF) had determined that such activities often occur under the aegis of charitable institutions, FATF required that the BVI enact an updated and strengthened law to prevent non-profit organisations (NPOs) from being used for such illegal activities.

Under the BVI's Non-profit Organisations Act, 2012, all NPOs operating in the territory must be registered or face substantial fines and/or imprisonment. Responsibility for the Act falls within the portfolio of the Minister of Health and Social Development.

Registration requires that substantial documentation, including financial statements, be provided by NPOs. Many leaders from the BVI non-profit community believe these requirements will unnecessarily burden NPOs, especially smaller community-based, public service groups that are generally operated by volunteers.

Thus far, the law reform process for NGOs in the BVI has been driven by those primarily concerned about *regulating* the non-profit sector. It remains to be seen whether the authorities implementing the law will demonstrate equal concern about a legal process that *strengthens* philanthropy and supports civil society organisations in the territory, including those focused on the environment.

2.3.2 Environmental NGOs in the British Virgin Islands

In the area of the environment, the non-government or non-profit sector in the BVI has not been especially vibrant, broadly based, or long-lasting—particularly when compared to the sector as seen elsewhere in the region.

The emergence of a private-sector conservation movement in the Commonwealth Caribbean can be dated to the mid-1960s and early 1970s when several national trusts, based on the British model, were established throughout the region. Although created by governments and with statutory authority, these early trusts often functioned very much like NGOs in that they had independent governing boards, were often membership based, and were responsible for raising funds.

During their early years, many of the emerging trusts in the region focused on the preservation of historic buildings, monuments and related historical and cultural artifacts. However, by the decade of the

1980s, several of the Caribbean's trusts had become important voices for a broader spectrum of environmental concerns and were taking on more broadly-defined environmental agendas, for example, the National Trust in St. Lucia.

In the 1980s, the region also witnessed the launching of several national environmental NGOs, which operated entirely in the private sector with no statutory authority. These groups took on a full agenda of environmental issues, and, in the smaller islands of the Eastern Caribbean, often succeeded because there was not an established national trust, for example, in Antigua, St. Kitts, and Nevis (Towle, 1995).

In the BVI, this general pattern was not repeated. In the first place, the national trust established in the 1960s had a clear focus on parks and was put in place specifically as a vehicle to manage early land donations for the purpose of conservation. Indeed, the word "parks" is in its title (National *Parks* Trust), thus embodying its primary purpose in its very name, the only trust to do so in the Caribbean.

It is true that, like its sister institutions elsewhere in the region, the National Parks Trust of the Virgin Islands takes on roles and functions similar to that of NGOs. Nevertheless, with 21 park sites under its direct management, the National Parks Trust's interests and agenda lie closer to its park management responsibilities than they do to environmental activism or the public oversight role more naturally assumed by NGOs with no government affiliation.

Thus, in the BVI, there has always been room for one or more environmental NGOs (also referred to in the BVI as non-profit organisations or NPOs) to take on leadership for a wide-ranging spectrum of environmental issues and concerns, to serve as an environmental advocate in the private sector, and to influence public policy and public action on behalf of the environment. But such environmental organisations that have emerged in the private sector have generally not sustained a leadership role for an extended period of time or have not taken on a broadly based environmental agenda.

A few conservation-focused NGOs emerged in the BVI in the 1980s and into the1990s. However, none assumed—when active—a broad environmental role. Instead, the programmatic focus was a single cause (*e.g.*, support for the Botanical Gardens by the BVI Botanic Society) or a single issue (*e.g.*, the preservation of historical and archaeological resources by the BVI Historical Society).

One NPO with a more inclusive environmental agenda has been active in the BVI since the mid-1990s. The **Association of Reef Keepers** (ARK) is dedicated to promoting the conservation and preservation of the marine environment. In recent years, ARK has been less active in promoting a wide-ranging environmental agenda and has concentrated primarily on its original reef monitoring programme. However, since 2013 and under new leadership, ARK is once more striving to become a territorial leader for the environment, while retaining its emphasis on marine resources.

To date, the **Virgin Islands Environmental Council** (VIEC) has been primarily focused on a single issue, *i.e.*, initiating legal action to seek judicial review of Government's approval for the Beef Island Development Project (see Box 10 of Chapter 8). It is not clear at this writing whether, or in what direction, the Environmental Council will extend its mission or agenda.

Green VI was founded as a non-profit organisation in Tortola in 2009 to help create "a green, clean, healthy, and prosperous BVI" (*www.greenvi.org*) (see also Sections 7.1.2. 6 and 7, Chapter 7). It aims

Photo 18.
Green VI's Glass Studio at Cane Garden Bay, Tortola, where discarded glass bottles are recycled into jewelry and art. The Studio raises awareness about waste management issues and serves as a fund-raising vehicle for Green VI.

to demonstrate the principles of sustainability while employing the themes of waste, education, energy and water. The organisation has become an important voice for applying on-island technology to address solid waste concerns and recycling opportunities (**Photo 18**). In 2012, Green VI coordinated UNESCO-funded sustainability training for the BVI and was instrumental in developing a Sustainability Network for the territory (Purkis and Miller, 2012).

The **Association for the Preservation of Virgin Islands Heritage** was established in 2014 to contribute to the public preservation, study and promotion of the historical, socio-cultural, and natural heritage of the BVI through active research, activism, education, and artistic representation. The group also seeks to encourage community appreciation of the territory's heritage, culture and arts, values, and historic sites. The Association's initial project is the restoration of the African Burial Ground at St. Philip's Church in Kingstown, Tortola, believed to be the oldest surviving free African church in the Western Hemisphere.

The **Caribbean Youth Environment Network** (CYEN) is a regional NGO (*www.cyen.org*) with a chapter in the BVI (**CYEN-BVI**). In Tortola, the group serves as an all-volunteer non-profit organisation dedicated to improving the quality of life for BVI youth by promoting their involvement in environmental activities and programmes. Local undertakings have included publications, educational campaigns, and grassroots activities such as tree plantings and clean-up campaigns.

Island Resources Foundation (IRF), a 43-year-old, Caribbean-focused environmental NGO, has worked in the BVI since the 1970s, primarily as an advisor to Government and local NGOs for environmental planning, biodiversity research, impact assessment, economic development and institutional capacity building. IRF established an official presence in the BVI in 1999 in cooperation with the H. Lavity Stoutt Community College. It is the sponsoring organisation of the current Environmental Profile Programme for the BVI.

A US NGO, **The Nature Conservancy** (TNC), has a long history in the BVI dating to the 1970s when it facilitated the donation of a 30-acre island, Fallen Jerusalem, to the National Parks Trust. Currently, the Conservancy is supporting the involvement of the BVI in regional conservation as a member of the Caribbean Challenge Initiative (see Section 2.2.4.12). In partnership with the Department of Conservation and Fisheries, TNC assisted in the development of a best management practices guide for reducing island erosion in the BVI (Gore and Leoniak, 2013).

Founded in 1986, the **UK Overseas Territories Conservation Forum** (UKOTCF, *www.ukotcf.org*) is a non-profit organisation in the UK that supports capacity building in UK overseas territories (OTs). It also supports deployment of specialist volunteers, development and implementation of conservation and education projects with local partners, providing advice to decision-makers, and sharing of ideas and experiences among the UK's overseas territories. In 2013-2014, the UKOTCF helped to organise major EU support for the BVI and two other OTs to support conservation through enhanced visitor facilities at national parks. It has also provided venues for the BVI to present its work and exchange expertise, *e.g.*, *www.ukotcf.org/1_vTours/tour.cfm?locn=BVI&TourType=FULL*.

Another BVI environmental NGO that has a broad programme agenda, although one that is focused on Jost Van Dyke and its neighbouring small islands and cays, is the **Jost Van Dykes Preservation Society** (*www.jvdps.org*). The Society was launched in the early 1990s, was relatively inactive throughout most of the 1990s, and reemerged in 2004 with its establishment as a BVI not-for-profit organisation. It now boasts an office and director headquartered in Great Harbour and supports a number of community-based research and educational programmes including publication of an environmental profile for Jost Van Dyke, in partnership with IRF.

In Tortola, a number of community organisations have taken an interest in environmental activities or incorporated environmental initiatives into their programme agendas. These include the following:

- The **Elmore Stoutt High School** (ESHS) Environmental Club has been an active organisation for about nine years. It offers students the opportunity to gain knowledge and skills in the preservation and protection of the environment.

Goals include involving club members in monitoring beach erosion, assisting members in gaining employment in environmental fields, encouraging members to be actively involved in the preservation of natural habitats and wildlife, and helping members to gain knowledge about the territory's national parks.

- The **Green Pledge** initiative was launched in 2012 under the leadership of the Ministry of Natural Resources and Labour. By accepting the pledge, businesses and other organisations in the BVI agree to be more accountable for their impact on the environment and to detail how they will reduce their overall carbon footprint. A total of 55 organisations have made pledges to undertake changes such as reduced energy usage and reduced dependence on plastic products (DDM, 2013).

- **Guana Science** is a programme of scientific research that began as early as 1932 at Guana Island. Reports and other publications from the programme can be accessed at its website: www.guanascience.com. Guana Science has been most active since the 1980s, with local and international scientists visiting Guana every October to conduct research on the island's natural ecosystems. Guana is also host to an annual marine science month focusing on the island's marine life with strong educational and community outreach components, including Science Week for Kids during which Guana has provided an on-island marine science experience for Virgin Islands young people, including members of the Youth Empowerment Project (YEP).

- **H. Lavity Stoutt Community College's Green Committee** is an on-campus administration group organised in 2010 to increase environmental awareness and promote environmentally sustainable practices on the College's campus. It is comprised of 12 members of faculty and staff. Achievements to date include installation of a solar panel system at the Marine Centre, a campaign to discourage use of Styrofoam containers on campus, use of LED lighting where possible, placement of signs throughout the campus that promote sustainable energy practices, and adoption of the MNRL's Green Pledge to reduce energy consumption by five percent.

- **H. Lavity Stoutt Community College's Renewable Energy Club** is a school group organised in 2013 to self-educate members of the student body about energy production and energy conservation. Activities to date have focused primarily on field trips to observe alternative energy initiatives. Additionally, HLSCC has partnered with the Ministry of Communications and Works to support a Renewable Energy Training Programme at the College. Its first course, entitled "Introduction to Renewable Energy Generation with Photovoltaic Systems," was launched in April of 2014 at HLSCC's Applied Marine Studies Centre.

- The **Rotary Clubs** on the island of Tortola have long participated in a project sponsored by the H. Lavity Stoutt Community College to provide a boardwalk experience for students and visitors within a mangrove ecosystem located on the College's campus at Paraquita Bay. Funding was initially provided by OTEP with the Rotarians providing volunteer labour and materials as part of the BVI's contribution to Rotary's Centennial Year. The Rotarians of Tortola remain committed to the project and continue to support expansion of the boardwalk and maintenance of the site.

- **Rotaract** is a non-profit group of young professionals, who have in the past collaborated with ARK in building awareness about the marine environment. In 2007, members of the organisation became certified divers in order to increase members' knowledge about the marine environment and enable them to provide greater leadership in marine conservation endeavors in the territory. More recently, members of the volunteer group have participated in the annual International Coastal Clean-up Day in the BVI.

- A pilot **SMART School** initiative was launched in 2014 for the Sea Cow's Bay community by the Department of Disaster Management. Three schools will partner with the Department to become more environmentally friendly and better able to withstand the impacts of natural hazards.

- The **Youth Empowerment Project (YEP)** is a non-profit organisation formed in 2007 to provide activities for BVI youth. Housed in a youth centre on the eastern end of Tortola, YEP has provided programmes for over 650 youth in the surrounding area. Programme facilitators are primarily adult volunteers who foster positive interactions between adults and youth. YEP has partnered with environmental organisations like Guana Science and Green VI as well as the Rotary Club of Tortola, Sail Caribbean, and the BVI Ministry of Education.

Issues, Conflicts, and Areas of Concern	Impacts of No Action/No Change	Short-term Options Long-term Recommendations
ISSUE ONE Although three, more modern and comprehensive laws have been enacted to protect and manage the environment (Fisheries Act in 1997, Physical Planning Act in 2004, and National Parks Act in 2006), the totality of the legal framework for the environment in the BVI is incomplete and many laws: – are outdated and therefore ineffective; – lack regulatory authority to fully implement legislated mandates; – lack standards for monitoring and enforcement; – are difficult to implement or enforce because implementing units of government lack the technical capabilities and personnel to do so; and – are difficult to enforce as the enforcement process can be cumbersome, for example, long wait times in the courts.	If the BVI Government does not fully update and/or revise several environment-related laws discussed in this chapter, as well as enact new laws where critical legislative gaps are evident, the territory's ability to do the following will be severely and continuously impeded: – protect the resource base, – enforce environmental standards and regulations, – honour treaty obligations, – provide for the sustainable development of a primary economic sector—tourism, and – maintain a high quality of life.	**SHORT-TERM OPTIONS** ***Although the following recommendations (nos. 1-4) are currently being pursued by Government, they are herewith included since action has not been finalised and all should be expedited as soon as possible.*** **1.** Government should expedite the drafting, approval and implementation of **Regulations to the Physical Planning Act.** Regulations for environmental impact assessments need to conform to international standards for the preparation, review and enforcement of EIAs for development projects, including those initiated by Government. **2.** **Biodiversity protection legislation** is needed in the territory, which currently lacks a sufficient legal framework to protect endangered wildlife and critical ecosystems and habitats, particularly if such are outside of officially designated protected areas. **3.** **Environmental pollution** also needs to be addressed,. Environmental pollution is not yet defined in law in the BVI, and regulations providing environmental quality standards have not been enacted. Modernised public health legislation, with appropriately strengthened national standards for water quality, pollution control, and waste management, is needed to ensure that the quality of life for BVIslanders is not compromised. Standards that are developed should take into consideration institutional capacities and resources for monitoring and enforcement. To fully implement pollution control legislation, a certified environmental testing laboratory will need to be established. **4.** Another area requiring attention is that of **coastal area (or coastal zone) management** legislation. In 1987, a draft Coastal Conservation Act was drafted by an environmental consultant undertaking a legislative review for the OECS. Even 28 years ago, it was recognised that a comprehensive coastal area management policy, embedded within legislative authority, was necessary to protect and manage coastal and marine resources and to achieve sustainable development of coastal areas.

<table>
<tr><th>Issues, Conflicts, and Areas of Concern</th><th>Impacts of No Action/No Change</th><th>Short-term Options
Long-term Recommendations</th></tr>
<tr><td></td><td></td><td>The proposed 1987 act was eventually abandoned, but it is recommended that the BVI Government now take appropriate steps to:

- re-examine the fragmented and limited legal authority and institutional capacity for managing the BVI's coastal environment;
- assess the adequacy of existing policy and the supporting legal framework; and
- consider options for new legislation to address integrated planning for and holistic management of coastal areas in the BVI.

LONG-TERM RECOMMENDATIONS

1. As new laws are enacted, the capability and capacity of assigned units of government to fully implement the laws must be considered, particularly as new mandates are added to units of government already tasked with substantial environmental responsibilities. Not only is the technical capacity of staff of importance, but access to necessary resources—including field equipment, electronic hardware, vehicles, boats, and the like—must be considered or new and modern laws will remain relatively benign tools rather than powerful instruments of change.</td></tr>
<tr><td>ISSUE TWO

Responsibility for the environment in the BVI is dispersed among a number of departments and statutory bodies within several ministries. For a small island state, it may surprise BVIslanders to learn how many public sector institutions have environment-related responsibilities (see Section 2.2.2).

(continued)</td><td>When environmental policies and priorities are driven mostly by the institutional mandates of individual public sector agencies, then the ability of the central government to act will be more constrained and less effective in two critical areas:

(1) The ability to execute coordinated environmental policy, and

(continued)</td><td>SHORT-TERM OPTIONS

1. Many within Government interviewed by the Environmental Profile team pointed to blurred lines of coordination between agencies with planning and resource management mandates, whether physical planning by the Department of Town and Country Planning or tourism infrastructure planning by the Tourist Board or national development planning by the Ministry of Finance or environmental planning by the Department of Conservation and Fisheries and the National Parks Trust. Clearer and more formal lines of coordination are required, with improved mechanisms for integrated and comprehensive national planning in the territory.

(continued)</td></tr>
</table>

Issues, Conflicts, and Areas of Concern	Impacts of No Action/No Change	Short-term Options Long-term Recommendations
One result of this diffusion is that effective implementation of the resource management, resource protection, pollution control, and planning functions of Government is mostly dependent on the ability of Government to coherently coordinate the many agencies with varying degrees of responsibility for a diverse number of resource sectors.	(2) The ability to influence national opinion on critical environmental issues. Concurrently, decisions about critical issues such as land use or development priorities will tend to be based on shorter-term considerations rather than longer-term planning.	**2.** Many of the territory's **national planning documents need updating and/or strengthening** as well as official approval by Cabinet, for example: the *National Environmental Action Plan* (which was never approved and is now little used), the *National Physical Development Plan* (which was not approved by Government in earlier versions), and the *National Integrated Development Strategy* (which was approved by Government but not fully implemented). The territory needs to reconsider the value of these earlier planning efforts and how to integrate the outputs of each in future planning efforts. **3.** Reporting requirements for national planning strategies are weak and need to be strengthened in future planning documents. At present, information on implementation, progress, need for revision, and lessons learned is generally unavailable and so does not feed into a **coordinated and continuous review, feedback, and evaluation process**. **LONG-TERM RECOMMENDATION** **1.** The territory has never had a National Development Plan, although a National Integrated Development Strategy was developed (1999-2003), but not updated or fully executed. In the past, BVI Governments have often converted political manifestos into governing "development plans," an option that confuses the purpose of development planning. What is required is a legally mandated or formally approved **national development plan** to provide a comprehensive framework for growth management and environmental protection in the territory.

3. HAZARDS AND ENVIRONMENTAL RISKS[3]

3.1 Hazards Affecting Tortola

3.1.1 Hazard Definition

It is important to understand the distinction between terms such as natural hazards, man-made hazards, hazard events, and disasters. Although humans can do little or nothing to change the incidence or intensity of most natural phenomena, they have an important role to play in ensuring that natural events do not become disasters as a result of their actions. For example:

- Human intervention can increase the frequency and severity of natural hazards, *e.g.*, when the toe of a landslide is removed to make room for a settlement, the earth can move again and could bury the settlement.
- Human intervention may also cause natural hazards where none existed before. Coastlines naturally change over time, but it is not until humans alter the shorelines through development that geomorphic changes are considered hazardous.
- Additionally, human intervention reduces the mitigating effect of natural ecosystems. Destruction of coral reefs, the coastline's first line of defence against ocean currents and storm surges, is a clear example of an intervention that diminishes the ability of an ecosystem to protect itself. An extreme case of destructive human intervention into an ecosystem is desertification, which by its very definition is a human-induced "natural hazard" (OAS, 1990).

For the purposes of this chapter, the following definitions have been adopted from the Organisation of American States publication, *Disaster, Planning and Development: Managing Natural Hazards to Reduce Loss* (OAS, 1990):

- **Natural Phenomenon**: A physical event, such as a volcanic eruption, that does not affect human beings is a natural phenomenon, but not a natural hazard. In areas where there are no human interests, natural phenomena do not constitute hazards nor do they result in disasters.
- **Natural Hazard**: A natural hazard constitutes atmospheric, hydrologic, and geologic (especially seismic and volcanic) phenomena that—because of their location, severity, and frequency—have the potential to adversely affect humans, their structures, or their activities.
- **Natural Hazard Event**: A natural phenomenon that occurs in a populated area.
- **Natural Disaster**: A hazardous event that causes unacceptably large numbers of fatalities and/or overwhelming property damage.
- **Man-Made Hazard**: Man-made hazards are caused by humans and occur in or close to human settlements. These can include technological hazards such as complex emergencies/conflicts, famine, displaced populations, industrial accidents, and transport accidents. Man-made hazards can also include environmental degradation, pollution and environmental accidents.

3.1.2. Tortola and Potential Hazard Impacts

Tortola comprises a land mass of approximately 54 sq km (21 sq mi). The physiological features of the island are made up of steep hillsides that rise from the sea to a peak elevation of 1,780 ft (543 m), leaving minimal flat coastal land available for major population centres. In addition to residential use, commercial and industrial activities are also located along the immediate coastline.

[3] The author of Chapter Three is Cynthia Rolli.

These and other physical characteristics and the geographic location of Tortola create inherent vulnerabilities to hurricane, seismic, landslide and tsunami risks. Recent predictions of impacts from climate change and sea level rise are also emerging as important indicators of severe risks to the population and environment of Tortola. But to understand climate vulnerability on islands, it is necessary to assess all dimensions of vulnerability. Islands faced with multiple stressors can be assumed to be at more risk from climate impacts (IPCC, 2014).

Island vulnerability is determined by climatic factors but also by socio-economic, physical and ecological stressors, as well as the interactions between them. Tortola's population has steadily increased in the last 25 years, coupled with expanding numbers of cruise ship passengers and overnight visitors. The trend of population growth increases socio-economic vulnerabilities as they are related to urbanisation, pollution and sanitation.

The hazards that have potential to affect Tortola are categorised by type of hazard in **Table 16**. It is noted that in this table development practices have been included as man-made hazards. Local development activities are the cause of much environmental change and associated human vulnerability in small islands. Many local pressures combine with global environmental change to place additional stress on local ecosystems. Examples include coral bleaching and mangrove loss, both increasing the exposure of coastlines to flooding (Pelling, 2001).

Table 16.
Potential hazards in Tortola, by type of hazard.

Type		Hazard
Natural	**Climatic**	Hurricane/Tropical Storms Low Pressure Systems Sea Swells Increased Temperatures Drought
	Geologic	Earthquakes Tsunamis Earthslips/Landslides
Man-Made	**Chemical/Industrial**	Oil Spills Hazardous Materials Spills Waste-water Fires Marine Accidents Vessel Groundings
	Physical Development Practices	Wetland Destruction Ghut Encroachment Slope Destabilisation Deforestation Coastal Reclamation
	Biological	Invasive Species Human/Animal Epidemics
	Terrorist	Weapons of Mass Destruction

The history of recorded hazard events impacting Tortola over the last 25 years is provided in **Figure 8**. Based on current hazard models and the ability to predict and quantify the values of impacts, it is relatively easy to understand the potential impacts of a single hazard event. What is not so straightforward are the *cumulative* impacts from *multiple* hazard events, coupled with increased demand on natural resources due to population growth. Additionally, ecological stresses, such as habitat loss and degradation, invasive species, pollution and overexploitation, can harm biodiversity and reduce the ability of ecosystems to recover after shocks.

The purpose of this chapter of the *Tortola Environmental Profile* is to convey the significance of cumulative environmental impacts resulting from hazard events, coupled with population growth, deficient development control practices and subsequent degradation of the environment. **Table 17** identifies the relationships between hazards and contributing factors that increase environmental risk if there are not sufficient means to reduce these causative agents.

A summary of hazard events that have impacted Tortola are briefly summarised in this chapter, while multiple studies and reports carried out by the Government of the British Virgin Islands provide a more in-depth analysis of the hazards, risks and probabilities of occurrence and impacts on Tortola. To a large extent, the information presented herein is derived from the long experience and research of the BVI's Department of Disaster Management.

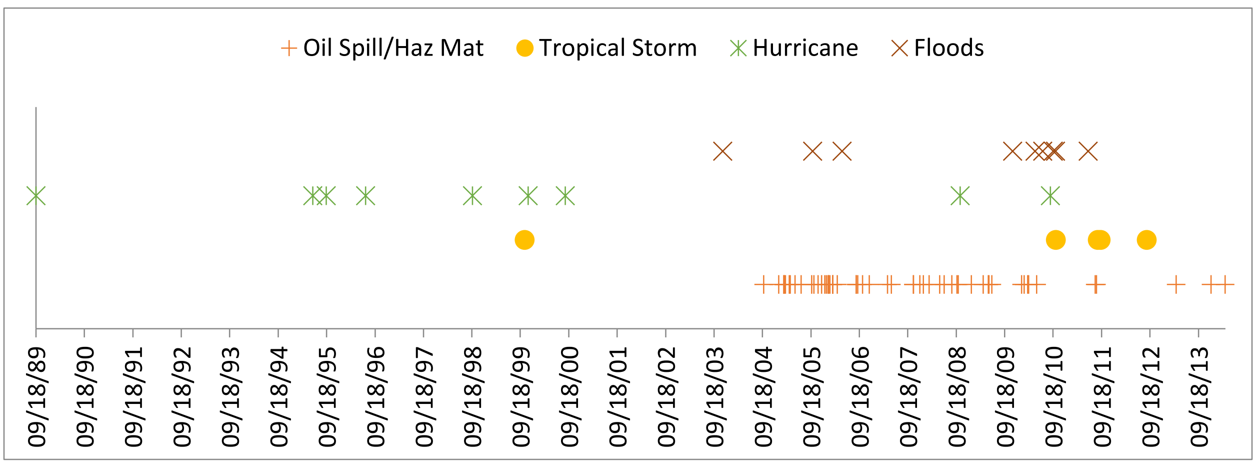


Figure 8.
Hazard events impacting Tortola, 1989-2013 (*source*: DDM).

3.1.3. Hurricanes and Other Storms

The location of the Virgin Islands at the northeastern tip of the Caribbean places it directly in the hurricane belt. Traditionally, there is a 25-to-30-year intensity cycle of tropical cyclone activity, and during that period the Virgin Islands may expect a category 4 storm and several categories 2 or 3 storms (Earl, 1997). The timeline in **Figure 9** represents hurricanes and tropical storms that have impacted Tortola over the last thirty years. A graphic distribution of the storm tracts is show on **Figure 10**, and **Table 18** summarises the damages incurred from hurricanes over the last 30 years.

Table 17.
Hazard events, contributing factors and environmental impacts.

	Source Event and Subsequent Processes						Environmental Impacts							Contributing Factors				
Hazard Process	High Winds	Coastal Flooding	Inland Flooding	Landslides	Erosion	Tsunami	Loss of Terrestrial Species	Coastal Erosion	Sewage/Waste contamination	Sedimentation	Reef Degradation	Decreased Fisheries Function	Natural Habitat Destruction	Mangrove/Coastal Vegetation/Habitat Destruction	Degradation of Reefs from Sedimentation and Sewage	Lack of Sewage Systems and Waste Control	Poor Development Practices; Lack of Erosion Control, Grading and Drainage	Loss of Wetlands/Salt Ponds
Hurricane Tropical Storm	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X
Flash Flood Events		X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X
Earthquake		X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Global Warming and Sea Level Rise	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X
Oil Spills Hazardous Materials Spills							X		X		X	X	X					

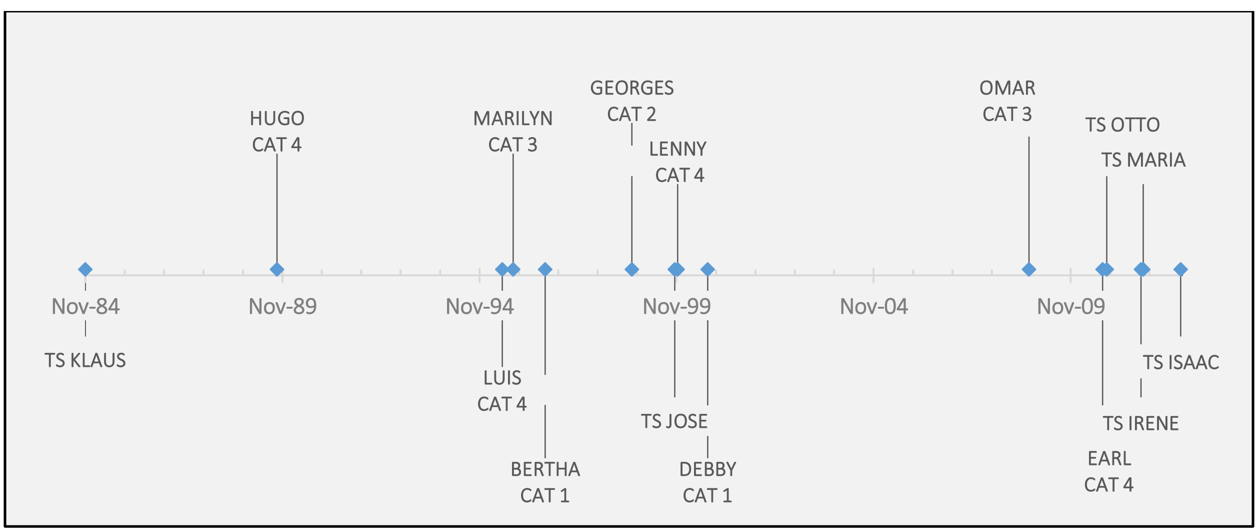


Figure 9.
Hurricane and tropical storm events impacting Tortola, 1984-2013 (*source*: DDM).

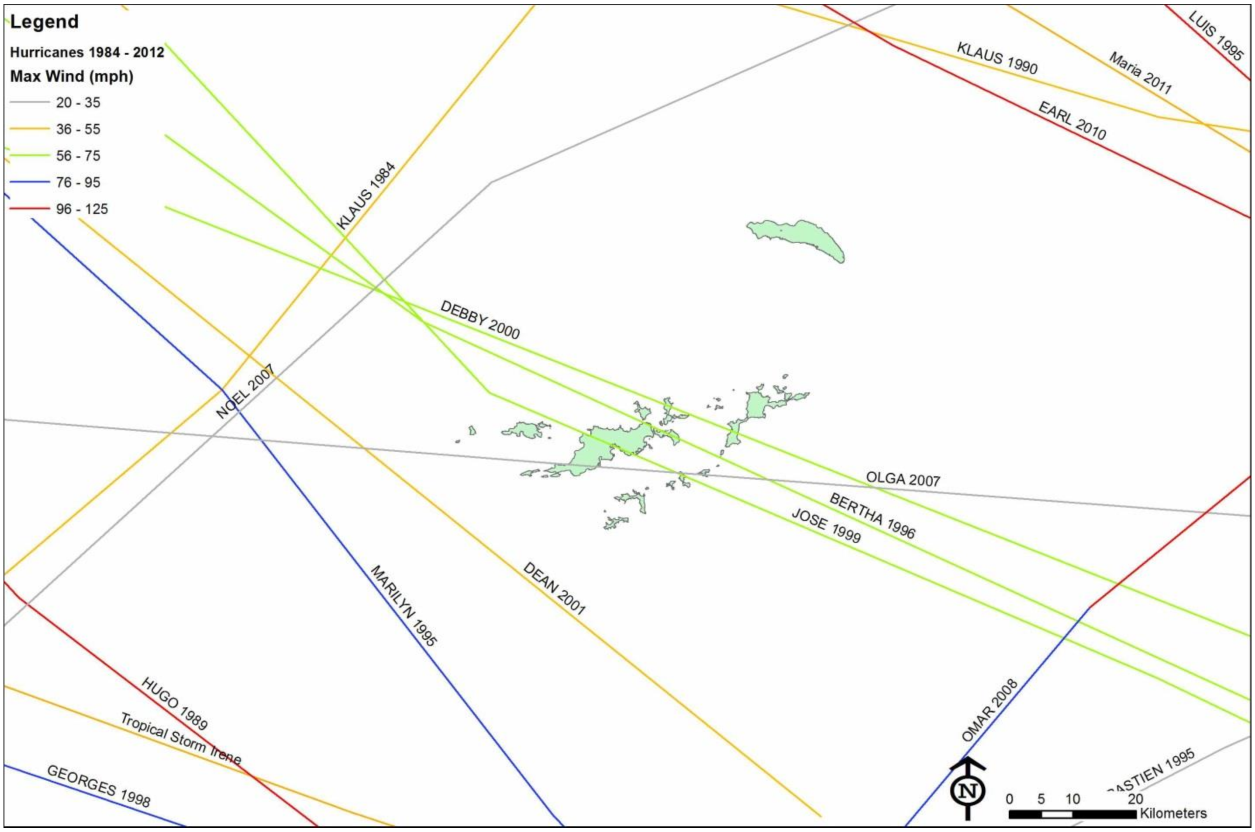


Figure 10.
Hurricane tracts for Tortola, 1984-2012 (*source*: NOAA, 2012).

3.1.4. Coastal Flooding (Inundation)

The major population centres of Tortola are located in coastal areas, with commercial and industrial activities being another predominant land use. These coastal communities have a high vulnerability to coastal flooding, which is primarily caused by severe weather events. Such events are among the most frequent, costly, and deadly hazards that impact coastal communities (NOAA, 2014).

Storm surge is an abnormal rise in water level, over and above the regular astronomical tide, caused by forces generated from a severe storm's wind, waves, and low atmospheric pressure. Storm surges are extremely dangerous because they are capable of flooding large coastal areas.

A project was recently completed in the territory which produced high-resolution, storm surge inundation maps for category 4 and 5 hurricane events from directional headings of 60 degrees and 290 degrees. The climate change scenario was defined for the hurricane event by adding one metre of sea level rise to the inundation data. The project, the Regional Risk Reduction Initiative (R3I), was funded by the European Commission, executed by the UNDP and coordinated by the DDM.

Figures 11 and **12** provide the inundation values for the island of Tortola, from both the western end and the eastern end of the island, for a Category 4 hurricane with a directional heading of 290 degrees plus one metre of sea level rise. The storm surge scenarios were developed based on historical records from the US National Oceanic and Atmospheric Administration (NOAA) (*pers. comm.,* Cynthia Rolli with DDM staff).

Table 18.
Hurricanes and tropical storms impacting the British Virgin Islands, 1984-2012, with estimated losses.

Date	Hurricanes and Tropical Storms	Impact Details	Estimated Impacts (all values are approximate based on source data)
7 November 1984	Tropical Storm Klaus	Maximum sustained winds (MSW): 65 mph	Record not found
18 September 1989	Hurricane Hugo (Category 4)	MSW: 120 mph	US$40 million
6 September 1995	Hurricane Luis (Category 4)	MSW: 120 mph Rainfall: 3.19 inches	US$10 million (with Marilyn)
15 September 1995	Hurricane Marilyn (Category 3)	MSW: 100 mph Rainfall: 2-4 inches	US$10 million (with Luis)
8 July 1996	Hurricane Bertha (Category 1)	MSW: 75 mph, Rainfall: 2.5 inches	US$2 million Widespread flooding and mudslides; coastal areas were battered by 4-foot storm surge
21 September 1998	Hurricane Georges (Category 2)	MSW: 90 mph Rainfall: 3-8 inches	US$12 million Roads undermined, sea defences destabilised, and infrastructure damaged; heavy rains, 7-foot storm surge, and destructive winds
21 October 1999	Hurricane Jose	MSW: 90 mph Rainfall: 2.21 inches	US$5 million
17 November 1999	Hurricane Lenny (Category 4)	MSW:130 mph Rainfall: 10-15 inches	US$29 million Very heavy rainfall (10-15 inches) and storm surges in the 10-12 foot range; extensive coastal damage
22 August 2000	Hurricane Marilyn	MSW: 75 mph Rainfall: 1-3 inches	US $2 million Vessel damage, storm surge at 3 feet above normal
16 October 2008	Hurricane Omar (Category 3)	MSW: 37 mph Rainfall: 5–7 inches	Minimal impacts; flooding of roads, a few wall collapses and falling rocks
29 August 2010	Hurricane Earl	MSW: 135 mph	Main damage occurred on the island of Anegada. However all islands sustained some damage. Severe damage to commercial docks, loss of some marine vessels, coastal inundation to some residential homes, roof damage to homes and commercial businesses, and property damage to local businesses and homes.
8 October 2010	Tropical Storm Otto	Rainfall: 16 inches	Cumulative flooding impacts in 2010 resulted in excess of US $10 million
21 August 2011	Hurricane Irene	Rainfall: 8 inches	No major damage was recorded: flooded homes, minor collapse of a few retaining walls. Extreme swells from the cyclone resulted in blockage of BVI Electricity's main inlet cooling tube. This resulted in most parts of the territory being without power for approximately two days.
11 September 2011	Tropical Storm Maria	Minimal impacts recorded	No damage recorded
23 August 2012	Tropical Storm Isaac	Heavy rains and storm surge	Coastal road impacts

Source: DDM Annual Reports; DDM, 2013.

Tropical storms and hurricanes have contributed to coastal flooding for Tortola's population centres located along the coastline. Low pressure systems can result in large swell events which occur over large areas and are different from waves generated by hurricanes or tsunamis. In March of 2008, a slow-moving, low pressure system in the western Atlantic generated very large swell waves. At the peak of this event, measurements off the US Virgin Islands indicated that the swell was 14-16 ft (>4.5 m) with a period of 17 seconds. Morphological impacts were recorded in Cooper and Charles, 2013.

Due to sea level rise caused by climate change, flooding associated with coastal storms and hurricanes is expected to increase in intensity, frequency and duration. The risks posed to Tortola by future flood events are significant, given population growth and proximity of communities to coastlines.

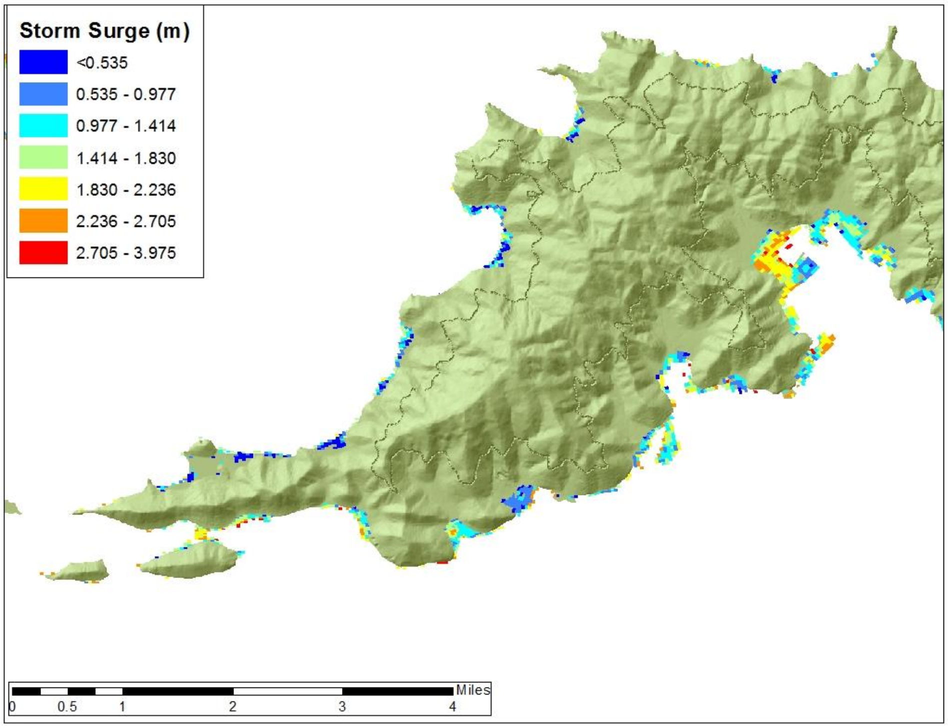


Figure 11.
Storm surge inundation depths for the western end of Tortola (*source*: DDM).

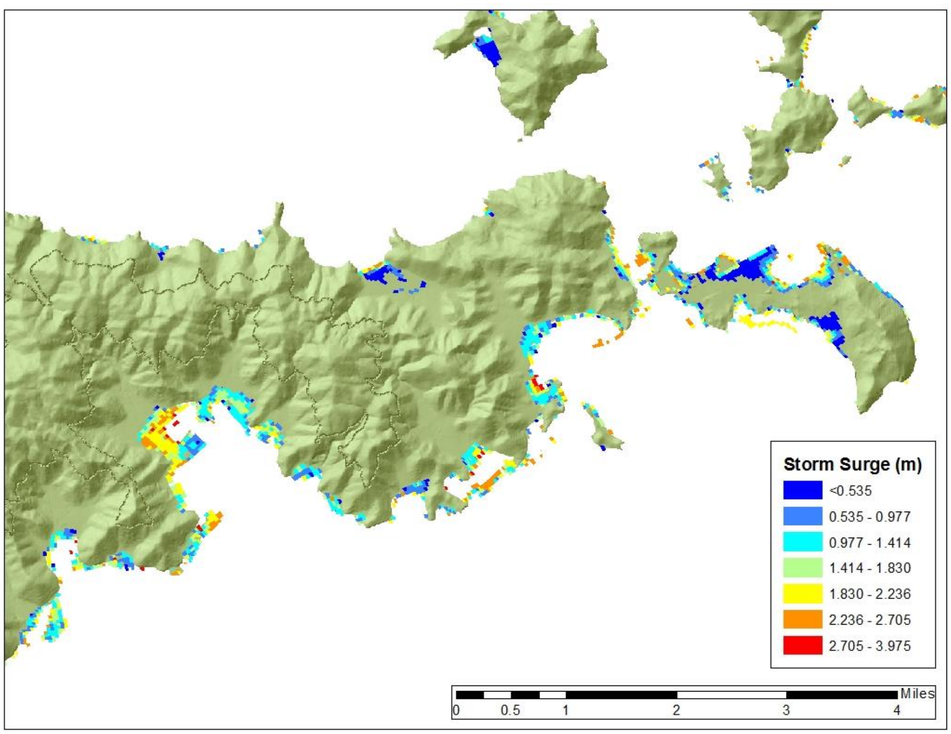


Figure 12.
Storm surge inundation depths for the eastern end of Tortola (*source*: DDM).

3.1.5. Coastal Erosion

Coastal erosion refers to the wearing or washing away of coastal lands. Tortola's coastal communities, including Beef Island, are vulnerable to the effects of erosion. Coastal erosion can result from a variety of natural or man-made actions, including:

- Storms and coastal flood events, usually rapid and dramatic (also called storm-induced erosion).
- Natural changes associated with tidal inlets and entrances to bays (*e.g.*, interruption of littoral transport by jetties and channels, migration or fluctuation of channels and shoals, formation of new inlets).
- Construction of manmade structures and human activities (*e.g.*, certain shore protection structures).
- Dredging or sand mining from beaches and dunes.
- Alteration of vegetation, surface drainage, or groundwater at coastal bluffs.

Coastal erosion and accretion is a natural process and should not normally be regarded as a problem. Problematic issues only arise when erosion threatens human activities or assets, or when the erosion is a result of human interference with coastal processes along an adjacent frontage (FEMA, 2011).

Erosion is capable of threatening natural resources and impacting human populations in Tortola in a number of ways, including the following (FEMA, 2011):

- Destruction of dunes or other natural protective features.
- Destruction of erosion control devices.
- Lowering ground elevations, undermining shallow foundations, and reducing penetration depth of pile foundations.
- Transporting beach and dune sediments landward, where they can bury roads and buildings.

Although the concept of erosion is simple, erosion is one of the most complex hazards to understand and predict at a given site.

The storm surge inundation values in **Figures 11** and **12** can be used to form the basis on which to implement planning for prevention and mitigation, preparedness and response, and recovery and rehabilitation. Examples of outputs from identifying the risk of storm surge include:

- Identification of critical facilities in storm surge high-risk areas.
- Identification of environmental attributes in high-risk areas.
- Identification of high-risk areas based on economic components.
- Development of mitigation strategies for vulnerable and high-risk areas.
- Incorporation of development conditions associated with high-hazard areas in the drafting of land use maps.

3.1.6. Flooding and Flash Flood Events

The environmental and physical (land) features of Tortola—including soil type, the presence of vegetation, and other drainage characteristics—all contribute to flooding, the most frequent and costly hazard event over time.

In the last 25 years, multiple flood events have impacted Tortola. The first notable event with recorded documentation occurred over a two-week period in November of 2003. During this event, approximately 51 cm (20 inches) of rain fell and severely impacted all of the British Virgin Islands.

In 2010, a combination of three tropical cyclones, in addition to moisture from various troughs, produced some of the heaviest downpours experienced in the territory. Assessment reports revealed that the damage sustained in the BVI was in excess of 10 million dollars. The impacts resulting from these flood events included: flooded homes and businesses, landslides, severe sedimentation of coastal waters, and—in the long term—substantial negative damage to the economy. Although many beneficial physical infrastructure works have been implemented to reduce the impact of flash flood events, inadequately controlled land development practices continue to increase risks to BVI residents and natural resources.

A timeline of flood events recorded since 2003 is illustrated in **Figure 13**. A summary of flood events and associated impacts recorded since 2003 are provided in **Table 19**.

When floodwaters recede, affected areas are often blanketed in silt and mud. The water and landscape can be contaminated with hazardous materials such as sharp debris, pesticides, fuel, and untreated sewage. Potentially dangerous mold blooms can quickly overwhelm water-soaked structures. Residents of flooded areas can be left without power and clean drinking water, leading to outbreaks of waterborne diseases like typhoid, hepatitis A, and cholera.

Figure 14 displays major impacted areas in Tortola after the passage of storm events in 2003. Additional illustrations are included in **Photo 19 (a-f)** following the passage of tropical storm Otto in October 2010 and a November rain event in 2009.

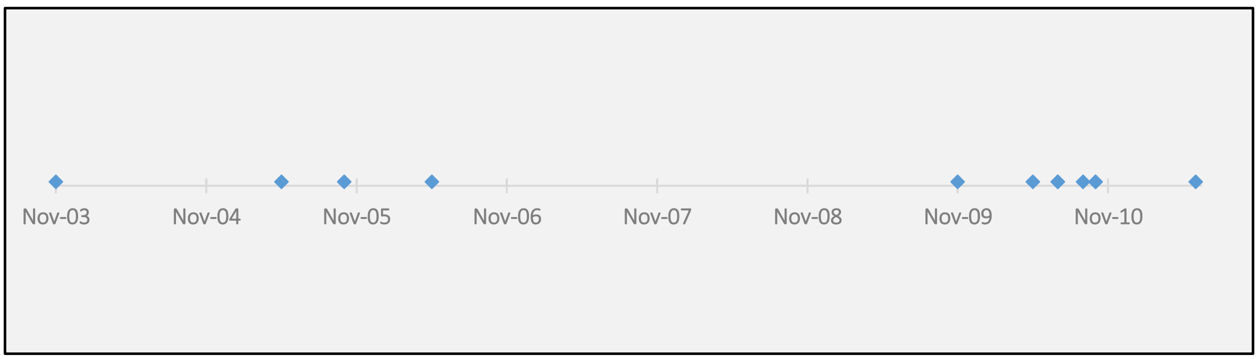


Figure 13.
Timeline of major flood events in Tortola, 2003-2013.

Source: Extracted from the Annual Reports produced by the DDM, in addition to After Action Reports published on the Department's website: *www.bviddm.com*.

3.1.7. Slope Failure and Land Erosion

Based on 2002 topographic data provided by the Government of the Virgin Islands, approximately 44 percent of the island of Tortola has a slope greater than 25 percent. The widespread occurrence of natural and man-made slope failures is largely related to extreme rainfall events. Massive slope failure events are concurrent with major floods affecting low-land areas.

The usual cause of land-sliding is destabilisation by over-steepening of slopes. The presence of over-steepened slopes is a common consequence of development on hillsides. Failure of the rock slope generally occurs during rain events because water pressure in rock joints reduces frictional forces. The extreme rain events of the last decade in Tortola have produced significant slope failures on upper hill slopes and rock cuts and serious flooding in low-lying areas (Joyce, 2006).

Table 19.
Floods affecting Tortola, 2003-2011.

Date	Hazard Event	Details	Estimated Impacts
9-22 November 2003	Low Pressure Trough Flooding	An average of 20 inches of rain over the two week period	Significant impacts to the major road network; flooding of businesses, schools, critical facilities and homes; collapsed retaining walls; undercut roadways; downed utility lines and poles causing power outages; damage to the sewerage plant and desalination plant on the northern side of Tortola; major debris and silt on beaches.
10 May 2005	Low pressure system	N/A	Localised flash floods and mudslides. Delta Petroleum Gas Station underground; gas tanks lost their covers which caused contents to leak into already flooded streets.
October 2005	Upper Level Trough	Flood (2 weeks torrential rain)	Major flooding in Purcell area. Flooding of the Delta Gas Station. Overflow of fuel storage tanks. Clean-up costs: $45,000. Evacuation of residents and major road closure.
11 May 2006	N/A	N/A	Major flooding: Road Town, Sea Cow's Bay, Hannah's Estate, Huntum's Ghut
16 November 2009	Low Pressure Storm Flooding	The rainfall amount totaled 5.2 inches from the period 14 November 2009, 11 am to 17 November 2009, 9 am. A peak rainfall amount of 2.2 inches was measured within one hour, between 8 and 9 am.	The heavy rains and winds resulted in flooding, fallen trees and electric poles, and vehicular accidents. The main areas that suffered flooding were Pockwood Pond, Fish Bay, Sea Cow's Bay, and Road Town.
5 May 2010	N/A	N/A	N/A
1 July 2010	N/A	N/A	N/A
20-21 July 2010	N/A	N/A	N/A
19 September 2010	N/A	2.08 inches	Significant flooding experienced in most low-lying areas
30 September – 7 October 2010	Tropical Storm Otto	20.05 inches	Cumulative flooding impacts in 2010 resulted in excess of US $10 million
5 October 2010	N/A	N/A	N/A
8 June 2011	Flood	N/A	Undermined roads, collapsed retaining walls

Source: Extracted from the Annual Reports produced by the DDM, in addition to After Action Reports published on the Department's website: *www.bviddm.com*. Some information could not be collected on specific events and is indicated by N/A.

Land erosion becomes a serious threat to the environment as a result of heavy rains and flash flood events. Unpaved roads and poor land development practices have produced severe sedimentation in Tortola's coastal waters. Studies undertaken in the neighbouring island of St. John, USVI, have identified the unpaved road network as the most important source of sediment on the island. These studies indicate that unpaved roads erode at rates that may be up to 10,000 times higher than undisturbed hill slopes, and that sediment delivery into coastal waters from watersheds containing unpaved roads are 300–900 percent higher than from undisturbed watersheds (Ramos-Scharron, 2007).

Increased sediment delivery to coastal waters is a key stress on coastal ecosystems. Increased sedimentation can cause a variety of negative impacts on coral reefs, including screening of light needed for photosynthesis, scouring of coral by sand and sediments, poor survival of juvenile coral due to loss of suitable substrate, and the direct smothering of coral in cases of extreme sedimentation.

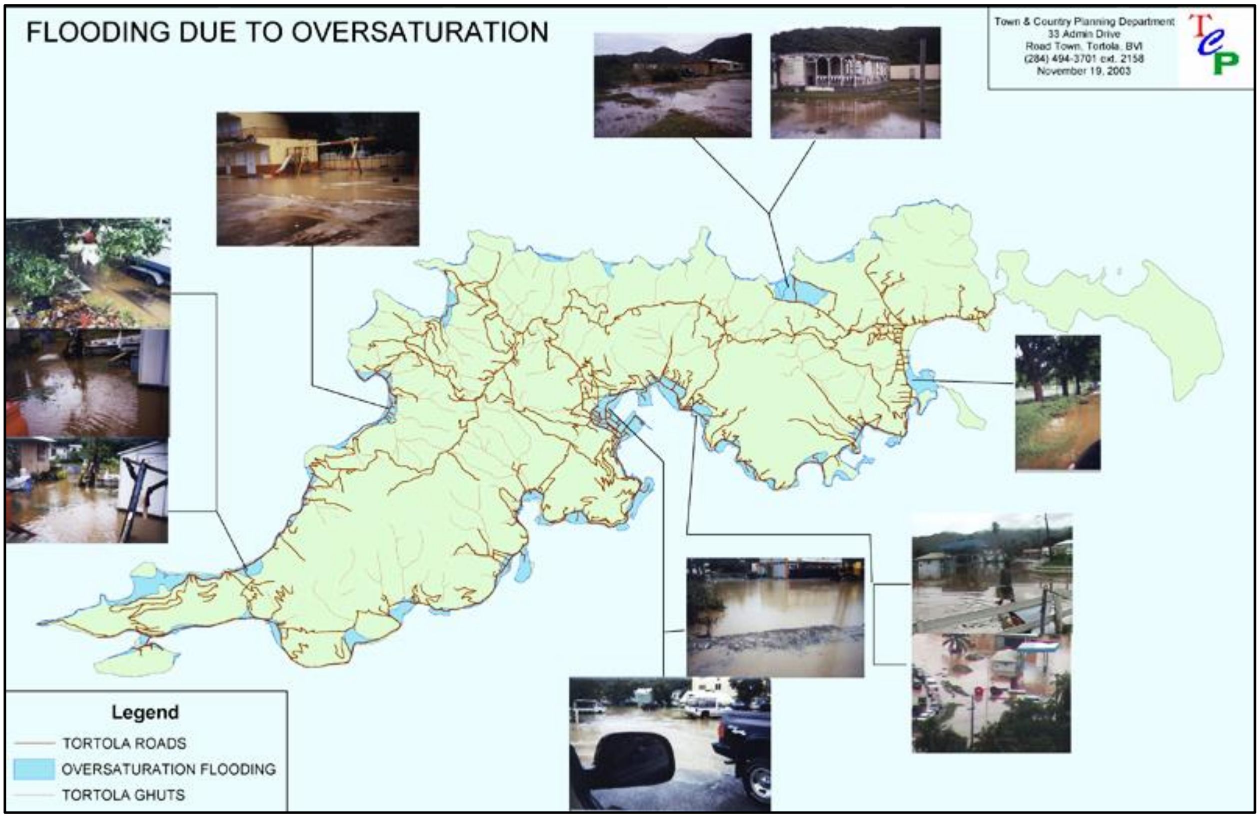


Figure 14.
Impacted areas in Tortola during a November 2003 flood event (*source*: DTCP).

Figure 15 provides a map of Tortola identifying the areas that are most vulnerable to slope failure, based on the type of geology, the angle of the slope and the orientation of bedrock.

After the November 2003 flooding event, the Department of Disaster Management contracted various professionals to undertake damage assessments to document the impact, and also to identify the potential causes of these impacts. Each assessment provided recommendations to mitigate and prevent impacts from future events. A summary of these reports, causes, and recommendations are provided in **Table 20**.

3.1.8. Earthquakes and Tsunamis

3.1.8.1 Earthquake Hazard

The islands comprising the British Virgin Islands are especially vulnerable to the impacts of earthquakes and tsunamis as they sit on the northeastern edge of the Caribbean Tectonic Plate where it meets the North American Plate at the Puerto Rico Trench (**Figure 16**).

The boundaries of the Caribbean Plate are characterised by intense earthquake activity caused by faulting induced by the differential movements of the plates. The edges of these plates, where they move against each other, are sites of intense geologic activity, such as earthquakes, volcanoes, and mountain building. **Figure 17** represents the seismic activity that occurred over a 10-year period.

Photo 19(a).
Tropical Storm Otto, October 2010 (*source*: DM).

Photo 19(b).
Tropical Storm Otto, October 2010 (*source*: DDM).

Photo 19(c).
Tropical Storm Otto, October 2010 (*source*: DDM).

Photo 19(d).
Tropical Storm Otto, October 2010 (*source*: DDM).

Photo 19(e).
Rain event, November 2009 (*source*: DDM).

Photo(f).
Rain event, November 2009 (*source*: DDM).

Photo 19.
Impacted areas following the passage of tropical storm Otto in October 2010 and a November rain event in 2009.

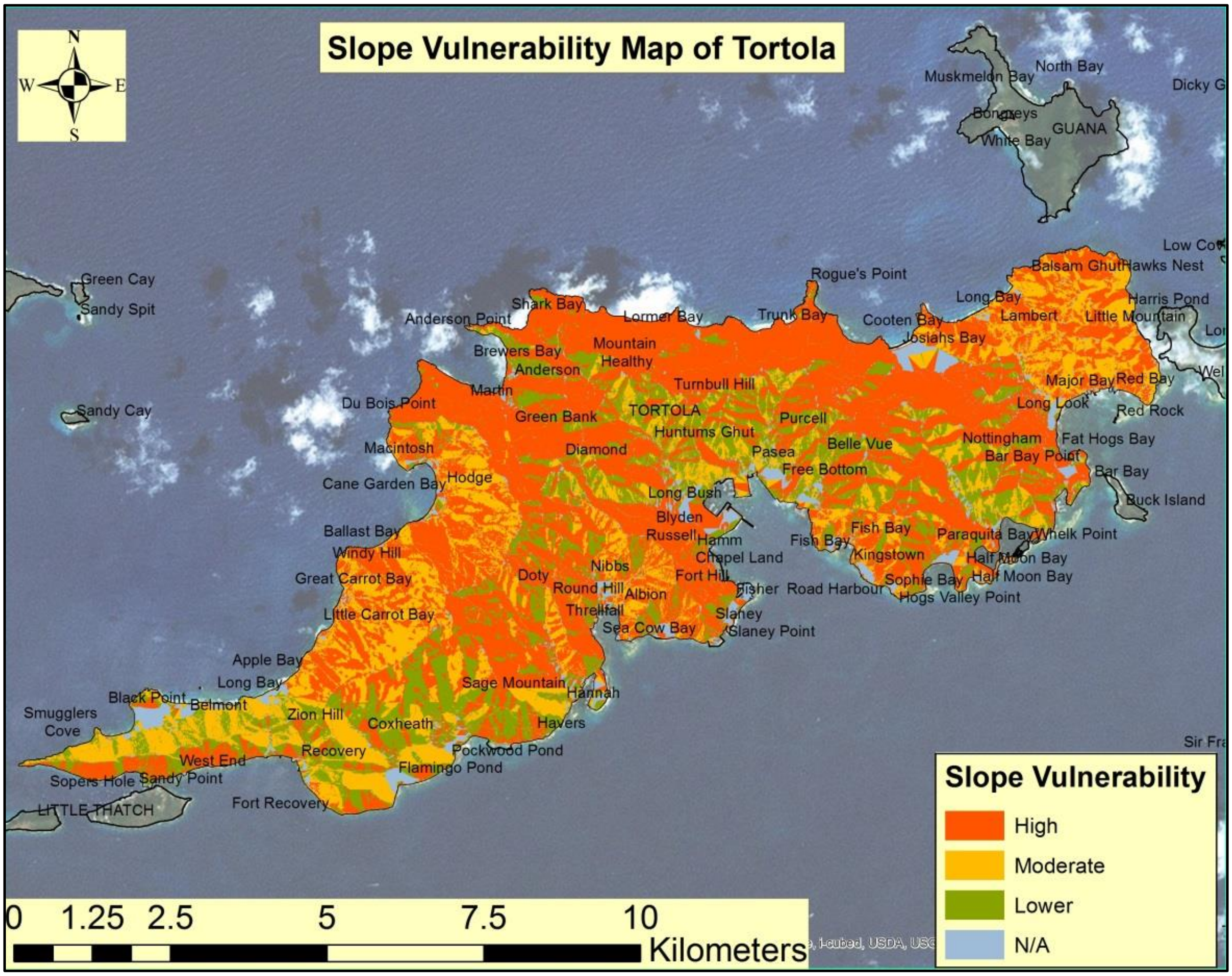


Figure 15.
Slope vulnerability map of Tortola (*source*: DDM).

Dr. Uri ten Brink—a geophysicist with the US Geological Survey's Woods Hole Science Centre who studies earthquakes, tsunamis and geology in Puerto Rico and the Caribbean region—writes that there are a number of possible sources for earthquakes and tsunamis in the Caribbean (*Science Daily*, 2005). He reports:

> *The threat of major earthquakes in the Caribbean, and the possibility of a resulting tsunami, are real even though the risks are small in the bigger picture. Local earthquakes, such as from the fault on Hispaniola or effects from distant earthquakes, can be severe. Landslides and volcanic eruptions can also cause major earthquakes and potential tsunamis in this region. It has happened before, and it will happen again.*

The BVI Department of Disaster Management has a partnership with the Puerto Rico Strong Motion Programme (PRSMP). Through this partnership, sensors for the real-time monitoring of strong motion have been installed around the territory. These sensors are monitored in real-time at the DDM and remotely by the PRSMP in Puerto Rico. The sensors collect critical data on the actual movements created by earthquakes, and this data can then be used to aid in structural design. The next phase of this project will expand the network further south and configure the system to send emails to individuals about the magnitude of earthquakes (DDM, Annual Report, 2010).

Table 20.
Damage assessment of November 2003 flooding event and slope failure in Tortola.

Event/Reports	Damage Assessment	Cause of Damage	Recommended Mitigation for Risk Reduction
November 2003 Floods: Over a 2-week period, when approximately 20 inches of rain was recorded, damage assessments were reported in the following reports: 1. A Damage Assessment Report of the Main Road Network (Cooper and Charles, 2003) 2. A Report on the Impact of the Rains on Hill Slopes, Embankments, Rock Cuts And Ghuts (Joyce, 2003)	• Most observed slope failures and embankment washouts were caused by accumulated roadway runoff discharging off roadway curves. • All surface runoff from slopes above roadways was concentrated on the roads, a problem worsened where culverts in ghuts were clogged by rock debris and overflowed on roadways. • Slope failures not related to roadway runoff largely occurred on steep rock-cut slopes along roadways and behind homes. • Natural slope failures were limited to debris flows in ghuts and steep rock slopes along the shoreline.	The two primary causes of damage impact were: 1. Uncontrolled roadway drainage. 2. Inadequate drainage capabilities of the ghuts.	1. In conjunction with expert geological advice, implement appropriate design-and-construction methods and standards to assure reliable road and drainage infrastructure. 2. Require engineering input for structure designs, with emphasis on access, constructability, and drainage. 3. Map the drainage network in the Road Town area and evaluate its suitability and efficiency to accommodate and dispose of runoff of the order experienced in recent (2003) rainfall events. 4. Address the overall drainage of all Tortola roads at all levels: planning, design and approval, and construction. 5. Clear all culverts of debris to allow for drainage in ghuts. 6. Where necessary, reinforce or rebuild embankments using rock gabions or retaining walls. 7. Initiate a study for redesigning problematic cut slopes and embankments. 8. Initiate a study for an integrated drainage system for Tortola that prevents erosion of the upper slopes and flooding in the lowlands. 9. Amend existing GIS geology maps to distinguish formations, rock types, landslide-colluvial deposits, reclaimed wetlands.

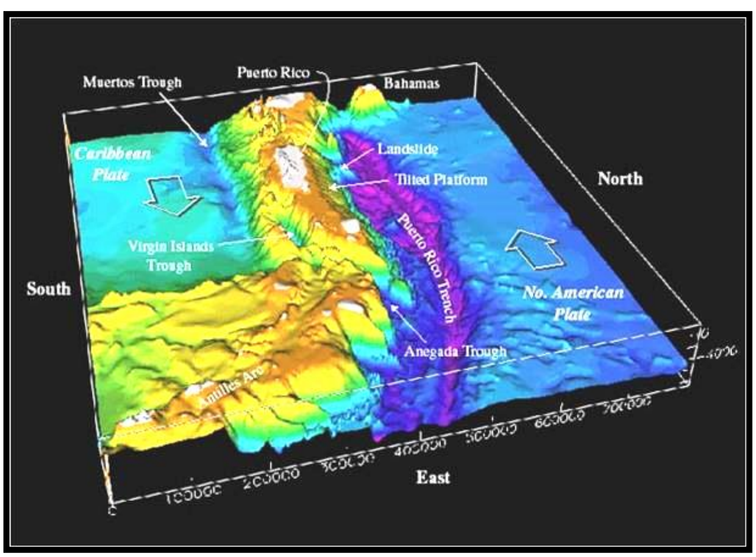


Figure 16.
Caribbean Tectonic Plate meets the North American Plate at the Puerto Rico Trench (*source*: US Geological Survey, Woods Hole Science Centre).

3.1.8.2 Tsunami Hazard

There is recent evidence to support the hypothesis that earthquakes and tsunamis have previously affected the Virgin Islands. The evidence is the result of an ongoing paleoseismic investigation conducted by a team of scientists including Mr. Brian F. Atwater of the US Geological Survey and Dr. Martitia P. Tuttle of M. Tuttle & Associates. The investigation was initiated in 2008 to determine the historical recurrence of earthquakes and tsunamis in the region and the earthquake and tsunami potential of the subduction zone marked by the Puerto Rico Trench.

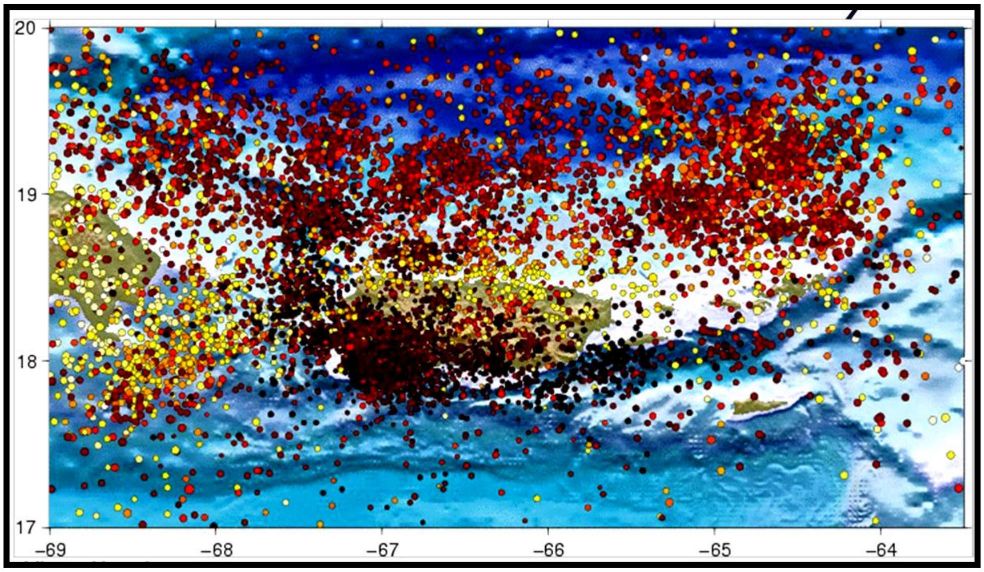


Figure 17.
Seismic activity on the northeastern boundary of the Caribbean Plate, 1995-2005 (*source*: Joyce, 2008).

Atwater and his fellow scientists discovered two tsunami-related events that impacted the island of Anegada between the time periods 1200-1450 AD and 1650-1800 AD. The evidence is supported by carbon dating of coral boulder deposits scattered hundreds of metres inland and numerical modeling of hurricane and earthquake scenarios. In a comparison among numerical models of storms and tsunamis, only tsunami waves of nearby origin managed to wash over an area where coral heads of medieval age are scattered hundreds of metres inland from the north shore of Anegada (Wei, 2012).

The likely scenarios related to the two time periods identified for tsunami-related impacts are:

(1) Deposits dated to 1650-1800 at Anegada represent either the largest known far-field tsunami in the Caribbean (1755, Lisbon) or some other tsunami or unusual storm that surpassed the Lisbon tsunami in its local geologic effects (Atwater, *et al*., 2012).

(2) The likely tsunami source responsible for the 1200-1450 overwash deposits found on the north shore of Anegada is faulting along the eastern Puerto Rico Trench 200 km (124 mi) to Anegada's north (Atwater, *et al*., 2012).

The recent Regional Risk Reduction Initiative (R3I) also produced tsunami wave-inundation modeling of scenario events and created quantitative hazard maps. The tsunami inundation depths were based on scenarios defined for several earthquakes (1755, 1867, and a hypothetical one in the Puerto Rico Trench) and landslides (one slide from the south of St. John and one from east of the Amphitheatre Escarpment, which is north of Puerto Rico).

The climate change scenario was defined for the tsunami hazard by adding one metre of sea level rise to the inundation data. **Figures 18** and **19** provide inundation values for Tortola from the western and eastern ends of the island. The tsunami inundation values that are provided are the Maximum of the Maximum, which represents the worst-case scenario for any given storm event. The tsunami scenarios were defined using historical records from the US Geological Survey (USGS) (*pers. comm*., Cynthia Rolli with DDM staff).

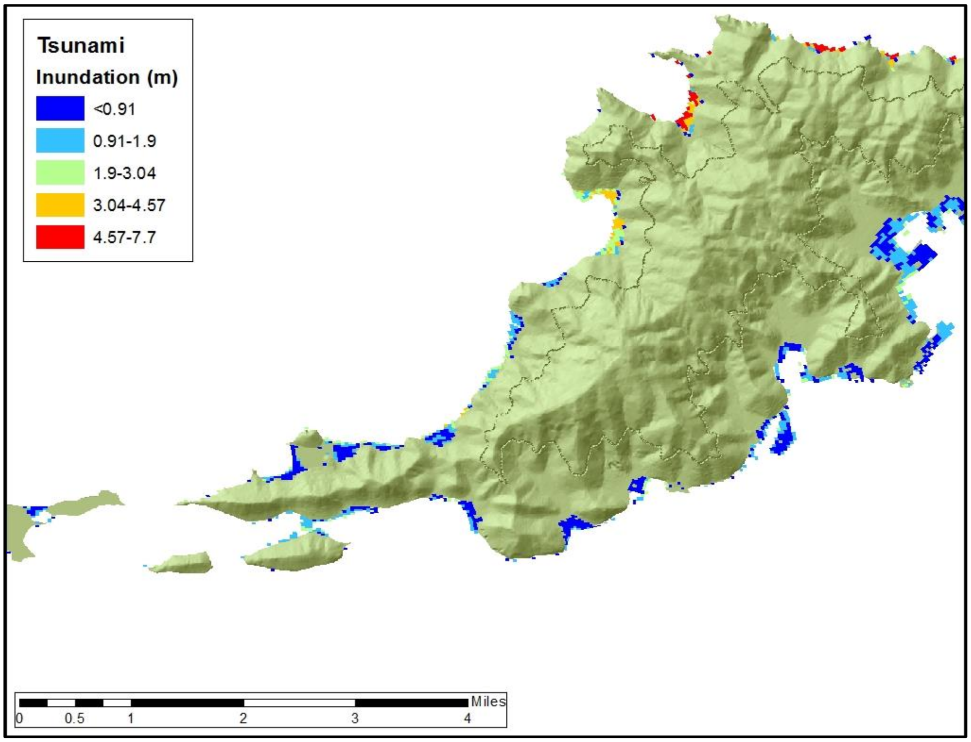


Figure 18.
Tsunami inundation map of the western end of Tortola (*source*: DDM).

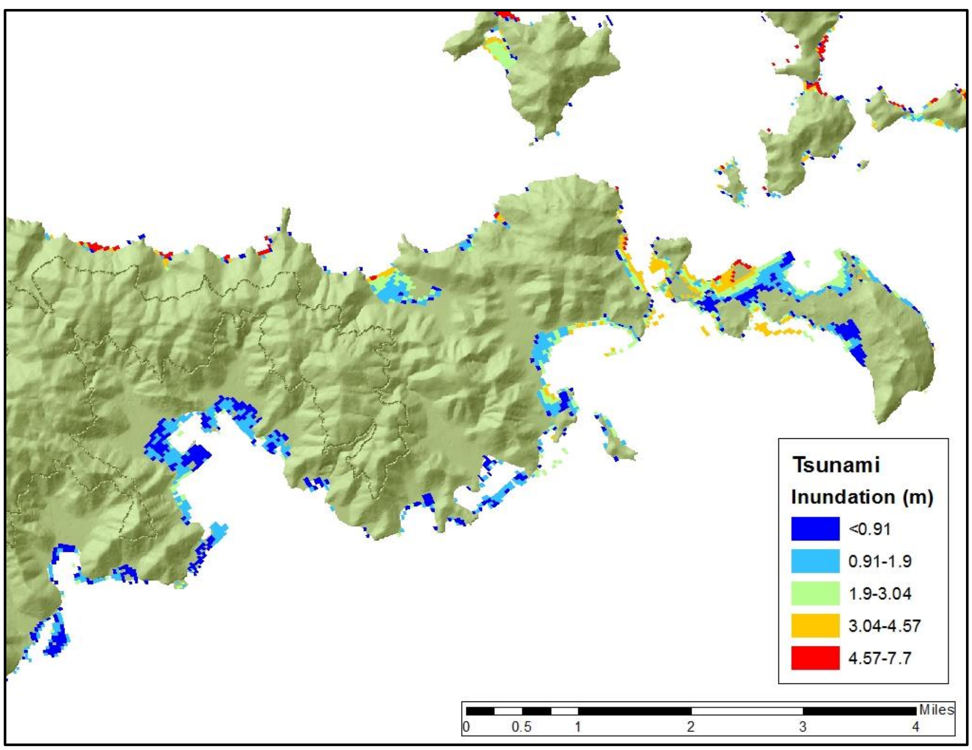


Figure 19.
Tsunami inundation map of the eastern end of Tortola (*source*: DDM).

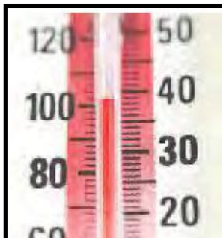
The DDM, through its partnership with PRSMP, has established linkages with the West Coast and Alaska Tsunami Warning Centre and the Pacific Tsunami Warning Centre; it has also established an Inter-Governmental Tsunami National Focal Point.

These partnerships allow the DDM to receive tsunami test messages and alerts that will improve the territory's ability to respond to and alert the public of an earthquake/tsunami event. The BVI has been officially added to the tsunami national contact list and tsunami warning focal point list under UNESCO. This allows the DDM to access tsunami information, alerts, and training (DDM, Annual Report, 2010).

3.1.9. Global Warming and Sea Level Rise

The BVI, like all Small Island Developing States (SIDS), is among the countries that will be the first and worst affected by climate change, as identified by the United Nations Framework Convention on Climate Change (UNFCCC) and the Intergovernmental Panel on Climate Change (IPCC) (Burnett-Penn, 2010). According to the IPCC (2014), the impacts of climate change will affect the livelihoods, coastal communities, infrastructure, ecosystems and economic stability of SIDS, and sea level rise poses an increasing threat to low-lying coastal areas.

The vulnerability of lowland coastal communities to global climate change is significant since its main effects will most likely include rising sea levels and ever-stronger hurricanes. Intensive development in the limited coastal zone of small islands like Tortola, combined with population growth and tourism, has placed great stress on the coast of these islands and has resulted in dense aggregations of infrastructure and people in potentially vulnerable locations (IPCC, 2014). **Figure 20** portrays those projected changes of most concern in the Caribbean region.



Rising temperatures

1°C - 5°C (1.8°F – 9°F) warmer by the 2080s under the Medium-High Carbon Emissions Scenario (Taylor et al., 2007);

Changing rainfall patterns

Up to 25% drier by the 2080s under the Medium-High Carbon Emissions scenario, accompanied by a *change in rainfall patterns such that more, heavier rain events and thus floods are likely* (Taylor et al., 2007);

Stronger, more persistent and devastating hurricanes

A greater likelihood of category 4 and 5 hurricanes as is already being observed (Mimura et.al, 2007).

Rising sea level

0.19 – 0.58 metres (0.6 – 1.9 feet) higher sea level by 2100 as a result of warmer ocean temperatures and melting polar glaciers (Mimura et.al, 2007).

Figure 20.
Predicted climate changes of most concern for the Caribbean region (*source*: Burnett Penn, 2010).

In the document *The Caribbean and Climate Change: The Costs of Inaction* (Bueno, *et al*., 2008), the authors identify the following potential impacts and increased vulnerabilities resulting from projected climate changes:

- Infrastructure in coastal settlements may not be able to withstand significantly stronger winds, deeper incursions from more forceful ocean surges, and heavier rains.
- Anticipated climate changes will accelerate the erosion of coastal beaches, land and protective mangroves. Coastal houses, hotels and other buildings, along with roads and additional infrastructure, are vulnerable, as are those who live and work there.
- Greater vulnerability and higher economic damages will result if new construction and development along the coast are not built to withstand the impacts of rising sea levels and increasing occurrence of floods as well as land and mud slides.
- Conditions of poverty and weak development control practices will contribute to substandard construction of buildings and infrastructure, accentuating their vulnerability.
- Higher temperatures will have serious consequences for agriculture and ecosystems. Important commercial fisheries are at risk as coral reefs are stressed by warmer waters, as was the case during the summer of 2005 when record bleaching of coral reefs occurred in the Caribbean. Coral reefs in the region have already been under stress from human impacts; climate change now emerges as a major new threat. Coral reefs are vital to many island economies, providing fishing grounds, coastal protection, and tourism opportunities. (See also Section 5.1.2.1, Chapter 5)

Recently, a comprehensive study was undertaken by the BVI Government under the leadership of the Department of Conservation and Fisheries to assess the potential impacts of global warming and sea level rise on the Virgin Islands. The findings of this study can be found in the report titled *Virgin Islands Climate Change Green Paper*. The Green Paper identifies and discusses the potential local effects of climate change, climate-related vulnerabilities, adaptation options, and the territory's capacity to respond (Burnett Penn, 2010).

As indicated in the Green Paper, sea level rise is a climate change impact of significant concern. By the end of the twenty-first century, the average global sea level is projected to rise between 0.19 – 0.58 m (0.62 – 1.90 ft) relative to 1980-1999 levels. Recent maps developed by the DDM illustrate the projected impacts of sea level rise based on a sea level rise scenario developed by the IPCC. The 8.5 RCP scenario is based on the highest projected global greenhouse gas values. **Figures 21** to **23** show the vulnerable locations and depths of inundation (flooding) projected for Tortola for selected years from 2030 to 2100.

The implications of this are serious. It would mean that beach areas and some low-lying areas of shoreline would be at risk of permanent inundation (flooding) (Burnett-Penn, 2010). In the Caribbean, sea level rise projections have been combined with elevation maps to estimate that 40-60 percent of tourist resort properties would be damaged, with implications for the economies of the region (IPCC, 2014). Burnett-Penn includes the following summary of the potential impacts from sea level rise:

- Increased beach erosion and shrinkage.
- Shoreline erosion and increased flood risk to low-lying coastal areas.
- Road networks (especially coastal roads) at greater risk of damage from floods and stronger storm surges.
- Critical facilities and developable lands (especially those in the coastal zone) at greater risk of damage from floods, stronger hurricanes and storm surges.
- Critical utilities at greater risk of damage from floods, stronger hurricanes and storm surges.
- Homes and developable lands (especially those in the coastal zone) at greater risk of damage from floods and stronger storm surges.

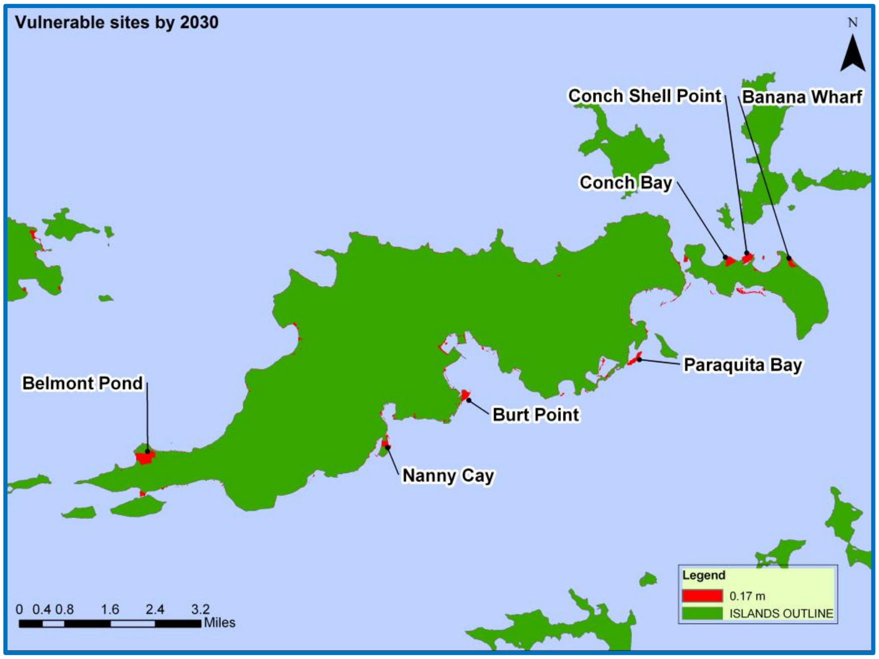


Figure 21.
Projected inundation depths of 0.17 m (0.56 ft) for vulnerable Tortola sites by **2030**, based on IPCC sea level rise scenario (*source*: DDM).

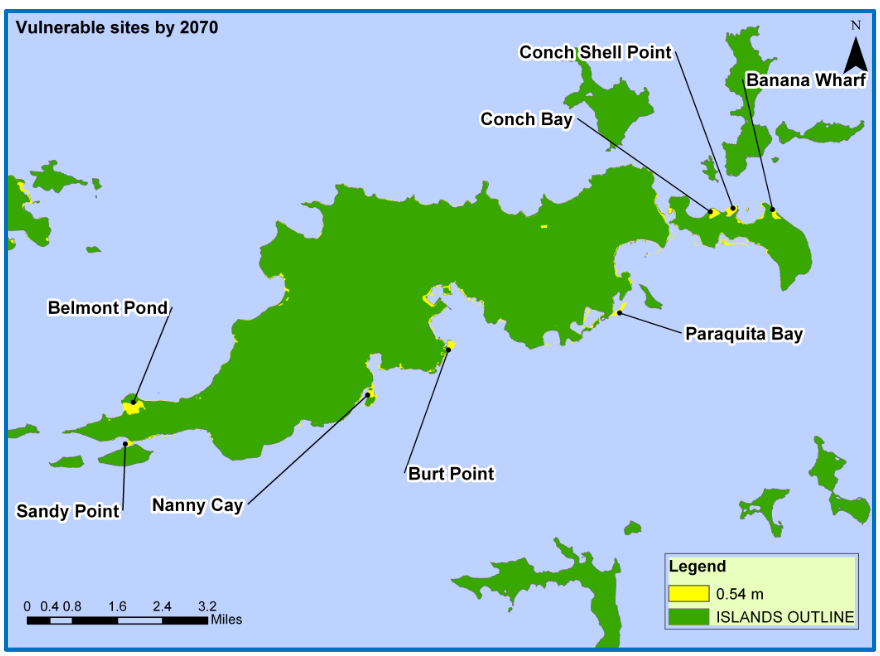


Figure 22.
Projected inundation depths of 0.54 m (1.77 ft) for vulnerable Tortola sites by **2070**, based on IPCC sea level rise scenario (*source*: DDM).

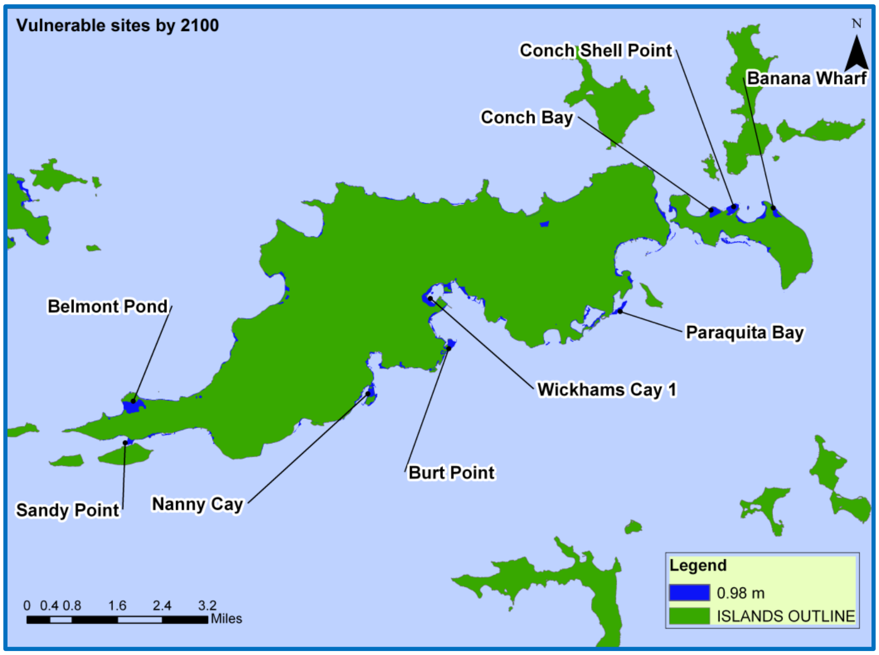


Figure 23.
Projected inundation depths of 0.98 m (3.22 ft) for vulnerable Tortola sites by **2100**, based on IPCC sea level rise scenario (*source*: DDM).

- Electricity system at greater risk of damage from floods, stronger hurricanes and storm surges.
- Loss of or costly damage to tourism infrastructure and properties from floods, stronger hurricanes and storm surges.
- Diminished natural tourist attractions, *e.g.*, coral reefs, beaches, and wildlife.

A Climate Change Adaptation Policy was developed as a result of the Climate Change Green Paper; it was approved by Cabinet in 2012. The objective of the Climate Change Adaptation Policy is to ensure that the local impacts of climate change are minimised through proactive planning and protective measures. To be successful, the Adaptation Policy must be fully integrated into territory-level planning and policy in all impacted sectors (DCF, 2012). See also Chapter 2, Section 2.2.4.9.

The portfolios of several territory-level, inter-agency committees or bodies allow them to have a direct influence on policies and decisions relevant to climate change adaptation. However, to fully accomplish these mandates, the Green Paper identifies major management gaps that need to be addressed by public sector managers and policy makers in: tourism and finance; land and critical infrastructure planning; water and electricity; the environment, agriculture and fisheries; and the health sector to ensure that adaptation strategies will minimise climate change impacts. According to the Green Paper, management gaps that need to be addressed include (Burnett Penn, 2010):

- A comprehensive Coastal Management Plan;
- Specific management plans for beaches (work is currently ongoing in this area; see Chapter 2, Section 2.2.4.10);
- A management programme for fish stocks;
- Management plans for designated Fisheries Protected Areas;
- A comprehensive Land Use and Physical Development Plan inclusive of zoning (see also Chapter 2, Section 2.2.4.5).

BOX 5

Benefits of Ecosystems as Natural Defences

Around the world, governments and communities are devising strategies for adapting to the negative impacts of climate change that are now seen as unavoidable. Adaptation strategies help society to plan better and minimise negative impacts, even turn new conditions to their advantage. Adaptation can take many forms: gathering information, drawing together stakeholders to plan for new climatic conditions, receiving early warning of disasters, or putting in place hard infrastructure. Another very important part of adaptation involves using nature to help adapt to climate change—often referred to as Ecosystem-based Adaptation or EbA (UNFCCC, 2011).

Preserving ecosystems to help adapt to climate change is of particular importance for islands, and many small island states in the Caribbean rely on the services ecosystems provide. For example, the value of coral reefs in the region has been estimated at between US$3.1 and $4.6 billion (€2.3-3.4 billion) for services such as fisheries, tourism and coastal protection (Mercer, *et al*., 2012).

A new study on the natural protection provided by coral reefs was published in the journal *Nature Communications* by an international team of researchers from the University of Bologna, The Nature Conservancy, U. S. Geological Survey, Stanford University, and University of California–Santa Cruz. (*Science Daily*, 2014). Key results from the study are as follows:

- Coral reefs provide substantial protection against natural hazards by reducing wave energy by an average of 97 percent (studies across all tropical oceans).
- The reef crest, or shallowest part of the reef where the waves break first, dissipates 86 percent of wave energy on its own.
- The median cost for building artificial breakwaters is US$19,791 per metre, compared to US$1,290 per metre for coral reef restoration projects.
- Coral reef restoration can be a cost-effective way to decrease the hazards coastal communities face due to the combination of storms and sea level rise.
- There are 197 million people worldwide who can receive risk-reduction benefits from coral reefs alone; alternatively, they may have to bear higher costs of disasters if the reefs are degraded. These are people in villages, towns, and cities who live in low-lying, risk-prone coastal areas (below 10 m elevation) and within 50 km of coral reefs.
- Restoration of coral reefs for coastal defence may be as low as one-tenth the cost of building artificial breakwaters. Reef defences can be enhanced in a cost-effective manner through restoration, a key factor in protecting small island nations and regions with limited fiscal resources.

3.1.10 Technological Hazards: Oil Spills/Hazardous Materials

Marine traffic—especially oil tankers, large cruise liners and cargo vessels in transit through the coastal waters of the BVI—present a risk for major oil pollution from collisions, fires and explosions, and groundings.

Land-based operations—such as fuel stations, garages and auto body repair shops—pose the greatest risk as sources of land-based pollution from spills, fires and explosions, and from improper disposal of petroleum-based waste products. Many industries in the Virgin Islands use oil and other pollutants in large quantities on a daily basis. The presence of such large quantities poses a potential hazard should there be an accident or if the products are not properly stored.

Because the disposal of oil and other pollutants at the Pockwood Pond landfill is costly and often inconvenient, illegal dumping of such products is common. The most likely place for such activity is in remote and environmentally sensitive areas.

The damage and pollution caused by a major oil spill or other harmful products would have a long-lasting and devastating effect on an environmentally sensitive area like the Virgin Islands. However, damage from an oil spill or other harmful products is not limited to major incidents; long-term leakage or dumping of small amounts, over time, can be just as harmful. Even small amounts in ecologically sensitive areas can lead to ecocide or other environmental issues (DDM, 2009).

Heavy metals, petroleum hydrocarbons (much of which comes from runoff of motor oil and other wastes from roads), and other toxic materials are a cause for concern because of their poisonous effects on aquatic life and because accumulation in the tissues of fish and shellfish can be harmful to human health.

Table 21 lists oils spills and hazardous materials events that have been reported on Tortola over the last ten years. The records were extracted from Anual Reports produced by the DDM. **Figure 24** shows the frequency of these hazard events over the last ten years.

Table 21.
Oil spills and hazardous materials events for Tortola (quantities in gallons).

Date	Type	Estimated Quantity	Location
September 2004	Fire	N/A	Wickham's Cay
January 2005	Oil Spill	N/A	Palestina
February 2005	Oil Spill	55	CSY Dock
February 2005	Oil Spill	55	Careering Hole
March 2005	Oil Spill	N/A	Cruise Ship Dock
March 2005	Oil Spill	N/A	Cruise Ship Dock
April 2005	Oil Spill	N/A	Cruise Ship Dock
April 2005	Oil Spill	N/A	Frenchman's Cay
May 2005	Oil Spill	30	Palm Grove
July 2005	Oil Spill	N/A	Sea Cow's Bay
September 2005	Oil Spill	N/A	Careening Hole
October 2005	Oil Spill	30,500	Pasea Estate
November 2005	Oil Spill	200	Road Town Ferry
December 2005	Oil Spill		Village Cay
January 2006	Oil Spill		Lloyd's Ghut
January 2006	Hazardous Materials Spill	N/A	Baughers Bay
January 2006	Oil Spill	N/A	Road Reef
January 2006	Oil Spill	N/A	Port Purcell
January 2006	Oil Spill	N/A	Road Reef
February 2006	Oil Spill	N/A	Road Harbour
March 2006	Oil Spill	N/A	Road Town
March 2006	Oil Spill	N/A	Long Bay
March 2006	Oil Spill	3,000	Baugher's Bay
April 2006	Fuel Tanker Explosion	N/A	Frenchman's Cay

Date	Type	Estimated Quantity	Location
August 2006	Oil Spill	1,500	Brandywine Bay
August 2006	Barge Sink	N/A	Brandywine Bay
September 2006	Oil Spill	3,200	Fort Burt
October 2006	Oil Spill	N/A	CSY Dock
December 2006	Oil Spill	265	Cane Garden Bay
April 2007	Oil Spill	1.000	Hodges Creek
May 2007	Oil Spill	200	Nanny Cay
October 2007	Oil Spill	200	Careening Hole
October 2007	Oil Spill	200	Pockwood Pond
December 2007	Oil Spill	500	Road Town
January 2008	Oil Spill	75	Road Town Ferry Dock
February 2008	Oil Spill	250	Pockwood Pond
May 2008	Oil Spill	200	Pockwood Pond
June 2008	Oil Spill	200	Hannah Bay
August 2008	Oil Spill	21	Sophie Bay
September 2008	Oil Spill	N/A	Public Works Department
October 2008	Oil Spill	25	Baugher's Bay
January 2009	Oil Spill	N/A	Road Harbour
April 2009	Oil Spill	N/A	Road Harbour
May 2009	Oil Spill	2,000	Pockwood Pond
May 2009	Oil Spill	75	Pasea Estate
June 2009	Oil Spill	N/A	Baugher's Bay
January 2010	Oil Spill	N/A	Port Purcell
February 2010	Oil Spill	N/A	Port Purcell
March 2010	Oil Spill	N/A	Trellis Bay
March 2010	Oil Spill	N/A	Duff's Bottom
May 2010	Oil Spill	350	Road Harbour
August 2011	Oil Spill	N/A	Road Town Jetty
August 2011	Oil Spill	N/A	Road Reef
April 2013	Oil Spill	N/A	Mooring's
December 2013	Oil Spill	N/A	Road Town Ferry
April 2014	Fire	N/A	Wickham's Cay

Source: DDM.

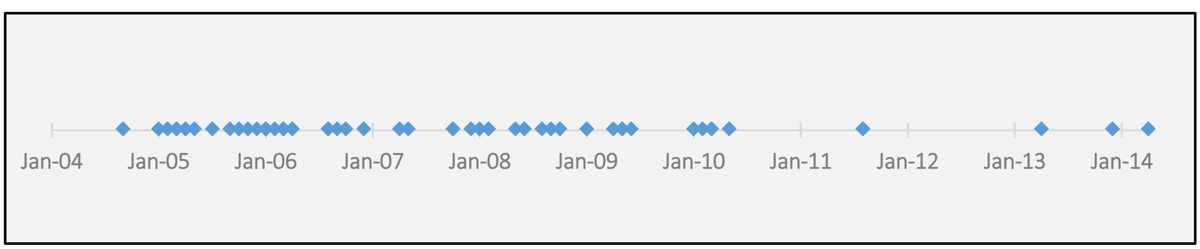


Figure 24.
Timeline of oil spills and hazardous materials events in Tortola from 2004-2014 (*source*: DDM).

3.2 Managing the Environment to Reduce Impacts from Hazard Events and Prevent Disasters

3.2.1 Development Practices and Increased Hazard Risks

The environment and disasters are inherently linked. For example:

- Environmental degradation affects natural processes, alters the resource base, and increases vulnerability to hazard events.
- Environmental degradation exacerbates the impact of natural hazards, lessens overall resilience, and challenges traditional coping strategies.

However, effective and economical solutions to reducing hazard risk by environmental enhancement are often overlooked. Little research and policy work have been undertaken on the subject. The concept of using environmental tools for disaster reduction has not yet been widely applied by practitioners (UN/ISDR, 2004).

In September of 1989, the centre of Hurricane Hugo passed 60 miles south of the British Virgin Islands. Wind speeds varied between 217-257 km (135 to 160 mi) per hour, storm surge was 0.9-1.2 m (3-4 ft), and wave height activity was estimated at 2.7-3.7 m (9-12 ft). Financial damage was estimated at approximately $40 million. Damage was sustained on all coasts of Tortola and Beef Island (Atwell, 1993).

In December of 1993, a report, *Post Hurricane Hugo Assessment Focusing on Sustainable Development Issues in the British Virgin Islands*, was produced by Lynette Atwell on behalf of the Pan American Health Organization. This post-Hugo assessment reported that environmental and physical impacts from natural hazard events are often the direct result of poor development practices, as displayed in **Table 22**.

Table 22.
Environmental impacts recorded in a post-Hurricane Hugo (1989) assessment for Tortola.

Causative Factors	→	Environmental Impacts
Uncontrolled sand mining Destruction of mangroves	→	Dune losses up to 9 m (10 yd) in Fat Hogs Bay, Brandywine Bay, Kingston Bay, and Josiah's Bay
Lack of development standards with reference to bulk heading Inadequate building setbacks Destruction of mangroves	→	Erosion of reclaimed lands was experienced in Road Town, East End, Fish Bay, Baugher's Bay, Sea Cow's Bay, The Towers Waves penetrated 27.5 m (30 yd) inland and moved stockpiled sand

Source: Atwell (1993).

In the disaster management sector of the BVI, Hurricane Hugo is often referred to as the territory's "*catalyst for change*." Following Hugo in 1989, the Department of Disaster Management emerged as an independent unit (in 1990) with the employment of the first full-time Disaster Preparedness Coordinator. Initial operations concentrated on the preparedness phase of disaster management until there was a paradigm shift towards what is known as Comprehensive Disaster Management (CDM), a concept that encompasses preparedness, prevention, mitigation, response and recovery. Today, the DDM is one of the leading national disaster organisations in the region (DDM, Annual Report 2013).

In reviewing the post-Hugo assessment (Atwell, 1993), the distinction between advances made in disaster management as opposed to advances made in environmental management becomes clearer. The purpose of the assessment was:

1) To focus on sustainable development issues;
2) To identify the lessons of post-disaster that resulted in development setbacks;
3) To recommend the most important mitigation measures that could be integrated in the territory's development trends for the future, including the identification of pathways for integrating disaster mitigation into the development process.

Many of the recommendations put forth by Atwell have been successfully implemented by the DDM. However, despite the progress made by the DDM, there are many recommendations that have not been implemented, and these are related to development planning and environmental management as illustrated in **Table 23**.

Table 23.
Status of mitigation recommendations from a post-Hurricane Hugo assessment.

Mitigation Recommendations by Atwell (1993)	2014 Status	Comments
Existing 50–foot building setback from the high-water mark is inadequate.	No change in development planning procedures.	Lack of Regulations for the Physical Planning Act (2004) impedes changes.
Mangrove areas should be conserved.	Provisions of the Physical Planning Act (2004) provide for the designation of "environmental protection areas" by the DTCP. None designated to date although Government drafted a management plan and national policy for salt ponds and mangroves in 2005 (DTCP, 2005). The document was never finalised or approved.	Lack of Regulations for the Physical Planning Act (2004) impedes changes. Mangrove wetlands might be more effectively protected and managed under comprehensive environmental management legislation currently in train (see Section 2.2.3.6, Chapter 2).
Detailed plans for marine areas, incorporating response-and-mitigation programmes, need to be developed.	Marine areas in the BVI can be protected in several ways: 1) Under the National Parks Acts (2006); only one marine park designated to date. 2) Under the Fisheries Act (1997); 14 fisheries protected areas have been declared under the Fisheries Regulations (2003). 3) Under the Physical Planning Act (2004) as "environmental protection areas;" none designated to date. Management plans for the designated marine protected areas have not been provided by either the NPT or the DCF. Several National Physical Development Plans have been prepared for the BVI (the most recent in 1996 and 2006). None of the Plans have been approved by Government. A new Plan is currently being developed by the DTCP (see Section 2.2.4.5).	It is not known why management plans for protected marine areas have not been prepared to date. It is not known at present whether a new National Physical Development Plan (under preparation 2014-15) will include detailed planning for the territory's marine areas.

In the post-Hurricane Hugo assessment report, Atwell wrote:

Mitigation is a major component of emergency management, yet it is the least understood, most complex and controversial of all measures. Unlike other aspects of disaster management, it occurs when no event is occurring and should form part of the everyday ongoing activities of many agencies and departments. Any mitigation programme must have as its focus the attainment of sustainable development, so that mistakes of the past are not repeated, and the potential for a more secure future is not sacrificed.

WHAT HAS NOT OCCURRED IN THE LAST 25 YEARS ARE SIGNIFICANT CHANGES IN THE CAUSATIVE FACTORS LINKED TO HAZARD EVENTS, SUCH AS THOSE LISTED IN TABLE 17. THE SAME MISTAKES CONTINUE TO BE REPEATED YEAR AFTER YEAR, HAZARD EVENT AFTER HAZARD EVENT.

As demonstrated in Figure 8 in Section 3.1.2, multiple hazard events have impacted Tortola since Hurricane Hugo. What also has occurred during the last 25 years is a substantial increase in population. Between 1990 and 2010, the population of the BVI increased by approximately 80 percent, with projections of annual tourist arrivals of more than 500,000 visitors to the territory per annum (PAHO, 2012).

3.2.2 Institutional Framework for Disaster Management

Atwell (1993) recognised the need to establish the framework necessary to achieve many of the recommendations put forth in her post-Hugo report.

In the B.V.I. some steps have been taken in the direction of integrating mitigative measures in the development process. [These] *are largely mitigative programmes designed by the Office of Disaster Preparedness, as well as proposals for the preparation of a Spatial Development Plan by the Town and Country Planning Department. However this is largely based on individual departmental initiatives and is not part of an overall cohesive policy on disaster mitigation. Like any other aspect of planning, disaster planning here meaning mitigation, should not be viewed as a separate chapter or sector but should form an integral part of all levels of the planning process which can inform policies and projects.*

Twenty-five years after 'the "*catalyst for change*" event represented by Hurricane Hugo, the accomplishments of the DDM have resulted in significant improvements in all the phases of emergency management. However, the responsibility for integrating disaster mitigation in the national development process ultimately lies with the territory's top policy makers as it is only at the national level that all-embracing strategies can be developed. As recognised by Atwell, the first step in the process of creating such linkages is placing responsibility at the highest levels of government.

Atwell's statement on the framework required to build an effective mitigation programme is evident in the challenges documented by the DDM in its Annual Report for 2013:

- While the Comprehensive Disaster Management Strategy is a national strategy, the DDM has borne most of the responsibility for implementing, monitoring and reporting, which has placed a significant burden on the department.
- There are sectors that have not come forward to participate in disaster mitigation because they do not understand the different phases of Comprehensive Disaster Management. Therefore, for the DDM to have maximum impact in mainstreaming CDM, it needs to ensure that it has on-going programmes focusing on sensitisation and awareness-building.
- While the DDM has successfully collaborated with the education and health sectors, much work still needs to be done to

build community-based and sector-based Disaster Risk Reduction initiatives in the tourism, financial services and food security sectors.

- The DDM has taken the lead for many national initiatives, *e.g.*, vulnerability and hazard assessment, tsunami and storm surge modeling. Other appropriate agencies now need to take over maintenance of such programmes, as has already occurred with the Town and Country Planning and the Public Works Departments.
- While concepts such as CDM and Climate Change Adaptation are concepts generally accepted in the BVI, they are not yet widely understood. Furthermore, there is not a commonly agreed upon set of criteria employed by Caribbean states for addressing how climate change is to be integrated into CDM.
- The outdated age of aerial photography and the inaccuracy of topographic datasets available to the DDM affect its ability to undertake hazard mapping and vulnerability and risk assessments. The National Geographic Information System needs to focus more on territory-wide GIS policy and standards. Consideration should be given to the creation of a National Data Repository.
- The DDM relies heavily on external funding sources for its programmatic work. These tend to fluctuate from year to year, and such funding is not always geared to national needs but to the objectives and mandate of external donors.
- The DDM's high dependence on external funding can negatively impact the rate and success of implementing future BVI disaster strategies. In addition, as a UK Overseas Territory, the BVI is not eligible for funding from a number of international development agencies.

3.3 Development Trends Affecting Natural Hazard Risk

Around the globe, land use and land cover changes are eroding the natural buffers that protect communities from hazard risk. These same changes often erode the capacity of humans to recover from disaster. Other environmental changes, such as anthropogenic global warming, will create new challenges to the security and sustainability of communities around the world. There are, however, opportunities to reduce disaster risk, and enhance community resilience (Global Alliance for Disaster Reduction, n.d.).

As stated earlier in this chapter, the BVI's population increased by approximately 80 percent in the decade between 1990 and 2010, with tourist arrivals projected at 500,000 visitors per annum (PAHO, 2012). Inevitably, increased development and expanded resource needs paralleled this growth and impacted every sector—social, economic, physical, and environmental.

The impact of BVI growth and development was documented following Hurricane Hugo in 1989 (Atwell, 1993), with major causative factors identified for damage to infrastructure, buildings, and the environment. These included:

1) Weak development standards and lack of maintenance of infrastructure.
2) Development located in areas that were considered vulnerable without measures taken to ensure that development was less exposed to severe hazard impacts.
3) Development in coastal areas in vulnerable locations relative to the sea, with a lack of observance of even minimal requirements for building setbacks.

While there has been considerable advancement in recent years in development control strategies employed in Tortola, many practices still fail to address the potential risks and consequential impacts inherent in land development activities, including:

- Minimally sized subdivision plots on steep hillsides.
- Insufficiently regulated development on steep hillsides.
- Inadequate drainage along major roadways.
- Inadequate drainage incorporated into residential and commercial properties.
- Inadequate setbacks from drainage pathways (ghuts).
- Inadequate design and construction of septic waste systems.
- Inadequate design of coastal reclamation projects.
- Inadequate building setbacks from coastlines.
- Removal/destruction of natural ecosystems, such as mangrove wetlands and salt ponds and mangrove stands.
- Inadequate slope stabilisation techniques.
- Inadequate shoreline stabilisation techniques.
- Unpaved roads.
- Inadequate waste disposal systems.

3.3.1 Planning and Building Regulations

Several planning initiatives, projects, strategies, and policies, focusing on risk reduction and mitigation planning, have been implemented in the territory and are provided in **Table 24**.

Currently, development applications submitted for review to the Department of Town and Country Planning must include a vulnerability assessment if the location or dimensions of the project appear to put the development at risk from hazard phenomena, whether natural or man-made. The Department of Disaster Management supports DTCP in this effort and conducts the hazard vulnerability assessment and prepares a report for each development requiring a hazard assessment.

Hazard vulnerability assessment reports are based on geological mapping and scientific models. In addition (and as important as the hazard data), recommendations are required for mitigation measures specific to each development and each hazard identified within the assessment. Mitigation recommendations may include:

- Cut-slope recommendations for the specific geologic formation associated with the project, based on the degree and direction of the slope.
- A geotechnical assessment of alluvial or reclaimed soils.
- A drainage plan.
- Erosion control recommendations.
- Coastal mitigation recommendations related to climate change adaptation measures.

The hazard data that is currently available from the DDM to assist applicants include the following:

- Storm surge inundation/flood hazard maps utilising high-resolution coastal topography data.
- Tsunami wave and surge inundation flood hazard maps utilising high-resolution coastal topography and bathymetry data.
- Wind and wave hazard maps.
- Reclaimed land maps.
- Bedrock and surficial geology maps and engineering characterisations.

- Landslide susceptibility, liquefaction susceptibility, and shaking amplification maps at high resolution.
- Comprehensive engineering vulnerability assessment of critical infrastructure, and development of vulnerability data collection methodology.
- Development and implementation of quantitative risk assessment methodology, with model runs for critical infrastructure.
- Compilation of multi-hazard risk mapping for "model housing" in the BVI.

The DDM is also working with the DTCP to identify development applications that require a geotechnical study to determine adequate design criteria in areas of reclaimed land, unconsolidated materials, and landslide vulnerability.

These efforts to incorporate hazard risk mitigation planning into development practices in the BVI are continually improving, particularly as coordination and collaboration are emphasised and implemented among key public-sector agencies overseeing land development in the territory.

Table 24.
BVI planning initiatives, projects, strategies and policies focusing on risk reduction and mitigation planning.

Project	Funding Agency	BVI Co-ordinating Agency	Objectives	Outputs	Status
Hazard and Risk Assessment Project (November 1997)	Caribbean Disaster Emergency Management Agency (CDEMA)	DDM	To provide information to mitigate losses resulting from hazardous events. The outputs were geared toward supplying agencies responsible for development planning and disaster management with information to assist in decision-making.	1. Hazardous mapping for hurricanes, land-borne flooding, seismicity, and landsides. 2. Inventory of risk elements. 3. Vulnerability analysis and loss estimates. 4. Mitigation and loss-reduction strategies.	Completed 1997
Quantitative Risk Assessment Project, Phase I and II (September 2006)	CDEMA GoBVI	DDM	To develop techniques and products to assist building/engineering professionals, developers, and the general public understand natural hazard risks and identify solutions for mitigating risks.	1. New storm surge inundation flood hazard maps utilising high-resolution coastal topography data. 2. Revised wind and wave hazard maps. 3. New maps and characterisation of reclaimed land. 4. New solid and surficial geology maps. 5. New landslide susceptibility, liquefaction susceptibility, and shaking amplification maps at high resolution. 6. Comprehensive engineering vulnerability assessment of critical infrastructure. 7. Quantitative risk assessment methodology with model runs for critical infrastructure. 8. Multi-hazard risk map for "model housing."	Completed 2006

Project	Funding Agency	BVI Co-ordinating Agency	Objectives	Outputs	Status
Regional Risk Reduction Initiative (R3I)	European Union, executed by the United Nations Development Programme	DDM	To develop the capacity, knowledge and tools to enable the mainstreaming of disaster risk management consistent with the Hyogo Framework for Action and CDERA-led Comprehensive Disaster Management.	1. Tsunami wave inundation modeling of scenario events, and creation of quantitative hazard maps. 2. High resolution storm surge inundation maps.	Completed December 2012
Community Disaster Risk Reduction Project for Anegada	Disaster Risk Management Sub-regional Programme, funded by the European Union and executed by CDEMA	DDM	To enhance human safety, to reduce social, economic and environmental costs of natural disasters, and to build more resilient communities.	1. Vulnerability analysis and risk profile (participatory approach). 2. Assessment of emergency communications. 3. Community Disaster Plan. 4. Community Preparedness Tool Kit. 5. Model Evacuation Policy. 6. Beach Restoration.	Completed 2013
Planning Regulations to the Physical Planning Act of 2004	CDEMA	DDM	To reduce the vulnerabilities associated with climatic events on the environment, through the development and subsequent application of Planning Regulations.	Regulations specified by the Physical Planning Act (2004) to include: 1. Procedures for environmental impact assessments and the form of environmental impact statements. 2. Incorporation of hazard vulnerability assessments to provide guidance for making decisions on development applications.	Pending Completion
Planning Database	Comprehensive Disaster Management Harmonised Implementation Programme, through CDEMA	DDM	To collect and monitor all development applications by linking all Government agencies with an integral role in development, as well as external stakeholders such as developers and individual applicants, and giving them the ability to track their applications in real time.	An electronic system to allow for the monitoring of planning applications and mitigation measures being implemented during early stages of the planning and development control process.	Completed 2013

Project	Funding Agency	BVI Co-ordinating Agency	Objectives	Outputs	Status
Enhancing Capacity for Adaptation to Climate Change in the Caribbean UK Overseas Territories	UK Department for International Development; managed by the Caribbean Community Climate Change Centre	DCF	To identify and assess the potential impacts of climate change in the BVI and the territory's vulnerabilities, adaptation options, and capacity to respond.	Virgin Islands Climate Change Green Paper	Completed August 2010
Climate Change Adaptation Policy	Climate Change Trust Fund (established 2015)	National Climate Change Committee	To ensure that the local impacts of climate change are minimised through proactive planning and protective measures.	Ongoing implementation of the Climate Change Adaptation Policy	Policy approved by Cabinet in 2012 Climate Change Trust Fund established in 2015
BVI Comprehensive Disaster Management Strategies: 2003-2008 2009-2013 2104-2018	GoBVI	DDM	To build the territory's resilience through disaster preparedness, risk reduction, mitigation, and Climate Change Adaptation. To integrate Comprehensive Disaster Management and climate change adaptation within Government. To engage the private sector and communities in building resilience and supporting preparedness and mitigation in the BVI.	• Strategy Framework • Results Monitoring • Evaluation and Reporting Framework • Strategy Implementation Plan	Strategies completed in: 2003 2009 2013

Issues, Conflicts, and Areas of Concern	Impacts of No Action/No Change	Short-term Options Long-term Recommendations
ISSUE ONE Lack of legislated authority that mandates an integration of environmental and development planning controls with hazard risk reduction.	Continued degradation of the environment and increased risk to persons and property from hazard events. Habitat destruction, loss of species, reduced quality of life.	**SHORT-TERM OPTIONS** **1.** Increase community and inter-governmental awareness of the need for improved integration of environmental concerns and development planning procedures with disaster management policies. **LONG-TERM RECOMMENDATIONS** **1.** Develop procedures to ensure that policy makers in all government agencies and departments link their forward-planning strategies with disaster management. **2.** Review and revise as necessary legislation that will support the integration of risk reduction in the activities of both the public and private sectors.
ISSUE TWO Inadequate emphasis on disaster management in Government's national planning agenda, an issue that is clearly demonstrated by the DDM's heavy reliance on external funding for implementation of its programmes and strategies.	Lack of multi-stakeholder participation in and support for the BVI's Comprehensive Disaster Management (CDM) Strategy will diminish successful disaster prevention and mitigation programming throughout the territory. Dependence on external funding sources reduces the feasibility of sustaining effective mitigation programmes in the BVI.	**SHORT-TERM OPTIONS** **1.** Government needs to provide increased support for implementation of the DDM's CDM Strategy III (2014-2018), which outlines detailed priority areas for focused project implementation across the public and private sectors.
ISSUE THREE Uncontrolled roadway drainage is a major cause of damage from hazard events in Tortola.	The overall drainage of Tortola's roads must be addressed if recent damage occurrences are to be avoided in the future, including: slope failures, sedimentation of coastal waters, pollution of cisterns, and habitat destruction.	**SHORT-TERM OPTIONS** **1.** The Department of Public Works needs to set as a priority the periodic clearing of all culverts from debris to allow for drainage in ghuts. Continued maintenance is a prerequisite to keeping culverts free from debris. **LONG-TERM RECOMMENDATIONS** **1.** The approval process in Town and Country Planning needs to include design-and-construction methods and standards that ensure reliable road and drainage infrastructure. Engineering input for road designs should be required, with an emphasis on access, constructability and drainage. *(continued)*

Issues, Conflicts, and Areas of Concern	Impacts of No Action/No Change	Short-term Options Long-term Recommendations
		2. Reinforce or rebuild embankments along roadways using rock gabions or retaining walls as necessary. **3.** Map the drainage network in the Road Town area and evaluate its suitability and efficiency to accommodate and dispose of runoff similar to that experienced in recent rainfall events discussed in this chapter's text.
ISSUE FOUR Inadequate drainage of ghuts has been identified as a major cause of damage from hazard events in Tortola.	See Issue Three	**SHORT-TERM OPTIONS** [These recommendations were put forth by Dr. Zoran Vojinovic after an assessment of the BVI's drainage systems (SKNVibes, 2012)]. **1.** Improve cooperation and integration between the DTCP, DPW, DWM, and DDM. **2.** Assess the current building process to identify areas where development should be restricted to allow for protection of drainage flow paths and to avoid development in hazardous areas. **3.** The DDM should consider more proactive disaster management strategies and implementation of early warning systems designed to address flood hazards. **LONG-TERM RECOMMENDATIONS** **1.** Widening of existing drainage channels and construction of new drainage channels. **2.** Development of detention/retention ponds. **3.** Development of sustainable urban drainage systems and measures such as: designated overland flow paths or swales, permeable car parks, using open fields to create natural ponds for capturing water, green roofs, infiltration trenches that lead to aquifers, and other non-traditional measures.
ISSUE FIVE Inadequate building setbacks on Tortola have led to a loss of natural resources.	If adequate setback parameters and exacting beach management guidelines are not implemented and enforced, construction and other human activities have the potential to cause significant coastal erosion and could increase the impacts from natural hazards (such as coastal flooding). *(continued)*	**SHORT-TERM OPTIONS** **1.** The DTCP should require applicants for development permits to undertake a coastal impact assessment if applying for projects in the coastal zone. **LONG-TERM RECOMMENDATIONS** **1.** The BVI Government should establish adequate setback requirements for all coastal developments in the territory. Such requirements should consider the following: *(continued)*

Issues, Conflicts, and Areas of Concern	Impacts of No Action/No Change	Short-term Options Long-term Recommendations
	Over time, these practices will contribute to the depletion of Tortola's natural resources. Improperly sited buildings and buildings with inadequate foundation support are especially vulnerable to the effects of coastal erosion.	**(a)** A coastal vulnerability assessment should be carried out using historical aerial photography to identify coastal change over time near any beach in the territory. Access to such data will help to improve decision-making about appropriate setbacks for development activities in the coastal zone. **(b)** Changing the term "*high water mark*" to "*natural vegetation line*" in designating setback requirements would provide a static survey position that can be more easily identified by anyone at any time, as well as on aerial maps. Where the vegetation line has been removed, the use of aerial photos can assist in making the determination. If this change was implemented, then setbacks such as the one described in the Land Development Control Guidelines of 1972 would thereafter begin from the vegetation line.
ISSUE SIX The construction of sea defences and the implementation of beach stabilisation projects are not always successful, whether in Tortola, other islands in the BVI, or elsewhere.	The possible adverse effects of shoreline stabilisation methods can be significant, including the following: • Increased erosion of the adjacent natural shoreline and scouring in front of stabilisation structures. • Reduced or degraded habitat for a variety of fish and wildlife species. • Impaired movement of organisms between aquatic and terrestrial habitat. • Altered physical structure of the water's edge, with changes to hydrology. • Local changes in water quality, including changes in temperature and increases in turbidity, nutrients and contaminants.	**SHORT-TERM OPTIONS** **1.** The BVI Government should establish adequate setback requirements for all coastal developments to allow for the natural fluctuation of the shoreline. **2.** All proposed engineering works along the shoreline in Tortola and elsewhere in the territory should require expert coastal engineering and environmental consultation prior to project approval, as well as the submission of design plans from a qualified coastal scientist. **LONG-TERM RECOMMENDATION** **1.** Once put in place, Government will need to enforce setback requirements and building regulations.

Issues, Conflicts, and Areas of Concern	Impacts of No Action/No Change	Short-term Options Long-term Recommendations
ISSUE SEVEN Continued loss of coastal resources from a lack of an adequate beach management policy and legislation.	If beach management guidelines are not implemented and enforced, construction and other human activities have the potential to cause detrimental erosion of the coastline, increase impacts from natural hazards (*e.g.*, coastal flooding), and deplete the natural resources of Tortola.	**SHORT-TERM OPTIONS** **1.** Footpaths to beaches should be created by Government or private property owners to ensure dune vegetation is not destroyed from trampling. In some cases, a raised boardwalk may be required to prevent interference with the dune system. The use of dune fencing is also recommended for dune restoration to help capture wind-blown sand. (For more information see: *Manual for Dune Management in the Wider Caribbean* found at: *http://www.cep.unep.org/issues/sanddunes.PDF*.) **2.** All proposed engineering works along the shoreline in Tortola and elsewhere in the territory should require expert coastal engineering and environmental consultation prior to project approval, as well as the submission of design plans from a qualified coastal scientist. **LONG-TERM RECOMMENDATION** **1.** The proposed Beach Management Framework for the BVI (see Section 2.2.4.10) should be approved and implemented by Government, perhaps as part of environmental management legislation current being drafted.
ISSUE EIGHT To ensure that safe and sustainable development is achieved in the BVI, design requirements applied to development projects (both public and private), and to the construction methods to be employed, need to incorporate appropriate building standards, drainage plans, and elevation and setback considerations to deal with the natural hazards such as: – recurring floods, – strong hurricanes and other wind storms, – earthquakes, – landslides, – storm surges, and – sea level rise.	With an increasing population and expanding physical development in the BVI, especially Tortola, the consequences of natural hazard events can be of disastrous dimensions in terms of impact on physical, economic and social infrastructure. Many impacts can be diminished if proper attention is paid to establishing and implementing building standards that mitigate the dimensions of disasters.	**SHORT-TERM OPTIONS** **1.** The Government of the BVI should take steps to: **(a)** Continue to enhance and improve mitigation planning within the key government departments and agencies charged with land use planning, development control, natural resource management, and disaster management. **(b)** Increase plot size requirements for steep slopes and develop subdivision application requirements. **(c)** Incorporate setback requirements for development activities in identified "high-hazard" areas. **(d)** Ensure that all aspects of proposed developments first address and then integrate topographic and natural features in the design and layout of projects. **(e)** Promote a multi-hazard approach to physical planning. (continued)

Issues, Conflicts, and Areas of Concern	Impacts of No Action/No Change	Short-term Options Long-term Recommendations
		(f) Ensure that in the planning phase for proposed land-use activities provisions are included for best management practices to control all types of potential erosion (*e.g.*, long-term erosion, storm-induced erosion, erosion due to inlets) and that erosion-control policies are employed when laying out lots and infrastructure near a shoreline. **(g)** Ensure that government-sponsored development projects are subjected to the planning requirements detailed in the Physical Planning Act (2004). **(h)** Employ a multi-disciplinary team approach to physical planning, including professionals with local knowledge and a variety of technical expertise and background. **LONG-TERM RECOMMENDATION** **(1)** Overtime, the Government of the BVI should implement procedures and policies for the following: **(a)** Require that all future coastal developments be constructed at adequate elevations or on pilings (no concrete structures) to ensure that natural dune systems are not disturbed and to allow for the uninterrupted flow of potential floodwaters. **(b)** Establish adequate setback requirements for all coastal developments. **(c)** Require that all roads be paved and incorporate adequate drainage within a reasonable period of time following the start of development. **(d)** Provide approved Planning Regulations under the Physical Planning Act (2004) (see Section 2.2.3.2). **(e)** Incorporate hazard risk reduction development-and-design parameters in the National Physical Development Plan currently in preparation (see Section 2.2.4.5). **(f)** Finalise the draft Beach Management Framework and the draft Wetlands Policy (see Section 2.2.4.10), or incorporate the provisions of each within comprehensive environmental management legislation currently being drafted.

4. BIODIVERSITY RESOURCES: THE TERRESTRIAL ENVIRONMENT[4]

As noted in Chapter 1, Tortola or "*Land of the Turtle Dove*" is said to have been given its "turtle dove" name by Christopher Columbus on sighting the island during his second voyage in 1493. But in fact, Columbus named the island "Santa Ana." This romantic view of the island's name is an intriguing story, but many authorities suggest that the island's name is derived from the Dutch *Ter Tholen*, named after an island off the coast of The Netherlands (see Section 1.2.2.2 of Chapter 1).

Nevertheless, "Land of the Turtle Dove" is perhaps more intriguing because it makes Tortola one of the few islands named for a native bird—and a great way to introduce the chapter on the biodiversity of the largest of the British Virgin Islands. Herein we explore the island's wild animals, plants and landscapes.

Although this chapter presents a summary of the terrestrial biodiversity of Tortola, it is by no means complete since there are species that are yet to be identified, taxonomic revisions that are ongoing, puzzles and questions that are still being investigated, and new discoveries yet to be made. There are also natural resources that may have been overlooked or missed during the current survey, but as time was their enemy, the authors of this chapter had to finalise their researches despite a desire to continue writing about the wonderful, even astounding, biodiversity of this island.

And yet, the team has tried to present the most salient aspects and details of Tortola's biodiversity. The authors hope that readers will be inspired by and learn from this review of the diversity of wild plants and animals that inhabit the "Land of the Turtle Dove."

4.1 Historical Studies of Tortola's Biodiversity

4.1.1 Studies of Tortola's Vegetation

The first person to focus attention on the natural flora and vegetation of the Virgin Islands is August Heinrich Rudolf Grisebach, a German medical doctor who also studied botany, phytogeography and other disciplines. He traveled widely throughout much of Europe and parts of the Middle East studying plants, vegetation, landscapes and cultures. He also visited the West Indies and collected and named many species new to science. One of his greatest works is *Flora of the British West Indian Islands*, first published in 1864 and updated and reprinted several times since. His work remains popular even today, being one of the first studies of its kind and offering initial records for many islands. His focus went beyond Tortola to include other British West Indian islands, thus allowing greater understanding and awareness of the species of native and naturalised plants that occurred during the early years of European colonisation.

Around the same period, Danish soldier, botanist and naturalist, Heinrich Franz Alexander Baron Von Eggers, published his work *The Flora of St. Croix and the Virgin Islands* in 1879. Egger's focus is mainly on the then-Danish island of St. Croix, but he does venture elsewhere to briefly describe the landscapes, farming practices, crops and some wild plants of Tortola. At that time, most of the Virgin Islands had been transformed by agriculture and human settlements, with little of the original forests remaining.

Egger's descriptions provide important glimpses of what life was like during that period, and how the native landscapes were transformed after European colonisation and development. He offers a basis for our understanding of how these changes took place and the impacts that these rapid and severe transformations had on habitats, species, local climate and ecosystem functions. It was not

[4] The authors of Chapter Four are Kevel C. Lindsay and Jean-Pierre Bacle.

only Tortola that experienced these dramatic changes, but all of the Virgin Islands.

Beginning in 1923 and ending in 1930, famed botanists and naturalists Nathaniel L. Britton and Percy Wilson began a series on the *Botany of Porto Rico and the Virgin Islands*. Britton is best known for his monumental works on cacti, the plants and landscapes of Cuba, and many discoveries of plants and animals in Asia. He was a well-known author who also studied the plants of the Virgin Islands, including many from Tortola, for which he provides records.

Stuart Danforth, eminent entomologist, ornithologist, zoologist and naturalist, worked from his base at the College of Agriculture in Puerto Rico where he taught. He visited many of the islands of the Greater and Lesser Antilles, focusing on birds, their foods and habits. Through his work, he increased awareness of bird and plant interactions, the natural control of insect pests on crops, improvements in farming methods and yields, and the landscapes of the islands he visited. He published two works relevant to the Virgin Islands, these being *Bird Records from the Virgin Islands* in 1930, and *Supplementary Account of the Birds of the Virgin Islands including Culebra and Adjacent Islands Pertaining to Puerto Rico, with Notes on their Food Habits* in 1935.

James Beard worked extensively throughout the West Indies, and in 1949 he published his well-known work on the vegetation of the Lesser Antilles and the British Virgin Islands entitled *The Natural History of the Windward and Leeward Islands*. He was intrigued by what he described as the unique vegetation on Sage Mountain, which he defines as "xerophytic rainforest," the only one of its type in the West Indies and similar only to the high elevation forest on the upper summits of Tobago (Tobago is more closely related to South America biogeographically).

Elbert Little and Frank Wadsworth of the U.S. Department of Agriculture in Puerto Rico wrote the first comprehensive handbook on the shrubs and trees of Puerto Rico and the Virgin Islands, describing many species, and providing line drawings of each plant profiled. The first volume was published in 1964, entitled *Common Trees of Puerto Rico and the Virgin Islands*. Volume Two, a more comprehensive work, followed in 1974 and includes Roy Woodbury as an author.

William D'Arcy, botanist, published his *Annotated Checklist of the Dicotyledons of Tortola, Virgin Islands* in 1967, in which he describes landscapes, vegetation, climate, and plant species from Tortola. His is the most complete list of this group of plants for Tortola to date, and provides an excellent baseline to compare more recent information, especially since he provides locations for many of his records.

Alain Liogier, a priest, naturalist and botanist, worked throughout much of the Antilles, researching plants and vegetation, and wrote several significant studies. His work on Virgin Islands flora culminated in publication of the five-volume series *Descriptive Flora of Puerto Rico and Adjacent Islands*, beginning in 1985 and ending in 1997. The volumes describe many native and naturalised species, including those of Tortola.

George Proctor, the region's most renowned fern expert, wrote the Virgin Islands' most complete and in-depth work on the ferns and their allies for this part of the region. Proctor visited and documented widely throughout the Virgin Islands over many years. His studies of pteridophytes resulted in the book entitled *Ferns of Puerto Rico and the Virgin Islands*, published in 1989. It provides descriptions of known species, including those of Tortola, with information on their habitats and locations on the island where they are found.

In recent years, the Royal Botanic Gardens, Kew has increased its involvement in the research and conservation of the flora of the British Virgin Islands. From the mid-1990s to the present, teams from Kew, working alongside the National Parks Trust, the Department of Conservation and Fisheries, and other local partners, have been diligently surveying, assessing and documenting the territory's native plants, with special focus on rare, endangered and endemic species.

Kew has published several works on the BVI, including *Status Report for the British Virgin Islands' Plant Species Red List*, (Pollard and Clubbe, 2003). Many of these works are available via the internet. Kew also maintains web portals, including blog posts, on its work in the BVI and other UK Overseas Territories, and these can be visited as follows:

- www.kew.org/discover/blogs/uk-overseas-territories
- www.kew.org/news/kew-blogs/welcome-to-uk-overseas-territories-blog.htm
- www.herbaria.plants.ox.ac.uk/bol/BVI/Home/Index
- www.herbaria.plants.ox.ac.uk/bol/ukot.

The latter is an online herbarium catalogue of the plants of the British Virgin Islands, including Tortola, which allows the visitor to search for species, locations and specimens of plants from each major island of the BVI. Kew and the NPT continue to map many of the rare, endangered and endemic species, and collect and preserve seed material for long-term conservation and management.

Other authorities have contributed to knowledge of the flora of Tortola and the Virgin Islands archipelago, including Eleanor Gibney, author, naturalist, botanist and historian. Gibney was born on St. John, USVI and has authored the book *A Field Guide to Native Trees and Plants of East End, St. John, U.S. Virgin Islands*, published in 2004. She has traveled widely throughout the Virgin Islands and is one of the most knowledgeable persons on the VI's flora and history.

Pedro Acevedo-Rodríguez has studied the flora of the USVI, especially of St. John, and authored *Flora of St. John, US Virgin Islands* in 1996, the most comprehensive work on the plants of any single Virgin Island to date. He participated in the first Darwin-funded project in the BVI undertaken by the NPT and Kew from 1998-2001. He continues to study plants and vegetation throughout the region, and maintains the most significant internet web portal for West Indian wild plant flora: www.botany.si.edu/antilles/WestIndies/index.htm.

4.1.2 Studies of Tortola's Fauna

The historical study of the fauna of the BVI follows a similar trajectory to that of flora, with many of the key players being common to both disciplines. Scientific research and environmental conservation in the Virgin Islands archipelago is largely a modern phenomenon of the twentieth century. However, the earliest studies of Virgin Islands' natural history began in the 1800s when European and American researchers, along with curious residents, first recognised the diversity and richness of the area's fauna and flora and began to collect, describe, and explain the natural world they explored.

The study of the fauna of the Virgin Islands has included a number of prominent experts. Nathaniel Lord Britton (1859-1934), founder of the New York Botanical Garden, was a renowned plant and herpetology expert whose influence on the study and understanding of the plants, amphibians and reptiles of the Virgin Islands is unquestioned.

Scholars such as Thomas Barbour (1884-1946), an American herpetologist who led the Museum of Comparative Zoology at Harvard University, explored the Virgin Islands, and many species are named after him. Barbour was the first to name the unique amphibian, the local toad *Peltophryne lemur* of Virgin Gorda, which is now thought to be extinct. In 1982, Dr. William P. MacLean at the University of the Virgin Islands in St. Thomas wrote the most significant and lasting study on reptiles and amphibians for the Virgin Islands, *Reptiles and Amphibians of the Virgin Islands*. It remains the single most comprehensive publication of its kind for the Virgin Islands to date.

For invertebrates, much of the early study and collecting of terrestrial insects and other non-vertebrates remains obscure. But by the 1920s, several individual collectors and research institutions had begun to shape our initial understanding of the Virgin Islands' diverse groups of invertebrates and their peculiarities and habitats. These included: the University of Puerto Rico; W.T. Forbes; Stuart Danforth of Puerto Rico; the Smithsonian Institution; the Museum of Comparative Zoology at Harvard; and West Indian naturalists George Seaman, Supervisor of Wildlife for the USVI Government, and his best friend and colleague, Harry Beatty, another VI native.

The birds of the BVI were celebrated by naturalist Rowan Roy of Tortola, who carefully observed and diligently recorded details on avifauna until his death early in the twenty-first century. Roy's years of exploration and study continue to the present in the person of biologist Clive Petrovic, whose love of all things BVI endow him with a commitment to environmental research and to sharing his knowledge of the territory's natural heritage.

4.2 Vegetation and Flora

Tortola often seems an island of illusions. From offshore, it appears much larger than it actually is. This is because of the steep slopes that hug and claw at Sage Mountain and the island's lengthy shoreline, indented with numerous bays and coves.

Tortola, the largest landmass of the BVI and third largest in all of the Virgin Islands (after St. Croix and St. Thomas), has the highest elevation of all with Sage Mountain at 543 m (1,781 ft). The island's rather high elevation contributes to steep valleys, indented bays and precipitous coastal cliffs.

From the sea, Sage Mountain rises above the peaks of many nearby islands, and Tortola often seems possessed by the clouds. Sage is regularly graced by these white and grey tufts, sometimes resulting in the optical illusion of the island seeming to float just above the sea, suspended from the sky by invisible chords.

4.2.1 Tortola's Vegetation Communities and Plants

Today, much of the mid-to-upper slopes of Tortola are covered in seasonal-deciduous woodlands and forests. But this was not always so. Paintings and photos of the slopes of many parts of Tortola from the 1800s to the early 1980s show that the island was largely deforested, and that much of the vegetation consisted of patches of low woodland, scrub, extensive areas of grasslands, pasture, occasional small fields of cultivation, and narrow ribbons of woodland along the ghuts. **Figure 25** shows a view from Ruthy Hill looking towards Road Town Harbour in 1827.

Figure 25.
View from "Ruthy Hill" looking south toward Road Town
(*source*: colour engraving by J. Johnson, 1827).

4.2.1.1 Tortola's Vegetation Types

There are approximately 23 vegetation types found on Tortola. **Table 25** provides a list of categories and types. **Figure 26** shows the distribution and locations for the communities. Both the vegetation types and the map have been adapted from Kennaway, *et al*. (2008). The IRF team has made adjustments to the 2008 material to accommodate: the distinct vegetation of Sage Mountain, which is regionally unique and rare; the woodlands and shrublands of the boulder fields on the eastern end of Tortola and at Beef Island; and the palm-dominated woodland on the western end of Tortola.

Today, the most extensive area of forest on Tortola is centred around Sage Mountain and on its north-western, western, and—in small patches—south-western slopes. On the upper summit is the xerophytic rainforest as described by Beard (1949). Further down the slopes are evergreen forest—less humid and with a somewhat more divergent mix of species than at the summit—and, in drier and more exposed areas, a seasonal-evergreen community occurs. Smaller patches of this seasonal-evergreen forest also occur throughout much of the northern coast and on lower hills and on the southern side of the island, especially the central western area. Here, the introduced and often invasive Tan Tan (*L. leucocephala*) may dominate.

On Beef Island, seasonal-evergreen forests and woodlands dominate much of the island. On the summits of the two highest points of Mount Alma, small patches of dry evergreen forests occur.

On the eastern end of Tortola near Balsam Ghut on the northeastern coast, small patches of boulder field woodland are found, somewhat reminiscent of the boulder fields on Virgin Gorda. Huge boulders pile onto each, thereby forming cavities and pockets that create opportunity for certain types of plants. On these rocks, trees such as *Clusia rosea*, *Ficus* spp., many vines, and numerous bromeliads abound, sending long aerial roots to drop down to the floor like ropes, thus helping to keep the rocks in place and retain rare and precious soil and organic matter. **Photo 20** shows a small patch of this woodland.

Photo 20.
Boulder field woodland at Balsam Ghut, Tortola.

Unfortunately, roads have cut into the area and are fragmenting the habitats, possibly exposing the community to severe solar radiation and drying winds, flooding, and the loss of precious organic material and soils. Further road and home developments are likely to exacerbate this situation. The bromeliad collections here are quite extensive, and there are several species, including some unusual hybrids, whose identifications are proving to be an ongoing challenge. These form large masses on rocks and trees, collecting dead and decaying plant and animal material that is slowly converted to soil, providing nutrients for the community. The bromeliads also store water, used by other plants, birds and other animals, especially during dry periods. Nowhere else on Tortola does such an extensive collection of bromeliads occur.

The boulder field vegetation on Beef Island is dominated by numerous vines, stunted trees, columnar cacti, *Tillandsia utriculata* bromeliad and the occasional *Clusia rosea* tree.

On the western peninsula of Tortola, forests and woodland communities intermix. On the south, drier conditions prevail and the trees are limited in height. Here too, the Tree Cactus (*Consolea* cf. *rubescens*) occasionally occurs, an indication of the prevailing drier conditions. The vegetation is also relatively young, dominated by the Tan Tan. This suggests that it started re-growing, perhaps sometime in the 1960s. Because of the limited availability of water and low humidity, complete restoration will take considerable time.

Table 25.
Vegetation and community types for Tortola.

No.	VEGETATION AND COMMUNITY TYPES
	Woodlands & Shrublands
1	Drought Deciduous Dense Woodland
2	Drought Deciduous Open Woodland
3	Boulder Field Evergreen Woodland
4	Boulder Field Evergreen Shrubland
5	Evergreen Palm Woodland
	Forest
6	Xerophytic Rainforest
7	Evergreen Gallery Forest
8	Deciduous, Evergreen Mixed Forest and Shrubland with Succulents
9	Seasonal Evergreen and Evergreen Forest
10	Semi-Deciduous and Drought-Deciduous Forest on Alluvium and Non-Carbonate Substrates
11	Seasonal Evergreen Forest with Coconut Palm
	Forested & Herbaceous Wetlands
12	Mangrove
13	Seasonally Flooded Savannahs and Woodlands
	Herbaceous Communities
14	Herbaceous Agriculture (Cultivated Lands)
15	Pasture, Hay or Inactive Agriculture
16	Pasture, Hay or Other Grassy Areas
	Sparse Vegetation
17	Bare Soil
18	Salt and Mud Flats
19	Quarries
20	Coastal Sand and Rock
21	Water – Permanent
	Urban/Developed Areas
22	High-Medium Density Urban
23	Low-Medium Density Urban

Source: Adapted from Kennaway, *et al*. (2008).

Although the native Thatch Palm (*Coccothrinax barbadensis*) (see **Box 6**) occurs on the southern slopes of the west end peninsula, it is more prevalent on the northern side, dominating the forest in some areas. The vegetation here is taller, more sheltered and better able to trap moisture and increase humidity levels. Some tall examples of *Bursera simaruba* dominate, as well as *Mastichodendron foetidissimum*, one of the larger emergent species, especially in sheltered gullies.

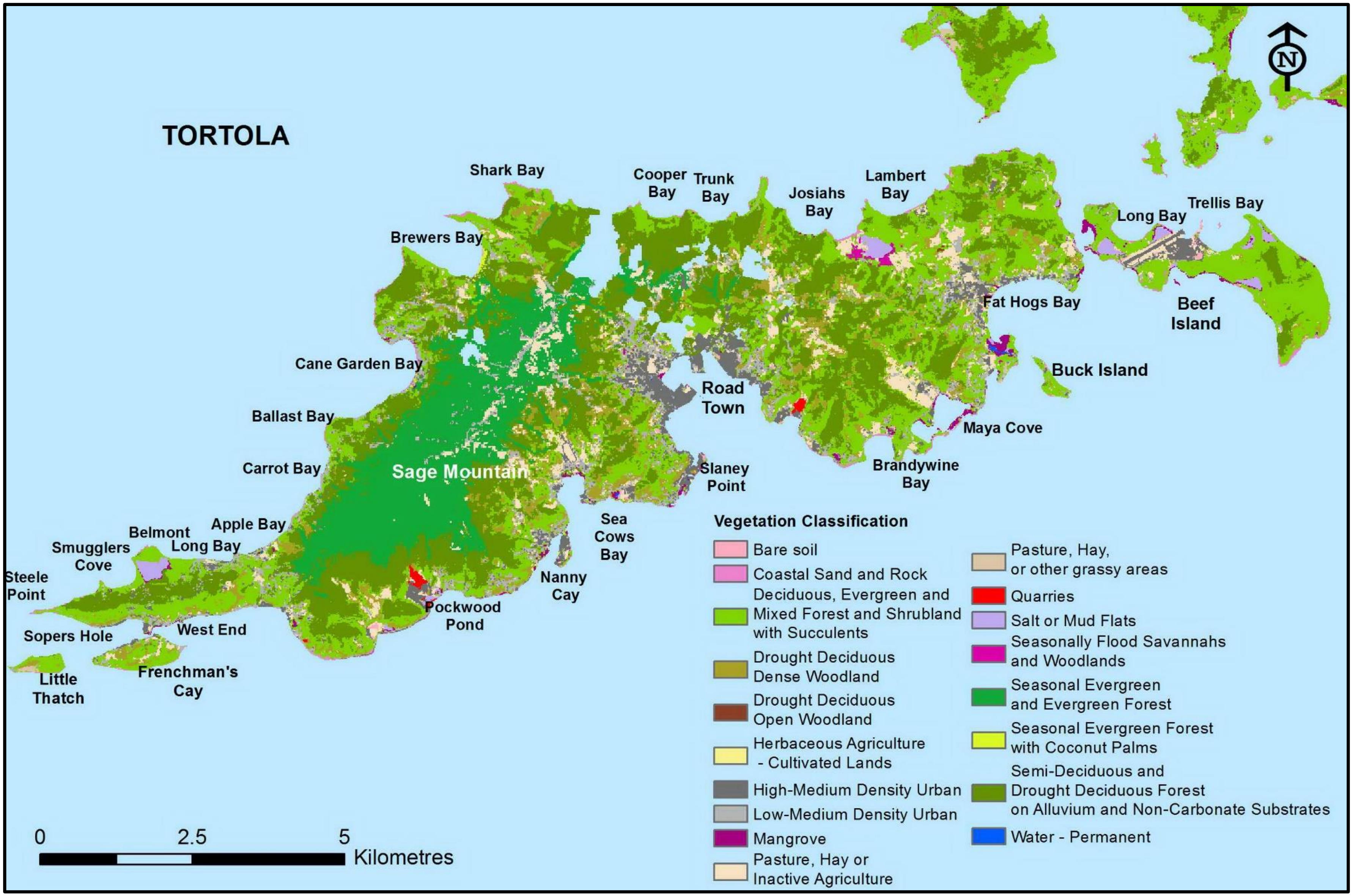


Figure 26.
General vegetation map of Tortola and nearby islands (*source*: Kennaway, *et al.*, 2008).

Nevertheless, this area also has a road, and this has opened up the canopy to the dry desiccating winds and solar radiation, exposing some sensitive species such as the ferns *Cheilanthes microphylla*, *Asplenium pumilum* and *Microgramma heterophylla*, all of which struggle to survive and maintain viable populations. **Photo 21** shows the seasonal-evergreen community on the northern slopes of the western peninsula.

Photo 21.
Evergreen Woodland at west end peninsula, Tortola.
Note the Thatch Palm in the centre.

BOX 6

A Short Note on the Virgin Islands Thatch Palm

This well-known and distinctive palm is found in dry woodland and on forests slopes of most of the Virgin Islands as far west as Puerto Rico. For much of the twentieth and early twenty-first centuries, it was considered to be endemic to the Puerto Rico Bank and was given the species name *Coccothrinax alta*. But in the last few years, some authorities have associated it with the more widespread *C. barbadensis*, found down the Caribbean island chain to Trinidad. It is understandable why historically it was classified as distinct, given its more slender trunk, smaller crown, and other characteristics. This suggests that the group as a whole needs more in-depth and careful field study and assessment to determine the ecological, biological/morphological and genetic characteristics of this beautiful palm.

In some areas along the coast, mangrove forests and woodland communities occur. One hundred years ago, these communities were far more extensive and widespread, even providing habitat for the now extinct Sea Cow or West Indian Manatee (*Trichechus manatus*). But as tourism became a dominant economic activity in the territory, many mangroves were removed and replaced with hotels, marinas, residences, roads and other infrastructure.

It has been estimated that Tortola has lost about 47 percent of its mangroves (including coastal marshes and salt flats and salt ponds) since the 1950s (Jarecki, 2006). Beef Island has lost much less due to less coastal development. **Photo 22** shows a Red Mangrove (*R. mangle*) forest and salt pond at Conch Bay salt pond on Beef Island (referred to as Runway Pond by Jarecki, 2006).

Photo 22.
Red Mangrove forest at Conch Bay Salt Pond, Beef Island.

On rocky coasts, dry desert communities thrive. These are dominated by cactus species including the *Consolea* cf. *rubescens*, *Melocactus* cf. *intortus*, *Mammallaria nivosa*, *Hylocereus trigonus* and *Pilosocereus royenii*. Both *Melocactus* and *Mammillaria* grow on rocks, finding niches in thin, dry, saline soils, or in small cracks. The cacti grow in direct association with many evergreen and deciduous shrubs and trees, including *Lantana* spp., *Piscidia carthagenensis*, *Randia aculeata*, *Coccoloba uvifera*, Tan Tan, and *Plumeria alba*, among others. There are also several herbaceous plants, primarily grasses, and the bromeliad *Pitcairnia angustifolia*.

Photo 23.
A cacti landscape dominates the south-facing coastal cliffs west of Pockwood Pond.

Unfortunately, this coastal desert community is under severe threat from road development, housing, frequent cliff collapses, increasing storm surge and rising seas. **Photo 23** shows a cacti landscape on one of Tortola's coastal cliffs.

4.2.1.2 Primary Vegetation Habitats

Following are descriptions of seven vegetation habitats on Tortola. Most are under varying levels of threat due to development and encroachment. Others, such as "native grasslands" and "boulder fields," are of special conservation concern because of their uniqueness and restricted range.

(1) Wetlands

Most of the wetlands of Tortola are found near or along the coast. These are primarily mangrove-associated systems that rely on frequent rainfall runoff from the land and seawater flushing and tidal inundations. But Tortola has lost much of its wetland habitats. Today, there are no natural freshwater systems aside from those found in ghuts. Gone are the freshwater marshes that were once associated with brackish flashes, salt ponds and salt flats.

Most of the mouths of the ghuts, such as those that fed Road Harbour and nearby areas, have now been fortified and lined with concrete to help reduce flooding, rock and soil deposition, and erosion. However, in the process, the unique biodiversity of the island's wetlands has been sacrificed, along with the natural protections that these wetlands offered. There are a few small artificial freshwater ponds scattered about Tortola, such as the sediment ponds near the airport at Beef Island.

Dr. Lianna Jarecki (2006) reports that over the last 50 years, a little less than half (47 percent) of Tortola's mangrove wetlands have been destroyed or reduced in size, importance and function. The wetlands of Tortola are listed in Table 1 (Chapter 1). This trend continues today, and the remaining wetlands around Road Town, Sea Cow's Bay, the West End, Beef Island and the north coast are under severe threat from tourism-related development, housing and road construction, pollution, erosion and sedimentation, marina construction and expansion, loss of seagrass and other coastal ecosystems, climate change and sea level rise.

(2) Rain and Moist Forests

By the early twentieth century (1900 to the 1940s), the xerophytic rainforest at Sage Mountain was but a mere patch of trees and scrub woodland, a far cry from the original extent of the forest. Surrounding the area were open patches of livestock pasture, crop farming, and fallow and abandoned lands. By the 1960s, efforts were undertaken to protect the last remaining tract, and the Sage Mountain National Park was created (**Box 7**).

The establishment of this protected area allowed the lands in the surrounding areas to revert to natural habitat, and the rainforest grew in size and extent. Many species such as the West Indian and Honduran Mahogany and the White Cedar were planted after the land was acquired by Government. Today, the rainforest has expanded downslope to include areas on the northeastern edge, the northwest areas above Great Carrot Bay and areas west, as well as to small valleys south and southwest.

Where moisture becomes less readily available, either because of reduced rainfall and/or increasing evapotranspiration, the forests become relatively small in stature, have fewer species overall, and many lose their leaves during the annual dry season.

BOX 7

Sage Mountain's Unique Rainforest

The Sage Mountain National Park was established in 1964 after Laurance S. Rockefeller, international businessman, philanthropist and conservationist, purchased lands from farmers in the area, which he then donated to the BVI Government to establish the territory's first park. It is not only symbolic that the highest point in the Virgin Islands represents the pinnacle of the BVI parks system, but also the beginning of a determined effort for the conservation of natural areas in the territory.

The Park is centred on a small patch of rainforest, a rare and exceptional plant community in the Virgin Islands. Long before Rockefeller and others set eyes on Sage Mountain, the area was already well recognised as a distinct Caribbean ecosystem by renowned botanist and forester, John Stanley Beard. He was the first to shed light on many of the region's forest and woodland habitats, especially those in need of protection.

Beard (1949) called the Sage Mountain forest a "xerophytic rain forest." He writes:

> *… present on Sage Mountain, Tortola, a fragment of a most interesting and unusual forest type…. The forest of Sage Mountain … corresponds very closely to the 'xerophytic rain forest' described by the writer in Tobago (1944)…. Floristically this is the most distinctive assemblage in the Virgin Islands…. The xerophytic rain forest of Tortola … is floristically unique. No such assemblage has been reported from Puerto Rico and nothing like it occurs anywhere in the Lesser Antilles. Its nearest relative is in Tobago where the dominant species are practically identical*.

He goes on to report:

> *Some of the large old bullet trees in the forest are evidently of great age and it is reasonably probable that the forest is actually primaeval and that the land has never been under cultivation*.

In the 1700s to the early 1800s, much of the land of Tortola, even up to the summit, was once cleared and cultivated, and this is still evidenced by the old charcoal pits, walls, terraces and the many introduced species that still persist there. But the core of the rainforest was able to hang on just long enough for conservation efforts to help restore the area into the beautiful forest we see today.

The rainforest is home to rare tree ferns (*Cyathea arborea*) and the endemic melastome (*Miconia thomasiana)*. Nowhere else in the Virgin Islands is there such an assemblage of plant species, habitats and the attractive interplay of colour, texture, views and context, with verdant ferns dripping wet, giant Heliconias with their red and yellow blooms, elephant ears with their leaves over 3 m (6 ft) wide, huge trees with buttress roots and bromeliads standing on narrow branches like ballet dancers perched on tightropes.

(continued)

But there is still much to learn about the unique Sage Mountain plant community. Every visit by researchers to the site turns up new plant records or something puzzling and exciting. As forests return, new challenges will present themselves, and new trials will test the resilience of the National Park and its surrounding areas.

Though the actual boundaries of the Park are relatively narrow and focus on the highest peaks and oldest patch of forest, some impressive and important habitats now occur outside the Park. Unfortunately, within the last five years, home construction has been increasing near the summit of the Mount. These developments now threaten the integrity and long-term prospects for the survival of the unique xerophytic rainforest. However, the recently approved Carrot Bay Development Plan prevents development of parcels along the northern boundary of the Park.

As Sage Mountain National Park turns 50, and as residents and visitors increase demands on this fragile ecosystem, scientists, naturalists, park managers, and residents all need to work hard to find ways to protect the Park's richness by expanding its size.

Photo 24 shows new colonies of giant Elephant Ear growing in seasonal-evergreen woodland near Arundel at Sage Mountain. This area will likely become transformed into a "moist" forest community over the next 10 to 15 years if left undisturbed.

Photo 24.
A spectacular stand of giant Elephant Ear near Sage Mountain.

As population and incomes grow, homes will continue to encroach on the forests and woodlands at Sage Mountain. Even within the highest points of the protected park area, homes, roads and other structures are to be found (**Photo 25**).

Photo 25.
Residential development near the entrance to Sage Mountain National Park.

(3) Beaches and Dunes

Beaches and dunes are at the forefront of the changes that will result from sea level rise and climate change as stronger and more frequent storm surges occur, especially during the rough seas of the winter months from October to March. We know that the amount of sand on some beaches ebbs and flows during differing periods of the year, but we still have much to learn and understand about the natural dynamics of sand movements.

Beaches and dunes are targets for coastal development. They are increasingly bulldozed, contained, and impacted by intense human pressures, especially for hotel and residential development.

There is a general attitude in the BVI territory, and indeed across the Caribbean, that coastal systems are resilient and therefore are able to withstand impacts from infrastructure development and increasing numbers of resource users. Even when natural beaches and dunes remain, these often become playgrounds and recreational sites with many eventually cleared of natural beach vegetation to create "park-like" settings.

Photo 26 illustrates the results of clearing natural vegetation at Long Bay, Beef Island, a beach treasured by residents for its cultural significance and beautiful setting. **Photo 27** shows a beach coastal community on Beef Island with blooming native orchid, *Tetramicra caniculata* [formerly *T. elegans*].

Photo 26.
Evidence of bulldozing of woodland at Long Bay, Beef Island. Note the clear undergrowth and the bare and sparsely vegetated ground.

Photo 27.
The native orchid (*T. caniculata*) found on a natural and undeveloped beach at Beef Island.

(4) Coastal Desert and Scrub Communities

Like natural and undeveloped beaches and dunes, coastal scrub areas, where cacti and other plants thrive, have largely disappeared due to coastal development, especially to cut easy-access roads for vehicular traffic, tourism infrastructure and upscale homes. These native plant communities were most common on the southwestern coasts, on Frenchman's Cay and the northeastern coast of Tortola. However, most of these have been destroyed or reduced to small patches, and this community is in danger of extinction on Tortola. **Photo 28** shows the small relicts of a coastal desert community along the cliffs near Fort Recovery, where the main access road has devastated much of the habitat.

Photo 28.
Coastal desert and scrub community near Fort Recovery, Tortola.

(5) Native Grasslands

The native grasslands of the BVI are largely understudied by researchers. These areas are quite small, some covering just a few square metres, and it is believed by some that for natural grasslands to be viable ecosystems, they would need to extend to dozens of hectares. The natural savannas of islands such as Trinidad, or in South America, seem much more compelling and attractive for comprehensive studies. As a result, many small patches of herbaceous grasslands and cryptogamic (seedless) plants—indulging some mosses, fungi, algae and others) plant communities—have been easily removed for development. So far, the only native grasslands known on Tortola are on the southeastern dry cliffs of Beef Island, and these exist in very small relict patches.

Photo 29.
An upland savanna near Sage Mountain.

On Sage Mountain, high elevation savannas or "glades" would have been fairly common prior to European colonisation. These were created when landslides occurred, or when storms and other disasters cleared thick forests and woodlands, allowing direct sunlight, heat, wind, and rain to penetrate the soil.

These communities were usually created on the upper steep slopes of Tortola where soils were thin and too poor to support a forest. These upland savannas would be populated by ferns, grasses, sedges, orchids, other herbaceous plants, dotted with small trees and clumps of shrubs. Some of these areas were temporary, as trees and shrubs slowly recaptured the site, thereby shading out the smaller plants. However, some would have been permanent. **Photo 29** shows an upland savanna formed as a result of agricultural, land clearing for roads and infrastructure.

(6) Boulder Fields

Boulder field vegetation communities are uncommon in the BVI. These communities usually differ markedly from one another as they may possess different species and dissimilar species compositions and populations due to boulder size, rainfall, elevation, orientation to prevailing winds and sun exposure. Common in large boulder fields are the cacti species *Clusia rosea*, and/or large bromeliad communities. This vegetation community is severely threatened on Tortola by road construction, housing development, and habitat fragmentation.

(7) Evergreen and Deciduous Woodlands, West End, Tortola

Like many of the coastal vegetation communities of Tortola, this community is threatened by road development, housing construction, habitat fragmentation, invasive species and exposure to the elements. **Photo 30** shows the road cut through the community in the West End of Tortola.

Photo 30.
Access road bulldozed through and fragmenting the evergreen and deciduous woodland, West End, Tortola.

4.2.2 Plant Species

Tortola, including Beef Island, has over 1,110 species of native and naturalised plant species. From the heights of Sage Mountain to the shallow mangrove ponds of Bluff Bay, trees, shrubs, vines and herbs clothe the island like a protective patchwork quilt of greens, browns, violets, yellows, beiges, reds, and an unending spectrum of other colours. **Table 26** provides a summary of the physiognomic categories of Tortola's plants. The single largest group of plants is the herbs, these making up about 43 percent of the total. Of the members of the Poaceae, the grasses (under herbs) are the most significant group, with about 67 species. Nearly a third of the grasses are introduced species.

A comprehensive list of plants for the island is provided in a supplemental document to this Environmental Profile (*Addendum I to the Tortola Environmental Profile: Preliminary List of Plant Species*) and is available at IRF's website at www.irf.org.

Note that this list of plants does not include some very important groups of the island's flora, including fungi, most algae and the lichens. Though some preliminary work on these groups has been completed, the information is very outdated, difficult to access, presents an insurmountable challenge to assimilate into this Profile, and requires a separate and more dedicated effort to complete.

Following is a description of six sample species selected for their uniqueness. Most are listed as Species of Special Conservation Concern in Section 4.2.3, **Table 27**.

(1) St. Thomas Melastome

There are many regional endemics and species that are rare, endangered and of special concern, but the one unique to Tortola is the St. Thomas Melastome (*Miconia thomasiana*) (**Photo 31**). This species was perhaps once found on St. Thomas, but today, it is known only from Sage Mountain on Tortola. The plant grows as a large shrub in the undergrowth of moist areas of forest, is not uncommon, but seems very vulnerable to disease since all plants observed showed some form of infestation, perhaps a virus or a small mite, that causes small and deformed leaves, discolouration, die-back, small galls, and poor bud development. To what extent this is affecting the overall population and survival of the species remains unknown.

Photo 31.
The endemic St. Thomas Melastome at Sage Mountain.

In addition to the Melastome, many other intriguing species are found at Sage Mountain, on nearby slopes, and along ghuts and other parts of Tortola. The IRF team encountered many identification puzzles during field surveys. Many of these plants have previously been assigned to known species, but assessment by the IRF team in 2014 revealed a number of questions that require more in-depth study before definitive conclusions can be reached. Many of these have temporarily been assigned to known or previously assigned species identifications, or have been tagged with question marks for further analysis. Below are a few examples.

(2) *Anthurium cordatum* Red Morph

The IRF team labeled this plant (**Photo 32**) a Red Morph of the more common and widespread *A. cordatum*. It differs from the more typical form by a narrower and more pointed, arrow-shaped leaf, a reddish tinge to the herbaceous parts of the plant, its inflorescence, and a relatively smaller overall size. It is likely to be a rare red form of the more common green type.

Table 26.
Physionomic categories of plants found on Tortola, including Beef Island.

Category	Numbers	Percentage
Herbs	474	43%
Shrubs	174	15%
Trees	319	29%
Vines	143	13%
Total	**1,110**	**100%**
Families	*135*	
Origin	**Numbers**	**Percentage**
Native	742	67%
Introduced	368	33%
Total	**1,110**	**100%**

NOTES TO THE TABLE:

(1) About 37 percent of introduced species have become naturalised.
(2) The table represents a working list, and with more fieldwork and research, many more species will be added. The data are not absolutes, but the figures nevertheless help to shed light on Tortola's extant plants.

Photo 32.
Red Morph (*Anthurium cordatum*) at Sage Mountain (red colouring indiscernible in the photo).

Photo 33.
Giant Elephant Ear at Arundel near Sage Mountain.

(3) Elephant Ear

A relatively large-leafed form of the Elephant Ear (*Philodendron giganteum*) occurs at Mount Sage, although it is rare (**Photo 33**). It is more terrestrial though sometimes it does grow up into trees. It can be distinguished by the rather large leaves that are 2 m (6 ft) in length, thick and robust petioles, and the entirely green spathe instead of the reddish-russet-yellow-green of the more typical form.

(4) *Vriesia* Bromeliad

A species of *Vriesia* bromeliad is common in moist areas of Sage Mountain (**Photo 34**). It is primarily arboreal, occurring high up in the canopy, on tree trunks, on rocks and sometimes on dead logs and on the ground. It grows singly or in small colonies or with other epiphytes such as orchids, other bromeliads, ferns, mosses and lichens. Mature plants seem to flower only at certain times of the year, unlike some other species of bromeliads. *Vriesia* species

Photo 34.
Hundreds of the *Vriesia* Bromeliad on rainforest trees at Sage Mountain.

are known from Puerto Rico, other parts of the Greater Antilles, the Lesser Antilles and tropical America. It is likely one of the species common on Puerto Rico, but absent from the other Virgin Islands.

(5) *Melocactus intortus*—Turk's Cap Cactus

The Turk's Cap Cactus (*M. intortus*) (**Photo 35**) is widespread, found in Hispaniola, Puerto Rico, the Virgin Islands, and some of the Lesser Antilles. At least two subspecies are currently recognised, but the genus in the region needs further study and understanding. Many forms have been proposed in the past, but conservative taxonomists have opted to keep such species numbers low until more definitive data become available.

Photo 35.
Turks Cap Cactus in Tortola.

The group is named for the wooly, red-prickled cephalium on the top of the plant, which to some resembled the cap worn by male Turks during the Ottoman Empire. In the Virgin Islands, *M. intortus* occurs on several islands, and can get quite large, sometimes growing to over one m (3 ft) when mature.

But the form on Tortola, nearby cays and parts of St. Thomas is smaller in size with more prominent separation of the ribs; it is squatter, typically a shorter cephalium, and the flowers begin opening by mid-afternoon and are fully open by early evening. Typical *M. intortus* opens by 2 or 3 in the afternoon in some populations, but begins closing by the time darkness has set in.

(6) White Cedar with Large Leaf

Most of the native Tabebuias of Tortola and its sister islands typically belong to species *T. heterophylla*—a plant with leaves midway between this mystery form and *T. lepidota*, which has very small leaflets measuring about 3 to 11cm (1.1 to 4.3 in) long. Introduced Tabebuias, Cedars or Poui trees, as they are called in some places, typically have larger leaves, reaching over 15 cm (12 in) or more, and with yellow and pink or red flowers.

On the higher slopes of Sage Mountain, a large-leaf species has been seen (**Photo 36**), but only in juvenile form. The leaves are thick and somewhat stiff and leathery, and are larger than any species of White Cedar typical of the Virgin Islands, with the largest leaflets 11cm (4.3 in) long or longer. Whether this form represents simply an eco-morphological type is to be determined. A similar form is reported by Eleanor Gibney, from nearby St. John in the USVI.

Photo 36.
Large-leaf Tabebuia at Arundel, Sage Mountain.

4.2.3 Plant Species of Special Conservation Concern

Tortola has approximately 90 species of plants of Special Conservation Concern (see **Table 27**). A great number of the plants are range-restricted species, including rare and vulnerable species endemic to the Greater Antilles, the West Indies, the Puerto Rico Bank, and the Virgin Islands (BVI and USVI). Many of the Species of Special Conservation Concern are limited to specific habitat types, and some have been reduced in population and size by disturbance and development.

Island Resources Foundation determined the conservation status of listed species by using a number of sources and approaches, including:

- the team's extensive field knowledge and experience including the previous BVI and OECS environmental profiles;
- previous studies and reports, including assessments by teams from the Royal Botanic Gardens, Kew;
- data from the International Union for the Conservation of Nature (IUCN);
- other expert opinions; and
- local knowledge.

IRF's methodology for reaching its status determination does not fully satisfy the requirements of the global standard provided by the IUCN guidelines, largely because of local data limitations. Nonetheless, general precepts of the IUCN approach were followed, and IRF researchers are confident its status determinations are congruent with international standards. Three of the categories used by IUCN to denote conservation status were employed in Table 27 to express tentative ranking for each species.

A more complete list of the native and naturalised plants of Tortola is provided in a supplemental document to this Environmental Profile (*Addendum I to the Tortola Environmental Profile: Preliminary List of Plant Species*) and is available at www.irf.org.

Table 27.
Plant species of Special Conservation Concern for Tortola.

Green = High Conservation Priority/Endangered **Yellow = Medium Conservation Priority/Threatened**

No Color = Lower Conservation Priority/Vulnerable

TABLE KEY: H = herb; S = shrub; T = tree; V = vine

Family	Species	Habitat	Status	Comments
Pteridophytes - Fens and Fern Allies				
Cyatheaceae	*Cyathea arborea* (L.) Sm.	T	Rare	
Dennstaedtiaceae	*Odontosoria aculeata* (L.) J. Sm.	V	Rare	WI Endemic
Pteridaceae	*Acrostichum danaeifolium* Langsdorff & Fischer	H	Rare	Almost extinct
	Cheilanthes microphylla (Sw.) Sw.	H	Rare	
Monocots - One Cotyledon-seeded Plants				
Arecaceae	*Prestoea montana* (R. Graham) G. Nicholson	T	Ext.?	WI Endemic. Listed by Beard, 1949. Seemingly extinct.
	Sabal causiarum (O.F. Cook) Becc.	T	Rare	WI Endemic
Asparagaceae	*Agave missionum* Trel.	H	Rare	WI Endemic; Endangered
Bromeliaceae	*Tillandsia fasciculata* Sw. var. *fasciculata*	H	Rare	
	Tillandsia fasciculata x setacea	H	Rare	Endemic? The two parent spp. seem to hybridise when growing together, producing this new form.

Family	Species	Habitat	Status	Comments
	Tillandsia setacea Sw.	H	Rare	
	Tillandsia variabilis Schltdl.	H	Rare	Listed here as tentative.
	Tillandsia x lineatispica Mez	H	Rare	WI Endemic
	Vriesia sp.	H	Rare	Possibly *Vriesea ringens*. It is also possible two species are present.
Orchidaceae	*Brassavola cucullata* (L.) R. Br.	H	Rare	
	Cyclopogon elatus (Sw.) Schltr.	H	Rare	
	Epidendrum boricuarum Hágsater & L. Sánchez	H	Rare	WI Endemic
	Eulophia alta (L.) Fawc. & Rendle	H	Rare	
	Habenaria monorrhiza (Sw.) Rchb. f.	H	Rare	
	Microchilus hirtellus (Sw.) D. Dietr.	H	Rare	
	Ponthieva racemosa (Walter) C. Mohr.	H	Loc.	
	Prescottia oligantha (Sw.) Lindl.	H	Rare	
	Tolumnia variegata (Sw.) Braem	H	Rare	WI Endemic
Poaceae	*Aristida portoricensis* Pilg.	H	Rare	WI Endemic
	Digitaria eggersii (Hack.) Henrard	H	Rare	WI Endemic
	Digitaria insularis (L.) Mez ex Ekman	H	Rare	
	Distichlis spicata (L.) Greene	H	Rare	
	Ichnanthus nemorosus (Sw.) Döll. var. *nemorosus*	H	Rare	
	Panicum polygonatum Schrad.	H	Rare	
	Pappophorum pappiferum (Lam.) Kuntze	H	Rare	
	Paspalum blodgettii Chapm.	H	Rare	
	Paspalum laxum Lam.	H	Rare	
	Paspalum plicatulum Michx.	H	Rare	
	Paspalum sp.	H	Rare	The species grows high on cut cliff faces, is maroon in colour, but species unknown.
	Pharus cf. *latifolius* L.	H	Rare	
	Setaria parviflora (Poiret) Kerguélen, Lejeunia	H	Rare	
	Spartina patens (Aiton) Muhl.	H	Local	Declining
	Spartina cf. *spartinae* (Trin.) Merr. ex Hitchc.	H	Rare	
	Sporobolus tenuissimus (Mart. ex Schrank) Kuntze	H	Rare	
	Sporobolus virginicus (L.) Kunth	H	Local	Declining.
	Steinchisma laxum (Sw.) Zuloaga	H	Rare	
	Stenotaphrum secundatum (Walter) Kuntze	H	Common	A sp. of upland savannas.
	Urochloa adspersa (Trin.) R.D. Webster	H	Rare	
	Urochloa fusca (Sw.) B.F. Hansen & Wunderlin	H	Rare	
Zingiberaceae	*Renealmia aromatica* (Aubl.) Griseb.	H	Rare	
Dicots - Two Cotyledon-seeded Plants				
Acanthaceae	*Oplonia spinosa* (Jacq.) Raf. subsp. *spinosa*	S	Local	WI Endemic. Declining as habitat areas are developed.

Family	Species	Habitat	Status	Comments
Annonaceae	*Guatteria blainii* (Griseb.) Urb.	T	Rare	WI Endemic
Apiaceae	*Hydrocotyle umbellata* L.	H	Rare	
Apocynaceae	*Rauvolfia biauriculata* Müll. Arg.	S	Rare	Very Rare. There is a species near Sage Mountain that is unlike any other local *Rauvolfia* and fits this sp.
Aquifoliaceae	*Ilex urbaniana* Loes.	T	Rare	WI Endemic
Bataceae	*Batis maritima* L.	H	Rare	
Boraginaceae	*Tournefortia gnaphalodes* (L.) R. Br. ex Roem. & Schult.	S	Rare	Formerly *Argusia gnaphalodes*
Burseraceae	*Tetragastris balsamifera* (Sw.) Kuntze	T	Rare	WI Endemic
Cactaceae	*Consolea rubescens* (Salm-Dyck ex DC.) Lem.	T	Rare	WI Endemic. The plants on Tortola more closely resemble *C. monili-formis*. Needs reassessment.
	Mammillaria nivosa Link ex Pfeiff.	S	Rare	WI Endemic
	Melocactus intortus (Mill.) Urb. subsp. *intortus*	S	Rare	WI Endemic. The plants of Tortola do not conform to the parameters for this species. Needs reassessment.
	Opuntia antillana Britton & Rose	S	Rare	WI Endemic
	Opuntia x *lucayana* Britton	S	Rare	WI Endemic
	Pereskia aculeata Mill.	V	Rare	Likely native
Cannabaceae	*Celtis trinervia* Lam.	T	Local	
Celastraceae	*Maytenus laevigata* (Vahl) Griseb. ex Eggers	T	Rare	WI Endemic
Combretaceae	*Buchenavia tetraphylla* (Aubl.) R.A. Howard	T	Rare	
	Bucida buceras L.	T	Local	Declining
	Laguncularia racemosa (L.) Gaertn. f.	T	Local	Declining
Euphorbiaceae	*Croton fishlockii* Britton	S	Rare	WI Endemic
Fabaceae	*Chaetocalyx scandens* (L.) Urb. var. scandens	V	Rare	
	Erythrina corallodendron L. var. *corallodendron*	T	Rare	WI Endemic
	Erythrina eggersii Krukoff & Moldenke	T	Rare	WI Endemic, declining
	Sophora tomentosa L. var. *littoralis* (Schrad.) Benth.	S	Rare	
	Vachellia tortuosa (L.) Seigler & Ebinger	T	Local	
Goodeniaceae	*Scaevola plumieri* (L.) Vahl	S	Rare	
Marcgraviaceae	*Marcgravia rectiflora* Triana & Planch.	V	Rare	WI Endemic
Malpighiaceae	*Malpighia woodburyana* Vivaldi	T	Local	WI Endemic
Malvaceae	*Bastardiopsis eggersii* (Baker f.) Fuertes & Fryxell	T	Rare	WI Endemic

Family	Species	Habitat	Status	Comments
Melastomataceae	*Miconia thomasiana* DC.	S	Rare	Endemic
	Tetrazygia elaeagnoides (Sw.) DC.	T	Local	WI Endemic
Meliaceae	*Cedrela odorata* L.	T	Rare	
	Trichilia hirta L.	T	Rare	
Moraceae	*Maclura tinctoria* (L.) D. Don ex Steud. subsp. *tinctoria*	T	Rare	Mirecki, *et al.* (1976) listed a *Morus* sp. for Sage Mountain.
Myrtaceae	*Calyptranthes kiaerskovii* Krug & Urb.	T	Rare	WI Endemic
	Eugenia sessiliflora Vahl	T	Local	WI Endemic
Rhamnaceae	*Reynosia uncinata* Urb.	T	Rare	WI Endemic
	Ziziphus reticulata (Vahl) DC.	T	Rare	WI Endemic
	Ziziphus rignonii Delponte	T	Rare	WI Endemic
Rhizophoraceae	*Rhizophora mangle* L.	T	Com-mon	Declining
Rubiaceae	*Ernodea littoralis* Sw.	S	Rare	Declining
Rutaceae	*Zanthoxylum thomasianum* (Krug & Urb.) Krug & Urb. ex P. Wilson	T	Rare	WI Endemic
Sabiaceae	*Meliosma herbertii* Rolfe var. *herbertii*	T	Rare	WI Endemic
Sapindaceae	*Paullinia plumieri* Triana & Planch.	V	Rare	WI Endemic
Sapotaceae	*Pouteria* cf. *multiflora* (A.DC.) Eyma	T	Local	
	Sideroxylon salicifolium (L.) Lam.	T	Local	
Surianaceae	*Suriana maritima* L.	S	Local	Declining
Staphyleaceae	*Turpinia occidentalis* (Sw.) G. Don	T	Rare	
Zygophyllaceae	*Guaiacum officinale* L.	T	Rare	

Conservation Status Definition and Approach for Table 27.

For the assessment of conservation status for Species of Special Concern, the IRF team incorporated IUCN methodology, and also sought local knowledge and other expertise to help develop a more comprehensive picture. The three categories used to characterise status are ***endangered, threatened,*** and ***vulnerable***, defined as follows:

ENDANGERED A species is considered *endangered* when the best available evidence indicates the species is facing a very high risk of being totally destroyed, including the habitats it relies on for survival.

THREATENED A species is considered *threatened* if it has been evaluated but does not yet qualify for the category of *Endangered*, but, it is close to qualifying or is likely to qualify as being endangered in the near and medium-term.

VULNERABLE A species is considered *vulnerable* when the best available evidence indicates that it is facing a high risk of threats that may elevate its risk to severe damage and disruption, and may elevate its status to *threatened* or *endangered* in the near and medium-term.

Note: A species is considered **STABLE** when it no longer falls under the categories of *Endangered*, *Threatened* or *Vulnerable* and when prevailing circumstances do not or will not immediately cause severe population declines and damage or loss to its habitats.

4.2.4 Invasive Plant Species

4.2.4.1 Tortola's Plant Invasives

The invasive plant species of Tortola are for the most part similar to those for Virgin Gorda, Anegada and Jost Van Dyke. Invasive plants are species that are usually exotic, *i.e.*, introduced from somewhere else, which may result in adverse environmental, economic, social and/or health impacts. There are several species identified as "invasive" and several other species recognised as "potentially invasive." **Table 28** provides a list of both the invasive and potentially invasive species found on Tortola.

A species evolves as invasive due to many factors, but primary among these is the action of humans. For example, wildfires may encourage certain non-native grass species to flourish because the burn eliminates native species, renders ecological conditions unsuitable for their growth, and prepares the ground for the invasion of new plants. Some species have a huge advantage under these conditions because they have adapted to fire or the fires have eliminated their competition and/or control mechanisms.

Although some species may prove benign in local situations, they may emerge as a problem elsewhere. An example of this phenomenon is the coconut (*C. nucifera*), a species ubiquitous with the image of a tropical and tranquil Caribbean but which, in fact, is native to Southeast Asia and some parts of the Pacific. In some islands of the Caribbean, it invades local wetlands and sandy shores, drawing up water resources and resulting in the demise of other plants. But it is difficult to convince a resort owner, for example, of these detriments for the owner primarily is concerned with the benefits to be derived by the presence of such a highly prized and beloved species. Equally hard to convince is the Tortolan who relies on the plant for food or comfort or because of cultural connections.

Nonetheless, invasive plants come in many forms and can have considerable ecological impacts, even when the species is considered an aesthetic or economic benefit by many. The problem of invasives is therefore not only a biodiversity issue but also a social and economic issue.

The invasive species of Tortola include those in the paragraphs that follow.

(1) *Antigonon leptopus*

Coralita, as it is often called, is a vine introduced from Mexico and Central America. It was brought to the West Indies in the late 1800s for the attractiveness of its bright pink and sometimes white inflorescence. It is grown in many botanical gardens and is very popular as a garden plant. It was often used by charcoal burners to line kilns. This allowed the seeds to be spread far and wide. It is also used during burials and is sometimes common at and around cemeteries. The species is quite hardy and develops tubers that may occur over 30 cm (12 in) below ground. This makes it hard to eliminate.

(2) *Azadirachta indica*

This relative of the Mahogany is a native of Asia and is considered by some as a highly valuable and sacred medicinal plant. It is also used as a shade tree, as an ornamental, in roadside plantings and for making charcoal. However, the plant readily escapes and can create monotypic stands (consisting of more or less one species), crowding out natives, disrupting local hydrology, and creating ecological disruption.

(3) *Cryptostegia madagascariensis*

This vine and sometimes scandent shrub—known as Purple Allamanda by many—is a native of Madagascar but has been introduced to the Virgin Islands as an ornamental. It is toxic and unpalatable to most animals; hence, it is often one of the only plants that may remain in an area after livestock overgraze. Somewhat salt tolerant, it can also grow in mangroves and along the coast.

(4) *Leucaena leucocephala*

This species is called Tan Tan in the Virgin Islands and is one of the most widespread and common species on Tortola. Native to parts of Mexico and northern Central America, it was introduced to the region early in the last century as fodder, for agroforestry and soil enrichment, and as a charcoal wood crop.

Table 28.

Invasive and potentially invasive plants of Tortola.

Family	Species	Habit	Origin	Status	Comments
Pteridophytes - Fens & Fern Allies					
Lomariopsidaceae	*Nephrolepis brownii* (Desv.) Hovenkamp & Miyam.	H	I	Natur.	Highly Invasive.
	Nephrolepis exaltata Cultivar.	H	I	Natur.	Highly Invasive cultivar. Also cultivated.
Monocots - One Cotyledon-seeded Plants					
Amaryllidaceae	*Hymenocallis caribaea* (L.) Herb.	H	N	Natur.	An introduced aggressive cultivar from Florida that is often cultivated and endangers the local population's gene pool.
Araceae	*Epipremnum pinnatum* (Linnaeus) Engler	V	I	Natur.	Invasive. Also cultivated.
	Syngonium podophyllum Schott	V	I	Natur.	Potentially Invasive.
Arecaceae	*Cocos nucifera* L.	T	I	Natur.	Though this is a highly prized species, it is often very invasive, especially along the coast.
Asparagaceae	*Agave fourcroydes* Lem.	H	I	Natur.?	Invasive.
	Sansevieria hyacinthoides (L.) Druce	H	I	Natur.	Highly Invasive. Also cultivated.
	Sansevieria trifasciata Prain	H	I	Cult.	Potentially very invasive.
Bromeliaceae	*Bromelia pinguin* L.	H	I	Natur.	Likely introduced, and invasive.
Commelinaceae	*Callisia fragrans* (Lindl.) Woodson	H	I	Natur.	Very invasive.
	Tradescantia pallida (Rose) D.R. Hunt	H	I	Cult.	Potentially Invasive.
	Tradescantia zebrina hort. ex Bosse	H	I	Natur.	Invasive.
Pandanaceae	*Pandanus dubius* Spreng.	T	I	Cult.	
Poaceae	*Bothriochloa pertusa* (Linnaeus) Camus	H	I	Natur.	Invasive.
	Megathyrsus maximus (Jacq.) B.K. Simon & S.W.L. Jacobs	H	I	Natur.	Invasive.
	Zoysia tenuifolia Willd. ex Thiele	H	I	Natur.	Potentially Invasive.
Dicots - Two Cotyledon-seeded Plants					
Acanthaceae	*Asystasia gangetica* (L.) T. Anderson	V	I	Natur.	Potentially very invasive. Escaping into the wild.
	Barleria repens Nees.	H	I	Natur.	Potentially very invasive. Also cultivated.
Apocynaceae	*Calotropis procera* (Aiton) W.T. Aiton	S	I	Natur.	Invasive.
	Cryptostegia grandiflora R. Br.	V	I	Cult.	Highly Invasive. Possibly naturalised.
	Cryptostegia madagascariensis Bojer ex Decne.	V	I	Natur.	Highly Invasive. Also cultivated.
Casuarinaceae	*Casuarina equisetifolia* L.	T	I	Cult.	Invasive.

Family	Species	Habit	Origin	Status	Comments
Cleomaceae	*Arivela viscosa* (L.) Raf.	H	I	Natur.	Invasive. Formerly *Cleome viscosa*.
Goodeniaceae	*Scaevola taccada* (Gaertn.) Roxb.	S	I	Natur.	Invasive. Sometimes hybridises with the above.
Meliaceae	*Azadirachta indica* A. Juss.	T	I	Natur.	Invasive.
Oleaceae	*Jasminum fluminense* Vell.	V	I	Natur.	Invasive.
Plantaginaceae	*Russelia equisetiformis* Schltdl. & Cham.	H	I	Natur.	Potentially Very Invasive. Also cultivated.
Polygonaceae	*Antigonon leptopus* Hook. & Arn.	V	I	Natur.	Highly Invasive.
Rubiaceae	*Morinda citrifolia* L.	T	I	Natur.	Invasive.
Rutaceae	*Murraya paniculata* (L.) Jacq.	T	I	Natur.	Potentially a serious invasive.
	Triphasia trifolia (Burm. f.) P. Wilson	T	I	Natur.	Highly Invasive.

Notes: H=herb, S=shrub, T=Tree, V=vine; N=native, I=introduced; Cult.=cultivated, Natur.=naturalised.

Fast growing and weedy in nature, the species quickly colonised wild places, especially disturbed grounds such as newly cut roadsides, paths, and forest clearings. It is found throughout all elevations of Tortola and invades forests, woodlands and scrublands, including dry coastal and cactus scrub. It shades and crowds out native species.

(5) *Megathyrsus maximus*

Often called Guinea Grass, this species has been introduced throughout the tropics and subtropics as a fodder crop. It also arrived accidentally as a stowaway in the stomachs of livestock and birds, and on the clothing and shoes of humans. It quickly establishes itself and may grow quite rapidly with the onset of heavy rains. Because it grows so aggressively, it overtakes native plants, especially herbs and shrubs, and can completely wipe out native grasslands and shrubland species, especially in dry areas. It is a difficult species to control, and only local area control may be feasible at this time.

(6) *Melicoccus bijugatus*

Virgin Islands residents call this tree Guinep, and its fruit is highly prized and even sold by local roadside vendors, and may also be planted in residential areas and on farms. Male and female flowers are on separate plants. In some parts of the Caribbean, the species was introduced by Amerindians, but in the Virgin Islands, it perhaps arrived in the nineteenth century. After farming declined, it quickly escaped and became naturalised. It is a very fast-growing and often aggressive species, overtaking native forests and woodland trees and shrubs, and sometimes may grow in almost pure stands, thereby reducing overall biodiversity, especially in coastal and riparian habitats.

(7) *Scaevola sericea*

This species is native to Asia and the Pacific and has been widely introduced to the Americas by hotels and the horticultural trade as an ornamental. It is often planted on beaches and around resorts. *S. sericea* readily hybridises with the native *S. plumieri*, a species, which has now become rare due to coastal development. *S. sericea* needs to be eliminated from the wild, and the remaining native habitats of *S. plumieri* should be protected. It is also important that resorts and home owners be informed about the risks posed by this introduced invasive.

4.2.4.2 Invasive Species Control for Plants

For Tortola and the rest of the British Virgin Islands, invasive species control is a challenge. The territory does not possess the technical and financial resources to aggressively pursue and completely eliminate major threats, and in fact no country or territory in the Eastern Caribbean currently does. Nor is it able to anticipate and act offensively to prevent the potential harm that these aliens may cause.

Several departments of agriculture in the Eastern Caribbean have had some success in using a plant protection approach. However, for such a programme to be successful in the BVI, the following would need to be in place:

- An invasive plant control policy for the territory, sensitive to local communities.
- An institution designated for management and enforcement.
- An education programme on invasive species control for stakeholders and the general public.
- A technical training programme for persons whose professional or personal activities bring them into contact with invasive species.
- Access to information networks that target effective and successfully applied approaches and applications for invasive plant control.

4.3 Fauna

The indigenous fauna of Tortola and Beef Island is, by extension, a part of the biogeographic region of the Puerto Rico Bank. It is largely Greater Antillean in origins. As humans arrived, they brought with them additional species.

It is a rich and diverse fauna, despite the seeming paucity of species. One cannot compare these environments to the Amazon or the African Congo, for those places are vast and with resources that are almost overwhelming and intricately complex given the number of species and human cultures. By contrast, Tortola and the rest of the Virgin Islands are oceanic, isolated, and small in nature. But they are a crucible of evolution, as are the better known Galapagos, for on these BVI shores can be found one of the world's smallest reptiles and other unique species.

4.3.1 The Birds of Tortola

For most observers, the "Land of the Turtle Dove'" may seemingly have retired its title as a haven for doves. Today, Tortola seems more subdued—gone are the numerous turtle doves. The most prominent of the avians is the ubiquitous **Pearly-eyed Thrasher** (*Margarops fuscatus*), whose calls may start before sunrise and cease after sunset (some birds may actually call throughout the night, especially during the full moon). They are common and widespread throughout the island, even in Road Town, and especially around homes and hotels, with birds going into houses and restaurants, stealing food, being aggressive toward pets and chasing smaller birds.

But other species compete with the Thrasher for the title of Tortola's most pervasive birds, including the **Bananaquit** (*Coereba flaveola*), the **Scaly-naped Pigeon** (*Patagioenas squamosa*), the **Zenaida Dove** (*Zenaida aurita*), the **Common Ground Dove** (*Columbina passerina*) and the **Smooth-billed Ani** (*Crotophaga ani*). These native birds are found throughout much of Tortola, and some, like the Zenaida Dove and the Scaly-naped Pigeon, are found even in urban environments such as Road Town, often seen on overhead utility wires, poles and communications towers. The Ani prefers open and wooded rural areas; agricultural fields; sparsely populated landscapes with a mix of trees, pasture, and shrubs;

mangroves; and even homes that allow flocks to find their favourite food such as lizards and large insects.

There are also birds that few Tortolans have seen or have heard about. The **Virgin Islands Screech Owl** (*Megascops nudipes newtonii*), an endemic subspecies, is now believed to be extremely rare, though there are occasional reports of the bird high on Tortola's slopes or from nearby islands such as Guana. It is a secretive and shy species, most active at night, and feeds on large insects, lizards and perhaps small birds. The Screech Owl of the Virgin Islands is said to be greyer and less rufescent above than the closely related Puerto Rican *Megascops nudipes nudipes*. It prefers tall forest with old trees, which provide suitable perches and cavities suitable for nesting. The Virgin Islands Screech Owl is recorded for Tortola, Virgin Gorda, St. John, St. Thomas, Culebra and St. Croix.

Another owl is the **Puerto Rican Short-eared Owl** (*Asio flammeus portoricensis*). It becomes active in late afternoon when it hunts for rodents, reptiles and birds. It has two tufts of feathers on the top of the head, one above each eye (these difficult to see from a distance), hence the name. The Short-eared Owl prefers a mix of woodland and open patches of pasture and grassland. It is a rare resident, often going unnoticed, but is believed that a small nesting population resides on Tortola.

In addition to the owls, another group of aerial hunters has found a home on Tortola. There are two resident species residing here throughout the year and a handful of others that migrate to the island or pass through during the fall, winter and spring months.

Dominating the skies is the **Red-tailed Hawk** (*Buteo jamaicensis*), the largest bird predator in the Virgin Islands. It is widespread across the region, often seen soaring above the treetops, hills or along the coasts. It sometimes associates in pairs or small flocks, riding the warm air thermals, spiraling thousands of feet into the sky. The silhouette of this bird, with its broad wings and red on the upper side of the tail, is quite characteristic. Its piercing, raspy scream of "ke-aar" is often uttered on the wing. It feeds on birds (including seabirds and chickens), reptiles—such as the iguanas and snakes—and rodents. It may also hunt bats as they emerge from their roosts.

The most common and widespread hunter is the **American Kestrel** (*Falco sparverius*), a small falcon distantly related to the hawk. It is sometimes locally referred to as the "killy hawk" because of its "killi-killi-killi" call sounded in rapid fire, and often answered by a second bird, usually the male or female partner of the pair. It often sits on a high perch such as the top of a lamppost, where it spies its favourite prey—lizards, small birds and large grasshoppers. It prefers drier coastal habitats and urban areas, but will also occur in upland areas, as well as semi-open woodlands and pastures.

A close relative to the Kestrel is the **Merlin** (*Falco columbarius*), a migrant species that passes through the islands during the fall and spring migration periods, although a few may remain for the winter. It is just a few centimetres larger than the Kestrel, a bit more robust and a faster flier, able to handle larger prey.

The largest of the falcons to visit the BVI is the **Peregrine** (*Falco peregrinus*). This species is also known as the fastest bird alive today and one of the fastest animals on earth, reaching speeds of up to about 112 km/h (69 mph) in normal flights, and dives of up to about 322 km/h (200 mph) have been clocked. It is a powerful hunter, preferring pigeons, waterfowl, shorebirds, herons and even chickens, but it will also take large lizards and small mammals. It is widespread across the globe, with several subspecies. It is not known which of these subspecies may visit Tortola, but it is believed that North American and perhaps European forms visit the territory, with a handful of birds throughout the winter months.

The **Puerto Rican Parrot** or **Puerto Rican Amazon** (*Amazona vittata*) is a species endemic to the island of Puerto Rico. But it was once more widespread across the northeast West Indies as historical records and fossil evidence suggest. When Europeans arrived in this part of the world, the Amazon was also found on Culebra and on Vieques (although no museum specimens exist), and fossils from the Lesser Antilles indicate that it extended to Antigua in the south and likely to all the islands in between. When the species became extinct in the Lesser Antilles is in question, but we know that the population on Culebra, Amazon (*A. v. gracilipes*), became extinct on that island in 1912 due to hunting and habitat destruction. The population on Vieques was the same race as that from Puerto Rico and Mona Island.

There are no historical records of the bird from the Virgin Islands, but it no doubt once inhabited these islands and could even have survived into post-Columbian times. However, it was never collected as the islands were quickly deforested and many unique animals rapidly went extinct.

Today, the only parrot that resides in the Virgin Islands is the **St. Thomas Conure** or the **Brown-throated Parakeet** (*Eupsittula pertinax*), a species that up to the present remains a mystery (**Photo 37**). It has been resident in the Virgin Islands as far back as the 1700s, and possibly even earlier, but no one knows how it got here. It is believed to be introduced, but no records or accounts speak of birds being brought to the island. It is quite possible that it came here naturally, arriving as a result of a hurricane.

Photo 37.
A pair of the St. Thomas Conure at Magens Bay, St. Thomas, USVI.

It is native to the Dutch Antilles islands off Venezuela and to areas of the nearby mainland. Populations may have once existed on Barbados and Martinique. It is now widespread on St. Thomas, although in the nineteenth and late twentieth centuries it was restricted to the eastern end of that island due to the paucity of available natural habitats. On Tortola, birds are sometimes observed on the west end, the north coast and east end of the island. It is unknown if it breeds on the island and is believed to be a vagrant here.

Of the hummingbirds, at least three species occur in Tortola (there are five known in nearby Puerto Rico). The smallest of the three is the common and widespread **Antillean-crested Hummingbird** (*Orthorhyncus cristatus*), with the characteristic pointed shiny emerald crest of the males (less prominent in females). The **Green-throated Carib** (*Eulampis holosericeus*) is less common than the previous species, but because of its larger size, bright emerald green colour and long curved bill, it is the most prominent of the local species. In good light, the bright blue patch on the breast becomes visible, and helps to distinguish this species from any other species.

The rarest of the species, the **Antillean Mango** (*Anthracothorax dominicus aurulentus*), has declined in numbers across the Virgin Islands. It is similar in size to the Carib, and in general outline and appearance it vaguely resembles that species. But in good light, the two can be easily distinguished from each other. The male Mango hummingbird has a brilliant green throat, a dark abdomen, and purple in the tail and light purple in the wings. The female is a duller green above and whitish to greyish-white on the throat and abdomen, with white tips to the outer tail feathers. Both species may occur together in the same habitat, especially during the late dry season when *Agave* species burst into bloom, offering abundant nectar, pollen and small insects. The Mango has been observed in recent years at Beef Island.

From its perches atop utility wires and the tops of trees, the **Grey Kingbird** (*Tyrannus dominicensis*) sallies forth to snag flying insects from the air and grab caterpillars and other invertebrates from the ground or from the leaves of plants. It is known for its characteristic "pitirre" or "pitchiree" calls and for its aggressive defence of its territory and nests, often chasing away much larger intruders than itself (including humans).

The Kingbird is a member of a group of birds called "*Tyrant Flycatchers*" and in addition to the Kingbird, two other members are resident on the island, including the **Puerto Rican Flycatcher** (*Myiarchus antillarum*), a Puerto Rican Bank endemic that is quite rare in the Virgin Islands (**Photo 38**). Only a handful of recent observations are known, and it is believed to be on the decline across the region. The reasons for this decline are not known. It is a species of coastal woodlands and steep wooded valleys. It also occurs in stable wooded coastal areas and has been observed on occasion near the salt ponds of Beef Island. It is endemic to Puerto Rico and the Virgin Islands, but very little is known about the VI population, and it may slowly be going extinct in these islands.

Photo 38.
Puerto Rican Flycatcher, St. John, USVI
(photo courtesy of Gary Kwiecinski).

The **Caribbean Elaenia** (*Elaenia martinica*) is the smallest of the island's Tyrant Flycatchers, and is not as common on Tortola as it is in the Lesser Antilles. Little is known about the BVI population, and the bird may be unfamiliar to most Tortolans. It prefers the tangled growths of woodlands and forests and is very flexible in its habits; it occurrs from coastal woodlands and mangroves up to the highest elevation. Birds may associate in small loose flocks, keeping in close contact with each other by their whistles, thrills and rattling calls.

It has one of the most fragmented distributions of any West Indian bird, being found in Puerto Rico, the Virgin Islands, the Lesser Antilles and islands off of Central America in the western Caribbean Sea. It is a species that needs more attention and study, if only because it is one of the region's most charming birds.

A group of smaller passerines birds found on Tortola include the vireos, warblers, finches, and finch-like birds. The **Black-whiskered Vireo** (*Vireo altiloquus*) is often heard but not seen as it creeps around the tangled vines and branches of woodlands. It is widely distributed from the coast up to the highest slopes on the island.

The **Bananaquit** is also a member of this group, as is the **Yellow Warbler** (*Setophaga petechia*), a widespread resident that is most common in coastal woodlands and mangroves. It is also found at higher elevations. It is known by its characteristic bright yellow, and males attain a bright reddish crown and darker red and brown streaks on the breast during the breeding season.

Its migrant cousin, the **Prairie Warbler** (*Setophaga discolor*), is a common visitor during the fall and winter months and prefers lower elevations with open woodlands and mangroves. During the winter, it takes on its non-breeding plumage, which is a somber yellow, with dark streaks on the throat, breast and abdomen, a dull black crown, and a black ring below the eye.

The **American Redstart** (*Setophaga ruticilla*) is a species that prefers wetter and thick forests and woodlands and is more common along the ghuts and thick forests around Sage Mountain. The males are black with orange-red patches below the wing, in the wing and on the tail. Females and juveniles have yellow to orange instead of the red. It is present for much of the year (August to May), although some non-breeding and juvenile birds may arrive in late July and depart the island for the northern climes in early June.

Of the true finches, the only resident is the introduced **House Sparrow** (*Passer domesticus*), now common at Road Town, other urban areas and the airport. Among the finch-like birds of Tortola is the common and widespread **Black-faced Grassquit** (*Tiaris bicolor*), a species often found feeding in grassy fields, low shrubbery and woodlands. It occurs at all elevations. The males have a dark greyish-black to black head, breast and abdomen, and a greenish-grey back. Females and juveniles are duller grey-green, sometimes with a bit of yellow wash and dark streaks on the breast and abdomen. The Grassquit may often be heard "chittering" to members of the flock as a way to keep in close contact with each member and keep the group organised. The call is a drawn-out series of insect-like buzzes and chips.

The other finch-like bird is the **Lesser Antillean Bullfinch** (*Loxigilla noctis*). Despite the shape of its bill, ornithologists believe that it is more closely related to tanagers than to true finches and has evolved to fill an ecological niche that was vacant. Males are a greyish-black, lighter on the abdomen, with red just to the front and above the eye, below the bill and under the tail. Females are brownish with a ruddy-brown to brown below the tail and light brown above the eye and below the bill. The species is believed to have colonised the Virgin Islands from the Lesser Antilles around 1970, although it could have been much earlier, perhaps as a result of a major storm. In Tortola, it prefers coastal woodlands and thickets, but it is nowhere common. It is found in small numbers throughout much of the lower slopes of Tortola, though it is more commonly seen on the island's eastern end including Beef Island.

At the other end of the evolutionary scale, there are seabirds, waterfowl, herons and wading/shorebirds. They normally associate with bodies of water. In the case of seabirds, they spend much of their lives at sea, coming ashore to mate and raise their young, or occasionally to find food. Waterfowl, which may include ducks and other diving birds and rails, often spend a great deal of the time on ponds and salt ponds, swimming and wading. The shorebirds are primarily waders, although many may also swim. The term shorebirds may give the impression that most of these species are fairly small birds, but in fact many are quite large and are some of the largest aquatic birds.

Since the introduction of the Small Indian Mongoose (*Herpestes javanicus*), no seabirds nest on Tortola. This is because their eggs, chicks and the adults are preyed upon by this voracious animal, as well as by cats, dogs, rats and pigs; they have also been disturbed by human activities and traffic. Most of the species of seabirds that are observed on Tortola come close to shore, especially in the bays and harbours. This includes the **Magnificent Frigatebird** (*Fregata magnificens*), called the Man-o-War or "pirate of the skies" because of its habit of harassing other birds to steal their prey. It is a black bird, females having white heads, males with a bright red throat sac during the breeding season. Frigatebirds have the largest wingspan of any bird of the Virgin Islands at about 2.15 m (7 ft). It nests on Great Tobago, one of Tortola's western cays.

Often seen in harbours and along the coastline are small flocks or individual **Brown Boobies** (*Sula leucogaster*), the brown upperside, yellowish bill and feet, and the white underside being characteristic. They hunt for fish by diving, with wings held back and close to the body. Brown Boobies nest on nearby Great Tobago and Little Tobago.

With the Frigatebird and the Booby, the **Brown Pelican** (*Pelecanus occidentalis*) may form loose flocks, hunting and sometimes resting on rocky ledges and coastal trees. It has a large bill and can extend its throat to form a large pouch with which it scoops up schools of fish or large prey, filtering the water and then swallowing the food. This is the most distinctive characteristic of the species.

Along the western end of Tortola, observers may see **Tropicbirds** (*Phaethon aethereus* and *P. lepturus*), with their long streamer tails fluttering in the breeze, a feature that distinguishes these birds from other species. They spend most of their lives at sea, feeding on shrimp, squid and other smaller marine life, coming ashore briefly to breed. They make shallow nests in small cavities on rocky cliffs along the coast. Most tropicbirds in the Virgin Islands nest on small cays away from human disturbance.

For many, the bird that most symbolises seabirds is the gull, an imagery most likely derived from the media and from books and documentaries from North America and Europe. But only one species nests in Tortola, the **Laughing Gull** (*Leucophaeus atricilla*). While a handful may remain around the shores throughout much of the year, numbers dramatically increase during early spring months when the breeding season begins.

These gulls nest on the offshore cays in large numbers, but patrol the waterfronts and upland areas for easy pickings, including scraps of discarded restaurant food, garbage and even handouts. They also prey on smaller birds, lizards and invertebrates. They are noisy (the call is like a maniacal laugh, hence the name), boisterous and can be aggressive toward other species. Nesting begins in April/May until August. Young and parents may be present until early October and then depart for warmer waters off South America. A few other species are vagrant to the warm waters of Tortola and the rest of the Virgin Islands, but numbers are fairly low, and sightings remain uncommon.

Related to gulls, several species of terns are resident in Tortolan waters, including the **Royal Tern** (*Sterna maxima*), with its black "spikey" crest. It is the largest of the species. The **Least Tern** (*Sterna antillarum*) is the smallest, resembling a small fluttering and graceful fairy as it hovers above the ocean, homing in on prey before plunging downward to snag the tasty morsel. It nests on open bare ground or sandy/gravelly areas usually along the coast or on the dry basins of salt ponds. Other nesting terns include the **Common Tern** (*Sterna hirundo*) and the **Roseate Tern** (*Sterna dougallii*). All resident species nest on cays scattered throughout the British and US Virgin Islands and around Puerto Rico.

Most of the species of waterfowl that occur on Tortola's shores are vagrant, but a number are also resident. At permanently flooded mangrove ponds, such as the one at Josiah's Bay, fairly large and consistent numbers of **Ruddy Ducks** (*Oxyura jamaicensis*) can be found. The males have black caps, bluish bills and brown bodies (**Photo 39**). Its overall numbers on Tortola are relatively small, no more than 100.

Sometimes associating with the Ruddy are flocks of **White-cheeked Pintails** (*Anas bahamensis*), with their white cheeks and bright red patches on the bill; the **American Gallinule** (*Gallinula galeata*), the noisy black relative of rails with yellow legs and red frontal shield; and the relative of the Gallinule, the **Caribbean Coot** (*Fulica caribaea*), black with a white bony frontal shield.

Photo 39.
A Ruddy Duck (right) and a White-cheeked Pintail at Josiah's Pond, Tortola.

At the mangrove ponds situated north of the Beef Island airport, flocks of resident and migrant waterfowl congregate and find shelter and food throughout much of the year, more so in winter. Many migrant species occur here, including the **Northern Shoveler** (*Anas clypeata*), the **Green-winged Teal** (*Anas carolinensis*), the **Blue-winged Teal** (*Anas discors*), and the **Ring-necked Duck** (*Aythya collaris*).

The herons, often called "gaulins," are relatively large gangly birds with heavy pointed bills and long legs (in some species) and a heck neck often held in an incomplete "*S*" shape. Several species occur on Tortola and are usually seen foraging in salt ponds. The most prominent is the **Great Blue Heron** (*Ardea herodias*), the largest of the species. There is the **Great Egret** (*Ardea alba*), a close relative of the previous, a bit smaller but all white. There is also the **Little Blue Heron** (*Egretta caerulea*), with its greyish-blue colour (white in juveniles).

The **Cattle Egret** (*Bubulcus ibis*) is so named for its frequent association with cattle and other livestock, farms and rural environments. It will stalk prey in open pastures and in yards, and roosts in flocks at the edge of ponds.

The smallest of the local species is the **Green Heron** (*Butorides virescens*), whose croaking squawks and guttural cackling are often emitted when it is disturbed or startled. Its crown and back are dark green, the neck and breast ruddy-brown and the feet yellow to reddish. It will stalk for prey in gutters in Road Town, high up the slopes in wet ghuts, and along the coast.

The **Yellow-crowned Night Heron** (*Nyctanassa violacea*) is a creature of the night, although it can sometimes be seen stalking prey in the daytime, especially juveniles, and prefers the deep recesses of trees associated with bodies of water, including along the coast (**Photo 40**). It feeds on fish and other aquatic life, but its favourite food is small crabs. When walking along a beach, the coast, near mangroves or even along ghuts, careful observers may come across a dried oval cake of discarded bits of crabs' shells, which indicates the regurgitated pellets left behind by the Night Heron after a successful meal.

Photo 40.
Night Heron adult displaying its head plumes at Josiah's Bay, Tortola.

The largest of the wading and shorebirds is the **Caribbean Flamingo** (*Phoenicopterus ruber*), perhaps once resident and nesting at the large mangrove ponds of Tortola, but hunted to extinction in the BVI until its reintroduction on Guana, Anegada, and Necker Islands. It is famous for its bright pink colour and curved bill with which it filters small crustaceans and algae from the saline water of mangrove ponds.

One of the least known, but most boisterous of Tortola's wading birds is the **Willet** (*Tringa semipalmata*). It nests in mangroves during the dry season when water levels are low, but becomes quite aggressive when it loudly tries to thwart intruders from its area, flying above them, dive-bombing and giving fake injury displays to distract the visitor or predator from its eggs and young.

Along beaches and the edges of mangroves, the casual observer may encounter the **Spotted Sandpiper** (*Actitis macularius*) or the **Solitary Sandpiper** (*Tringa solitaria*). These small waders are solitary or may associate in loose pairs, and they stalk the edges of the ocean and wetlands for small insects, crustaceans, worms and fish. Both species are vaguely similar in appearance, with small spots on the back, wings and below, but the Spotted Sandpiper is easily recognised by its habit of regularly bobbing its head and swishing its tail as it feeds and walks.

The **Common Snipe** (*Gallinago gallinago*)—locally called "snipe" by many, a term also used in other parts of the world—forages for food in urban areas, pastures and along wet soggy streams. It stays hidden in the grass and brush of swampy ground, including drainage gutters and ponds, perfectly camouflaged due to its cryptic markings and colour. It is streaked with yellow and brown and has a very long bill and short legs. The bill is instantly recognisable when the bird takes flight, while the rapid fire of its wings, the whistling sound of its feathers, and its chipping alarm call are all characteristic. It feeds on invertebrates, including worms and crustaceans, as well as small fish.

Among the shorebirds, the plovers are distinctive, often with short bills and rounded heads. Most of the species on Tortola are migrants, but the **Killdeer** (*Charadrius vociferus*) and **Wilson's Plover** (*Charadrius wilsonia*) are residents and nest on the island. The Killdeer may even nest in urban settings in Road Town where there are grassy areas situated close to the sea. Wilson's Plover prefers areas along the edges of salt ponds and along the shore, and its thick and heavy bill easily distinguishes this species. It can become very defensive during the breeding season, displaying, loudly calling and charging at intruders when it feels threatened.

Among the migrant species, the very rare **Piping Plover** (*Charadrius melodus*) stands out, ironically because of its rather small size and because it is a species that is receiving considerable attention from federal authorities in the United States (where it is considered endangered). In North America, it nests along coastal beaches with natural dunes, and these are precisely the places that are attractive for tourism developments that can level and trample the bird's habitats. It is rare in the mangroves of Beef Island during fall, winter and spring (it is easily overlooked due to its small size).

For a list of the birds of Tortola, see **Table 29**.

Table 29.
The birds of Tortola (TO), including Beef Island (BI).

COMMON NAME	SCIENTIFIC NAME	TO	BI
Pied-billed Grebe	*Podilymbus podiceps*	X	X
Least Grebe	*Tachybaptus diminicus*	X	
White-tailed Tropicbird	*Phaethon lepturus*	X	
Red-billed Tropicbird	*Phaethon aethereus*	X	
Red-footed Booby	*Sula sula*	X	
Brown Booby	*Sula leucogaster*	X	X
Brown Pelican	*Pelecanus occidentalis*	X	X
American White Pelican	*Pelecanus erythrorhynchos*		X
Magnificent Frigatebird	*Fregata magnificens*	X	X
Greater Shearwater	*Puffinus gravis*	X	
Audubon's Shearwater	*Puffinus lherminieri*	X	
Great Blue Heron	*Ardea Herodias*	X	X
Great Egret	*Ardea alba*	X	X
Snowy Egret	*Egretta thula*	X	X
Little Blue Heron	*Egretta caerulea*	X	X
Tricolored Heron	*Egretta tricolor*	X	X
Cattle Egret	*Bubulcus ibis*	X	X
Green Heron	*Butorides virescens*	X	X
Western Reef-Heron	*Egetta gularis*	X	
Yellow-crowned Night Heron	*Nyctanassa violacea*	X	X
Greater Flamingo	*Phoenicopterus ruber*	X	X
Double-crested Cormorant	*Phalacrocorax auritus*	X	
White-cheeked Pintail	*Anas bahamensis*	X	X
Northern Shoveler	*Anas clypeata*	X	X
Northern Pintail	*Anas acuta*	X	X
Green-winged Teal	*Anas crecca*	X	X
Cinnamon Teal	*Anas cyanoptera*	X	X
Blue-winged Teal	*Anas discors*	X	X
Ring-necked Duck	*Aythya collaris*	X	X
Lesser Scaup	*Aythya affinis*		X
Ruddy Duck	*Oxyura jamaicensis*	X	X
Osprey	*Pandion haliaetus*	X	X
Broad-winged Hawk	*Buteo platypterus*	X	
Red-tailed Hawk	*Buteo jamaicensis*	X	X
American Kestrel	*Falco sparverius*	X	X

COMMON NAME	SCIENTIFIC NAME	TO	BI
Merlin	*Falco columbarius*	X	X
Peregrine Falcon	*Falco peregrines*	X	X
Clapper Rail	*Rallus longirostris*	X	X
Common Moorhen	*Gallinula chloropus*	X	X
Sora	*Porzana Carolina*	X	
American Coot	*Fulica americana*	X	
Caribbean Coot	*Fulica caribaea*	X	X
Purple Gallinule	*Porphyrula martinica*	X	
Black-bellied Plover	*Pluvialis squaterola*	X	X
Wilson's Plover	*Charadrius wilsonia*	X	X
Semi-palmated Plover	*Charadrius semipalmatus*	X	X
Piping Plover	*Charadrius melodus*	X	X
Killdeer	*Charadrius vociferus*	X	X
Whimbrel	*Numenius phaeopus*	X	X
American Oystercatcher	*Haematopus palliates*	X	X
Black-necked Stilt	*Himantopus mexicanus*	X	X
Greater Yellowlegs	*Tringa melanoleuca*	X	X
Lesser Yellowlegs	*Tringa flavipes*	X	X
Solitary Sandpiper	*Tringa solitaria*	X	X
Spotted Sandpiper	*Actitis macularia*	X	X
Ruddy Turnstone	*Arenaria interpres*	X	X
Common Snipe	*Gallinago gallinago*	X	
Short-billed Dowitcher	*Limnodromus griseus*	X	X
Sanderling	*Calidris alba*	X	X
Dunlin	*Calidris alpina*		X
Western Sandpiper	*Calidris mauri*		X
Semi-palmated Sandpiper	*Calidris pusilla*	X	X
Least Sandpiper	*Calidris mitunilla*	X	X
Willet	*Catoptrophorus semipalmatus*	X	X
Herring Gull	*Larus argentatus*	X	
Laughing Gull	*Larus atricilla*	X	X
Ring-billed Gull	*Larus delawarensis*	X	
Great Black-backed Gull	*Larus marinus*	X	
Royal Tern	*Sterna maxima*	X	X
Sandwich Tern	*Sterna sandvicensis*	X	X
Roseate Tern	*Sterna dougallii*	X	X
Common Tern	*Sterna hirundo*		X
Least Tern	*Sterna antillarum*	X	X
Bridled Tern	*Sterna anaethetus*	X	X
Brown Noddy	*Anous stolidus*	X	X
Scaly-naped Pigeon	*Columba squamosa*	X	X
White-crowned Pigeon	*Columbia leucocephala*	X	X
Bridled Quail-Dove	*Geotrygon mystacea*	X	
White-winged Dove	*Zenaida asiatica*	X	X
Zenaida Dove	*Zenaida aurita*	X	X
Common Ground-Dove	*Columbina passerine*	X	X

COMMON NAME	SCIENTIFIC NAME	TO	BI
Short-eared Owl	*Asio flammeus*	X	X
Antillean Nighthawk	*Chordeiles gundlachii*	X	X
Chuck-Will's Widow	*Caprimulgus carolinensis*	X	
Yellow- billed Cuckoo	*Coccyzus americanus*	X	X
Mangrove Cuckoo	*Coccyzus minor*	X	X
Smooth-billed Ani	*Crotophaga ani*	X	X
Green-throated Carib	*Eulampis holosericeus*	X	X
Antillean Crested Hummingbird	*Orthorhyncus. cristatus*	X	X
Belted Kingfisher	*Ceryle alcyon*	X	X
Caribbean Elaenia	*Elaenia martinica*	X	X
Puerto Rican Flycatcher	*Myiarchus antilarum*	X	X
Gray Kingbird	*Tyrannus dominicensis*	X	X
Caribbean Martin	*Progne dominicensis*	X	X
Bank Swallow	*Ripiria riparia*	X	
Cliff Swallow	*Hirundo pyrrhonota*	X	
Northern Rough-winged Swallow	*Stelgidopteryx serripennis*	X	
Barn Swallow	*Hirundo rustica*	X	X
Northern Mockingbird	*Mimus polyglottos*	X	X
Pearly-eyed Thrasher	*Margarops fuscatus*	X	X
Black-whiskered Vireo	*Vireo altiloquus*	X	X
Red-eyed Vireo	*Vireo olivaceus*	X	
Yellow-throated Vireo	*Vireo flavifrons*	X	
Northern Waterthrush	*Parkesia noveboracensis*	X	
Louisiana Waterthrush	*Seiurus noveboracensis*	X	
Yellow Warbler	*Setophaga petechia*	X	X
Northern Parula	*Setophaga americana*	X	X
Golden-winged Warbler	*Vermivora chrysoptera*	X	
Black-throated Blue Warbler	*Setophaga caerulescens*	X	
Magnolia Warbler	*Setophaga magnolia*	X	X
Prairie Warbler	*Setophaga discolor*	X	X
Palm Warbler	*Setophaga palmarum*	X	X
Yellow-rumped Warbler	*Setophaga coronata*	X	X
Cape May Warbler	*Setophaga tigrina*	X	X
Blackburnian Warbler	*Setophaga fusca*	X	
Kentucky Warbler	*Geothlypis formosa*	X	
Blackpoll Warbler	*Setophaga stiata*	X	X
Black-and-White Warbler	*Mniotilla varia*	X	
American Redstart	*Setophaga ruticilla*	X	
Chestnut-sided Warbler	*Setophaga pensylvanica*	X	
Worm-eating Warbler	*Helmitheros vesmivorum*	X	
Ovenbird	*Seiurus aurocapilla*	X	
Hooded Warbler	*Setophaga citrina*	X	
Common Yellowthroat	*Geothlypis trichas*	X	X
Wilson's Warbler	*Cardellina pusilla*	X	
Prothonotary Warbler	*Protonotaria citrea*	X	
Bananaquit	*Coereba flaveola*	X	X

COMMON NAME	SCIENTIFIC NAME	TO	BI
Scartlet Tanager	*Piranga olivacea*	X	X
Northern Oriole	*Icterus galbula*	X	
Bobolink	*Dolichonyx oryzivorus*	X	X
Shiny Cowbird	*Molothrus bonariensis*	X	X
Black-faced Grassquit	*Tiaris bicolor*	X	X
Mallard	*Anas platyrhynchos*	X	
Lesser Antillean Bullfinch	*Loxigilla noctis*	X	X
Indigo Bunting	*Passerina cyanea*	X	X
Blue Grossbeak	*Guiraca caerulea*	X	
Northern Oriole	*Icterus galbula*	X	
Puerto Rican Spindalis	*Spindalis portoricensis*	X	
House Sparrow	*Passer domesticus*	X	X
EXOCTIC SPECIES			
Muscovy Duck	*Cairina moschata*	X	X
Red Junglefowl	*Gallus gallus*	X	X
Helmeted Guineafowl	*Numida meleagris*	X	
Common Peafowl	*Pavo cristatus*	X	
Silver Pheasant	*Lophura nycthemera*	X	
Rock Dove	*Columba livia*	X	X
Eurasian Collared Dove	*Streptopelia decaocto*	X	X
Cockatiel	*Nymphicus hollandicus*	X	
Budgerigar	*Melopsittacus undulatus*	X	?
Lovebirds	*Agapornis sp.*	X	
Rose-ringed Parakeet	*Psittacula krameri*	X	
Monk Parakeet	*Myiopsitta monachus*	X	
Brown-throated Parakeet	*Aratinga pestinax*	X	
Red-and-green Macaw	*Ara chloropterus*	X	
Blue-and-yellow Macaw	*Ara ararauna*	X	
Severe Macaw	*Ara severa*	X	
Eclectus Parrot	*Eclectus roratus*	X	
Yellow-crowned Parrot	*Amazona ochrocephala*	X	
Amazon Parrot	*Amazona* sp.	X	
Red Siskin	*Carduelis cucullata*		X

SOURCES FOR THE ABOVE TABLE:

Primary Source: Petrovic and Roy (2012).

Additional Observers: Clive Petrovic (Econcerns); Kevel Lindsay and Jean-Pierre Bacle (IRF); Nancy Pascoe (NPT).

4.3.1.1 Bird Species of Special Conservation Concern

The bird species of Special Conservation Concern are provided in **Table 30**. A total of 34 species are listed, with the status given and a brief description of the threat and/or reasons for the decline of the species. Note that much of the decline in bird numbers and nesting success is due in large part to human activities. Most of the species listed are coastal, marine and wetland species.

Table 30.
Bird species of Special Conservation Concern for Tortola.

SPECIES	COMMON NAME	CONSERVATION STATUS	THREATS/CONCERNS
Phaethon aethereus L.	Red-billed Tropicbird	Rare	Does not nest on Tortola, but occurs on offshore cays. The species is vulnerable to invasive predators, tropical storms, and human disturbances.
Phaethon lepturus Daudin	White-tailed Tropicbird	Very Rare/Declining	Does not nest on Tortola, but numbers in the BVI seem to be on the decline.
Pelecanus occidentalis L.	Brown Pelican	Uncommon/Declining	Brown Pelicans once nested on Tortola. Nesting pelican numbers are very small in the BVI, the USVI, PR and the rest of the region, due in large part to predators, and coastal habitat destruction.
Pufflnus lherminieri Lesson	Audubon Shearwater	Rare/Nesting?	This species nested throughout much of the region during pre-Columbian times, but due to development, introduced predators and human disturbance, numbers have sharply declined, and virtually no recent sightings of nesting birds have been confirmed for the area.
Onychoprion anaethetus Scopoli	Bridled Tern	Uncommon	Nesting cays are vulnerable, especially to invasive predators such as rodents and cats.
Sterna hirundo L.	Common Tern	Uncommon	Nesting cays are vulnerable, especially to invasive predators such as rodents and cats.
Sterna dougallii Montagu	Roseate Tern	Rare/Vagrant	Nesting cays are vulnerable, especially to invasive predators such as rodents and cats.
Sternula antillarum Lesson	Least Tern	Uncommon	Nesting cays are vulnerable, especially to invasive predators such as rodents and cats.
Thalasseus maximus Boddaert	Royal Tern	Uncommon	Nesting cays are vulnerable, especially to invasive predators such as rodents and cats.
Thalasseus sandvicensis Latham	Sandwich Tern	Uncommon	Nesting cays are vulnerable, especially to invasive predators such as rodents and cats.
Phoenicopterus ruber L.	Greater Flamingo	Very Rare/Vagrant	A declining number of salt ponds and foraging habitats offer little opportunity for re-colonisation.
Podilymbus podiceps L.	Pied-billed Grebe	Very Rare	Limited available habitat, especially freshwater systems.
Tachybaptus dominicus L.	Least Grebe	Uncommon	Limited available habitat and salt pond systems.
Anas bahamensis L.	White-cheeked Pintail	Locally Common Declining	Limited available habitat and salt pond systems. Threatened, by rodents, feral cats and human activity.
Dendrocygna arborea L.	West Indian Whistling Duck	Locally Extinct	Locally extinct due to hunting, habitat destruction, and predation by introduced mammals.
Oxyura jamaicensis Gmelin	Ruddy Duck	Rare	Limited available habitat and salt pond systems. Threatened by feral cats, rodents and human activity.
Himantopus mexicanus Müller	Black-necked Stilt	Locally Common Declining	Limited available habitat and salt pond systems. Threatened by feral cats, rodents and human activity.
Charadrius melodus Ord	Piping Plover	Very Rare/Migrant	Considered *Endangered* by federal authorities in the US. Globally, it is considered a *Vulnerable* species by IUCN.
Numenius phaeopus L.	Whimbrel	Uncommon to rare	Limited available habitat and salt pond systems. Threatened by rodents and feral cats.
Tringa semipalmata Gmelin	Willet	Rare	Limited available habitat and salt pond systems. Threatened by rodents, and feral cats.

SPECIES	COMMON NAME	CONSERVATION STATUS	THREATS/CONCERNS
Haemantopus palliates	American Oystercatcher	Rare/Nesting	Threatened by reduced coastal habitats and food sources due to coastal development.
Fulica americana Gmelin	American Coot	Rare/Declining	Limited available habitat and salt pond systems. Threatened by rodents, feral cats, and human activity.
Fulica caribaea Ridgway	Caribbean Coot	Uncommon/Declining	Limited available habitat and salt pond systems. Threatened by rodents, feral cats, and human activity.
Gallinula galeata Lichtenstein	American/ Common Gallinule	Uncommon/Declining	Limited available habitat and salt pond systems. Threatened by rodents, feral cats, and human activity.
Rallus longirostris Boddaert	Clapper Rail	Uncommon/Declining	Limited available habitats and salt pond systems. Threatened by rodents, feral cats and human activity.
Patagioenas leucocephala L.	White-crowned Pigeon	Very Rare	Limited available coastal habitats and salt pond systems. In the past, hunting pressures in the VI and in PR have almost driven this species extinct in this part of the region.
Asio flammeus portoricensis Ridgeway	Puerto Rican Short-eared Owl	Rare/Subspecies endemic to Puerto Rico and Virgin Islands	Limited natural coastal and open plains habitat. Also vulnerable to introduced invasive predators and to human disturbance.
Megascops nudipes newtoni Lawrence	Puerto Rican Screech Owl	Very Rare	This subspecies has not been officially reported for Tortola and the rest of the VI for many years but has been reported for St. John and St. Thomas in the last few years, including reports of birds calling from the upper reaches of Coral Bay, St. John in February 2015. It requires large old trees with cavities for nesting.
Anthracothorax dominicus L.	Antillean Mango	Very Rare/Declining	Competition from the Green-throated Carib, coastal development, habitat destruction and human activities may be the cause of this species decline.
Myiarchus antillarum Bryant	Puerto Rican Flycatcher	Very Rare/Declining	This species requires stable lowland seasonal forests and woodlands, as well as undisturbed mangroves and beach vegetation to survive. Human development and habitat destruction are likely the cause of its decline.
Progne dominicensis Gmelin	Caribbean Martin	Rare	The limited availability of cavities for nesting may restrict population numbers of this species in the Virgin Islands.
Carduelis cucullata Swainson	Red Siskin	Very Rare/Accidental?	This species is considered globally *Endangered* by IUCN. Although the population in Puerto Rico is introduced, it nevertheless is considered important to help save the world population.
Loxigilla noctis L.	Lesser Antillean Bullfinch	Rare	The species is primarily limited to coastal woodlands and forests. Numbers on Tortola are low, and the species is rare on Beef Island. The reasons for this remain unclear.
Spindalis portoricensis Bryant	Puerto Rican Spindalis	Extremely Rare/ Endemic to PR and VI	The birds seen in the BVI may be vagrant, but nevertheless it is still a Puerto Rican Bank endemic. There are no population numbers for the VI.

4.3.1.2 Invasive Birds

There are several introduced bird species in Tortola, including the Eurasian Collared Dove and the House Sparrow, but these are confined to urban environments and, so far, their overall impacts on native birds, habitats and ecology are limited to these areas.

The one species considered invasive is the **Red Jungle Fowl** (*Gallus gallus)*, more widely known as "chicken". In most islands of the Caribbean, the Jungle Fowl has not gone feral because of human pressures. They are tasty and are quickly captured and eaten. They are valuable for their eggs, so they are kept caged or domesticated in yards. Also, the Small Indian Mongoose and feral cats have limited the bird's ability to establish wild populations. However, in the VI, including Tortola, the low numbers of Mongoose have allowed the Jungle Fowl to go feral and thereby establish viable populations with little or no means of controlling them. They are considered invasive instead of introduced because they are more widespread as opposed to being concentrated in urban environments, and they feed on a wide range of food sources. They can also spread pests and diseases to other species. This means that they kill and displace native fauna and disrupt natural ecosystems and ecologies.

4.3.2 The Mammals of Tortola

4.3.2.1 Native Mammals

The only native mammals that are still present in the BVI are bats. There are at least six species recorded. Bats often evoke fear and apprehension when discussed or observed by residents. When the IRF field team interviewed local residents about caves and roost for bats, many invariably complained that they had bats in their roofs and asked the team to remove them forthwith. Some refer to these small insectivorous (insect-eating) animals as "rat bats" because of their small dark furry appearance. They are also known as "roof bats."

Contrary to local beliefs and legends, bats are not deaf nor are they blind. They hear extremely well—far better than humans—and have excellent eyesight, which allows them to see in the night while flying in search of food, avoiding danger, and locating their friends and family. They are excellent fliers, and some species can out-perform most birds in their ability to maneuver their wings in tight spaces, including avoiding objects in pitch-black situations such as caves. They also are not rats, mice or rodents, and none of the species on Tortola drink blood or are vampires!

Despite the relative rarity of bats in the Virgin Islands, the species are important, not only because they are native mammals, but also because they play a significant role in the local ecology, *e.g.*, by reducing invertebrate populations, including flies, mosquitoes and moths. Additionally, bats are very useful in helping to spread plant seeds, especially in forests. They also pollinate the flowers of some species of plants such as cacti and the Calabash (*C. cujete*). They are the primary dispersers of figs (*Ficus* spp.), which rely on bats to carry their seeds far and wide. *Ficus* are some of the most important plant species in native forests and ecosystems.

Bats were revered by the Amerindians as representatives of their ancestors' souls. They were often depicted on pottery, carvings and petroglyphs. The closest examples of petroglyph depictions are on St. John in the neighbouring USVI.

There is still much to learn and understand about the bats of the Virgin Islands, including the total number of species, critical roost sites, and how land development is affecting their habitats.

The species of bats for Tortola include a mix of insect, fruit, plant and fish-eating bats. These species are discussed in the following sub-sections.

(1) Red Fig-eating Bat (*Stenoderma rufum*)

Photo 41.
The Red Fig-eating Bat of Tortola.

This species is endemic to Puerto Rico and the Virgin Islands, meaning that it is unique to these islands and found nowhere else on earth. There are two subspecies—*i.e.*, a group that has distinctive characteristics and/or behaviour that separates it from other members of the same species. They are *S. rufum darioi*, found only on Puerto Rico, and *S. rufum rufum*, found in the Virgin Islands. The Red Fig-eating Bat prefers intact forest habitat along mid-to-lower elevations.

The IRF team recorded this species for the first time in the BVI on Tortola in February 2014, and only one specimen has been observed so far (**Photo 41**). It is known only from Brewer's Bay, an area which is threatened with development and habitat fragmentation.

The Red Fig-eating Bat roosts in small colonies in trees and feeds on fruit and possibly leaves. It is sensitive to habitat disturbance, fragmentation, and decline in food and large roosting trees. No roost trees have been observed in Tortola or any of the Virgin Islands thus far.

(2) The Cave Bat (*Brachyphylla cavernarum*)

Photo 42.
The Cave Bat showing the characteristic "pig face" of the species.

This species is known as the Pig-faced Bat, due to its snout that vaguely resembles a pig (**Photo 42**). Cave Bats primarily roost in natural rock caves, especially along the coast. It eats fruits, nectar and some invertebrates. It is quite rare here, and to date no cave roosts have been found on Tortola. It may visit the nearby smaller islands when food is available there. It has been observed at Brewer's Bay on Tortola.

(3) The Jamaican Fruit Bat (*Artibeus jamaicensis*)

This Fruit Bat is the most common and widespread bat species of the Virgin Islands. It roosts in caves, old buildings and ruins, old cisterns and wells, in ceilings, and occasionally in trees and palms. Like the Cave Bat, it eats fruits, nectar and some invertebrates but will also chew leaves and extract the nutritious juices and vital moisture.

This species might only be encountered by its "calling card," namely, excrement splattered against walls during the night. This usually occurs near large Fig Trees. Often times, it may leave half-eaten almonds under trees and on the floor of buildings.

(4) The Mexican Free-tailed Bat (*Tadarida brasiliensis*)

Tadarida is not yet officially recorded for the island of Tortola, but specimens have been caught on the nearby islands of Guana and Beef. It undoubtedly occurs on Tortola. Like the Velvety Free-tailed Bat, it roosts in cracks, crevices, caves, cavities in trees, the roofs of houses, ruins and other places. It seems rare in the Virgin Islands, known only from a handful of specimens. It feeds on insects, helping to control mosquitoes, flies, beetles and other bugs.

(5) The Velvety Free-tailed Bat (*Molossus molossus*)

This is the Roof Bat species that most people encounter in Tortola. It is most common around town areas since it roosts under galvanised roofs and building shingles and in the cracks and cavities of older structures. The Roof Bat feeds on invertebrates, primarily flying insects, which it catches by chasing after them or by snatching them from the leaves of trees.

(6) The Greater Bulldog (or Fisherman) Bat (*Notilio lepocinus*)

The Fisherman Bat is by far the largest bat in the Virgin Islands with a wingspan that exceeds 50 cm (10 in). Although observed foraging along coasts and salt ponds, none are officially recorded for Tortola. However, one specimen was captured by IRF researchers on Beef Island in 2012. This bat roosts near ghuts and coastal marine habitats where it feeds on small fishes and other aquatic species.

4.3.2.2 A Wave of Extinctions

Many other native mammal species became extinct on Tortola and the other Virgin Islands after or just before European arrival. Because of the lack of written records, we can only speculate about some of the species of animals that once inhabited Tortola, based on similar situations and findings from the nearby USVI.

Birds, reptiles, amphibians and mammals were introduced throughout the Caribbean, and it is likely that species such as the **Agouti** (*Dasyprocta* sp.) were once a part of the fauna of Tortola and sister islands of the territory. Agoutis are believed to have survived in the BVI up until the early twentieth century, although in small numbers. It was the introduction of the Small Indian Mongoose (*H. javanicus*), that caused the extinction of this animal.

Other animals that may have been important to the Amerindians include the **Puerto Rican Hutia** (*Isolobodon portoricensis*), an extinct mammal resembling a large Agouti, and the **West Indian Shrew** (*Nesophontes edithae*), an endemic small insectivore (about the size of a House Mouse), which became extinct sometime around the 1400s. However many anecdotal reports in the Virgin Islands describe the species being present up until the early 1990s in small numbers. It was a nocturnal species, possessing a long and very sensitive snout, which was covered in fine long hairs and used to detect earthworms, other invertebrates, and perhaps the eggs and nestlings of ground-nesting birds, reptiles and amphibians, and even edible fungi and some seeds. **Figure 27** shows an artistic rendition of what this species may have looked like in the Virgin Islands.

Figure 27.
An artist's rendition of the extinct West Indian Shrew preying on a large earthworm (sketch provided by Kevel Lindsay).

4.3.2.3 Introduced and Invasive Mammals

After Europeans arrived, the landscapes and biodiversity of Caribbean islands began to undergo dramatic changes. The new arrivals brought with them many species new to the region, unleashing centuries of change to these small and ecologically fragile islands.

Early on, European settlers introduced the domestic **Pig** (*Sus scrofa domesticus*), often dropping small numbers off on uninhabited islands, thereby allowing them to breed and increase in numbers. Then, on return voyages, they had ready meat to harvest. They also brought the domestic **Goat** (*Capra aegagrus hircus*), **European Cattle** (*Bos taurus primigenius*), the domestic **Donkey** (*Equus africanus asinus*), the domestic **Horse** (*Equus ferus caballus*), **Sheep** (*Ovis aries*), European domesticated **dogs** (*Canis familiaris*) and domestic **cats** (*Felis catus*). With their arrival also came the invasive and voracious **Black Rat** (*Rattus rattus*), the **Brown** or **Roof Rat** (*R. norvegicus)*, and the **House Mouse** (*M. musculus)*.

Issues surrounding feral and free-roaming livestock are summarised in the Issues Table at the end of this chapter (see Issue Two).

Feral cats are now known to roam some parts of Tortola. These animals are often discarded as kittens or pets released into wild areas by owners who can no longer care for them. Feral cats are notorious predators that wreak havoc on native birds, frogs and reptiles, and decimate native ecosystems. The practice of discarding unwanted cats, dogs and other pets should be discouraged, and a system of drop-offs at the local Humane Society should be supported. Most pet owners do not spay and neuter their animals, and this is a concern that the BVI Humane Society is trying to address through education.

In the early twentieth century, British residents introduced the **Small Indian Mongoose** (*H. javanicus*) to rid Tortola of rats that were decimating cane harvests and other crops. However, the Mongoose had little effect on the Black and Brown rats and the House Mouse, since these species were nocturnal and the Mongoose hunts during the day. Instead, the Mongoose quite quickly turned its attention to native birds and reptiles and may have contributed to the extinction of the West Indian Shrew.

White-tailed Deer (*Odocoileus virginianus*) were introduced to the US Virgin Islands sometime around 1790 (or possibly earlier) by colonists. Small populations persist on St. Thomas and St. John. They move quite easily among the area's minor islands and cays, including, occasionally, Tortola. Small numbers have been seen on the west end, the north coast and even up on the slopes to Mount Sage. It is not uncommon for boaters to see deer moving between the islands. They are adept swimmers and migrate from island to island in search of food, mates, and new ground. Clive and Daniel Petrovic of

Tortola have reported seeing an individual swimming between Tortola and Jost Van Dyke (*pers. comm*., circa 2010).

The Amerindians would likely have brought other species of mammals with them, including the domestic **Dog** (*Canis familiaris*), an essential species to early settlers. Some suggest that there were two breeds of dog, one raised for food and another for hunting rodents and other animals. Some dogs held spiritual importance, while hunting dogs were highly prized for their skills. Many burials in the West Indies contain the remains of dogs. Researchers have similarly found the remains of perforated dog teeth, which were worn as necklaces and other adornments.

Another species of mammal likely brought to the Virgin Islands, and elsewhere in the West Indies, by Amerindians is the **Guinea Pig** (*Cavia porcellus*). This species was brought from South America and was raised for meat consumption.

During the past 20-30 years, there have been reports of monkeys in the BVI. All reports likely pertain to the Vervet or **Green Monkey** (*Chlorocebus pygerythrus*), originally from West Africa but introduced to parts of the West Indies between the 1500s and 1700s. A recent report and photo (**Photo 43**) published in the Tortola press, suggest that it is indeed this species (*BVI Beacon*, 30 September 2013). The species is likely from the northeast Caribbean because of cultural ties between the BVI and the Federation of St. Kitts and Nevis where the Green Monkey occurs.

Photo 43.
Photo of Green Monkey in Tortola
(*source*: *BVI Beacon*).

It is speculated they were smuggled into the BVI, perhaps as juveniles, and when they grew too big and unmanageable, they were released into the wild. The monkey in Photo 43 is a male, and this may explain why it was released since sexually mature males can become quite aggressive.

Monkeys have been reported from Spring Gut, Brewer's Bay, the western end of Tortola and other areas, but it is believed that these reports all represent a single animal since reports thus far indicate that the animal is always alone, and, when calling, there are no responses from other individuals. However, every effort should be made to remove the animal from the wild since it only takes one mature female to start a wild population on the island, and the impacts could be quite devastating to native flora and fauna and to farmers and homeowners.

4.3.2.4 Highlighting the Loss of Two Unique Mammalian Species

One of the BVI's most enigmatic species is the **West Indian Manatee** (*Trichechus manatus*) or Sea Cow (**Figure 28**). It is typically a coastal mammal, though it occurs in estuaries and some freshwater habitats when these are available.

The West Indian Manatee is the largest surviving member of the order Serenia, which includes the Dugon (*Dugong dugon*) of the Indian and Pacific Oceans and the Steller's Seacow (*Hydrodamalis gigas*) of the cold coastal waters of the northern Pacific, the largest of the group. The Steller became extinct by the 1770s after increased hunting by European colonists.

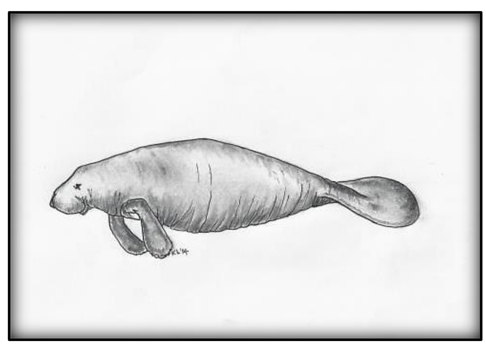


Figure 28.
West Indian Manatee (*Trichechus manatus)*
(sketch provided by Kevel Lindsay).

The West Indian Manatee once occupied part of the coastal marine habitats of Tortola. Place names such as Sea Cow's Bay are testimony to the fact that the Manatee was once present, finding home and refuge in many of the mangrove bays, ponds and channels and feeding on the many seagrass fields that once existed throughout the BVI.

The animal was hunted by Amerindians for food, but it was after European colonisation that the species rapidly declined. Not only were they killed for food, but also because of superstition as it was often believed the animal was a harbinger of doom and misfortune, especially by fishermen. As their habitats declined, the once mighty cow of the sea became extinct although it likely persisted in local waters until the beginning of the twentieth century.

Today, it is found in Puerto Rico, where it is endangered, and also in other Greater Antillean islands, in the Bahamas and Florida. It is also found from Mexico to northern South America. Throughout its entire range, the species is declining and is critically endangered in many places.

Occasionally, individuals wander from their home around Puerto Rico and arrive in the Virgin Islands' waters. There have been a handful of sightings around Tortola and other islands, including St. Thomas. There was a sighting of an individual at Peter Island about 20 years ago. Another sighting was of an animal at the Bitter End Yacht Club in Virgin Gorda about 15 years ago (the Caribbean Stranding Network—which assists marine mammals that become stranded or wonder away from their home ranges—came from Puerto Rico to deal with it). A Manatee was also observed in Charlotte Amalie, St. Thomas in the mid-1980s.

Evidence for the presence of the **West Indian (Caribbean) Monk Seal** (*Neomonachus tropicalis*) in the BVI comes from place names such as the Seal Dog Islands just northwest of Virgin Gorda, named for the small pods that once congregated there. This seal species first came to world attention when Christopher Columbus mentioned it in his account of his second voyage to the Caribbean in 1494.

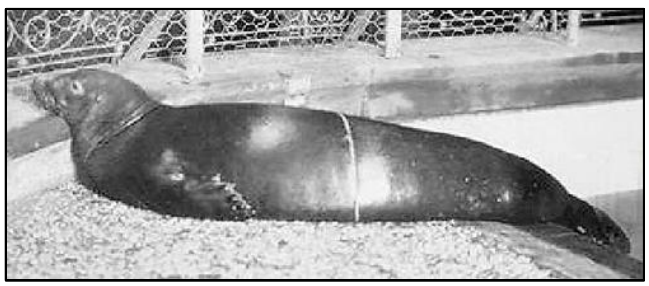


Photo 44.
One of the last captive West Indian Monk Seals, at the New York Aquarium in 1910.

The West Indian Monk Seal was familiar to native Amerindian peoples throughout the Caribbean Basin, some of whom undoubtedly hunted it for meat. However, it was not until the arrival of Europeans that the species began its decline. It was hunted by early explorers for its meat, skin and heavy oil—used for cooking, food preservation and fuel. Later, as it became rare, many private and public museums and zoological collections clamored to obtain live animals for their parks. **Photo 44** shows one of the last living specimens caught for the New York Aquarium. The animal was put on display in 1910.

It was believed to be primarily distributed in the Gulf of Mexico, off Central America, Florida, the Bahamas and Turks and Caicos, perhaps up to Georgia in the United States, into the Greater Antilles and then on down the Lesser Antilles where it was perhaps vagrant. In the Virgin Islands, it migrated, moving as the winters in the north pushed it south and eastward.

The West Indian Monk Seal grew to about 4.8 m (8 ft) in length, and was more streamlined than its cold water seal cousins. Males were larger than the females. They were brownish to greyish above, and a lighter colour below. The young had a yellowish colour. The fur had growing algae, thereby giving the animals a greenish hue.

They are closely related to the Hawaiian Monk Seal (*Neomonachus schauinslandi*), which is *Critically Endangered*. Both species are closely related, and perhaps became isolated when the Central American landmass arose, bridging North and South America and thereby cutting off the Caribbean from the Pacific some three million years, before present during the Pliocene. Recent studies by Scheel, *et al.*, 2014 and Thompson, 2014, suggests that the Caribbean and Hawaiian monk seals belong in a different genus than the Mediterranean Monk Seal (*Monachus monachus*) and are therefore unique in the family tree of pinnipeds (including sea lions and walruses).

The West Indian Monk Seal became extinct before there could be adequate and comprehensive studies of its habits and diets, but it is assumed that it fed on fish and invertebrates such as lobsters, crustaceans, slugs and perhaps even jellyfish. Like other pinnipeds, it is believed that one dominant male controlled a group of females called a harem, which he defended from other males. Each female bore one pup per year.

The West Indian Monk Seal was declared extinct in 2008 after many years of extensive searches by the US National Oceanic and Atmospheric Administration (NOAA) and others. It was last confirmed as alive in 1952.

4.3.2.5 Mammal Species and Habitats of Special Conservation Concern

The mammals of Special Conservation Concern in the BVI are mostly limited to five species of the Chiropteran family (bats). Although not sighted in the BVI for over a decade, the West Indian Manatee is included in the list (**Table 31**).

Table 31.

Mammal species of Special Conservation Concern for Tortola.

SPECIES	SUB-SPEICES	COMMON NAME	CONSERVATION STATUS	DISTRIBUTION	HABITATS OF SPECIAL CONCERN
Brachyphylla cavernarum Gray	*Intermedia* Swan. & Gen.	Cave Bat	Rare/PR Bank Endemic	Roosts in caves located along the coasts and on offshore cays.	Caves; riparian corridors (along ghuts); upland moist forests; permanent freshwater pools.
Molossus molossus Pallas	*fortis* Miller	Velvety Free-tailed Bat	Uncommon to locally common	Urban areas, within roof structures. Few natural roosts exist.	Natural and stable rock cavities and caves; permanent freshwater pools.
Noctilio leporinus L.	*mastivus* Vahl	Greater Fishing Bat	Rare	Needs small caves and cavities for roosting and to raise young. Found mostly along coasts and stream corridors.	Coastal rock caves and cavities and hollows in large old trees. Mangrove ponds; permanent freshwater pools; coastal waters.
Stenoderma rufum Desmarest	*Rufum*	Red Fig-eating Bat	Extremely Rare/Virgin Islands Endemic	Seasonal and evergreen forests, woodlands and moist riparian corridors (ghuts) on the north side of Tortola.	Seasonal and evergreen forests; woodlands and moist ghuts on north side of Tortola; large old trees for roosting; permanent freshwater pools.
Tadarida brasiliensis I. Geoffroy	*antillularum* Miller	Mexican Free-tailed Bat	Extremely Rare	At all elevations; roosts in caves, roofs of houses, and old buildings and ruins.	Rock cavities and caves; upland seasonal forests and woodlands; permanent freshwater pools.
Trichechus manatus L.	*Manatus*	West Indian Manatee	Extremely Rare; permanent breeding population extinct, now vagrant.	Stable harbours, inlets, seagrass beds, mangrove channels and lakes.	Coastal bays and inlets, seagrass beds, extensive mangroves and marshes.

4.3.3 The Amphibians of Tortola

On any given night in Tortola, it is almost impossible not to notice the distinct chorus of frogs that comprises the vibrant night-tableau of the island. The "peeps," "chirps," "grunts," and "whistles" that are commonly played as part of the night's backdrop are owned by frogs. Males call to females, announcing themselves, defending territories, guarding future generations, and warding off the hubris of other male suitors by singing the night away. For most, the calls of the island's frogs are a signature of the night and a defining feature of Caribbean islands. Tortola has at least five species of frogs, and one of them is introduced (see **Table 32**).

Table 32.

The amphibians (frogs and toads) of Tortola and Beef Island.

SPECIES	COMMON NAME	DISTRIBUTION	STATUS
Eleutherodactylus antillensis Reinhardt & Lutken	Antillean Coqui/ Tree Frog/Bo Peep	Puerto Rico, Vieques, Culebra, US and British Virgin Islands	Widespread and common.
Eleutherodactylus cochranae Grant	Whistling Coqui/ Bo Peep	Puerto Rico and the Virgin Islands	Widespread but localised.
Eleutherodactylus schwartzii Thomas	Virgin Islands Coqui/ Tree Frog/Bo Peep	BVI and St. John, USVI	Uncommon to rare and localised in some areas; distribution seems patchy. Listed as <u>*Endangered*</u> by IUCN and hence is a species of *Special Conservation Concern*.
Leptodactylus albilabris Günther	White-lipped Frog/ Puerto Rican Ditch Frog	Puerto Rico and the Virgin Islands	Very Rare.
Osteopilus septentrionalis Dumeril & Bibron	Cuban Tree Frog	Native to Cuba, widely introduced through the Virgin Islands and much of the West Indies	Introduced to Tortola and Beef Island; widespread and common.

(1) Antillean Coqui/Tree Frog/Bo Peep (*Eleutherodactylus antillensis*)

The Antillean Tree Frog is the most abundant and widespread of the native frogs in Tortola and, indeed, throughout much of the Virgin Islands and Puerto Rico, to which it is endemic (**Photo 45**). It is found throughout much of Tortola, around homes, cisterns and tanks, wet ditches, and gutters and under moist debris, construction material and the like. It has undoubtedly moved around the Virgin Islands, deliberately and accidentally, since a recent study (Barker, 2012) has shown that there is a great deal of genetic uniformity between many populations from various locations throughout the Virgin Islands.

Photo 45.
The Antillean Tree Frog.

(2) Whistling Coqui/Bo Peep (*Eleutherodactylus cochranae*)

Endemic to the Virgin Islands and Puerto Rico, the Whistling Coqui is smaller than *E. antillensis*, growing to about 2.5 cm long (1 in); it is variable in colour, with a smooth underside and a light green abdomen. Its call is said to be like the sounds from the movements of an old rusty swing or metal gate. It is found at all elevations of the island, and prefers damp spots like trash piles, thick leaf litter, stone heaps and in bromeliads.

(3) Virgin Islands Coqui/Tree Frog/Bo Peep (*Eleutherodactylus schwartzi*)

This species is endemic to the BVI and to St. John (although it has not been seen from that island in many years). Females grow to about 3.2 cm long (1.25 in), about the same size as the largest *E. antillensis*. It is a yellowish-tan on the upper side; the sides and upper areas of its legs are reddish to bright yellow; the underside is whitish with a greenish tinge on the stomach. It has a gold colour on the upper half of the iris. Its call is a "bo-peep," repeated often. It seems to have a preference for the deep rosette of the thorny terrestrial bromeliad *Bromelia pinguin*.

(4) White-lipped Frog (*Leptodactylus albilabris*)

The most aquatic of the local species, the White-lipped Frog can often be heard calling from wet and flooded ditches, pools, ponds, holes and bromeliads. It lays its eggs in flooded places, where its tadpoles rapidly transform into tiny froglets. This species is endemic to Puerto Rico and the Virgin Islands.

(5) Cuban Tree Frog (*Osteopilus septentrionalis*)

This species has been introduced to the Virgin Islands from Florida. The Cuban Tree Frog was first reported from St. Thomas around 1970. It was first officially reported for Tortola in 1990 (Owen, *et al*., 2006), but likely arrived sometime during the 1980s.

This frog needs standing freshwater to reproduce, as well as damp environments to prevent its skin from drying out. It will often be found in cisterns, tanks, pools, and ponds in high concentrations. Its tadpoles are fairly large—the largest of any wild species in the VI—and are voracious predators. Adult Cuban Tree Frogs will prey on small birds, lizards, other frogs, invertebrates, and smaller Cuban Tree Frogs.

Small glands on parts of its skin produce a toxin that is mildly noxious, creating a numbing sensation around the lips, the tongue and eyes of people who handle specimens and touch their faces. The toxin is a natural defence mechanism that deters potential predators. **Photo 46** shows a large Cuban Tree Frog hunting at night, waiting for prey to happen along, on the limb of a tree at Great Carrot Bay.

Photo 46.
The Cuban Tree Frog at Great Carrot Bay, Tortola.

4.3.4 The Reptiles of Tortola

There are about 22 reptile species found on Tortola (**Table 33**). They fall into two broad categories: those living on land and those that live in the sea. The terrestrial reptiles are further sub-divided into smaller groups, including aquatic species, tortoises and terrapins, land lizards and snakes.

Of the 22 reptiles, there are twelve lizards, four snake species, one land turtle, and two terrapins (which are freshwater turtles), and three sea turtles. Four of the species of reptiles are recent introductions.

The largest lizard is the **Green Iguana** (*Iguana iguana*), a species that is a relatively recent arrival to Tortola, although it has been present in much of the US Virgin Islands and Puerto Rico for quite some time (**Photo 47**). Some reptile experts believe that populations in this part of the region are the result of released pets, but others have argued that it may be native. Genetic studies will be required to clarify the issue.

Photo 47.
A Green Iguana basks on a Flamboyant Tree
(photo courtesy of Caroline Rogers).

The smallest of the lizard species are the dwarf geckos in the genus *Sphaerodactylus*. Two species are reported for Tortola and one for Beef Island.

Table 33.
The reptiles of Tortola.

SPECIES	COMMON NAME	DISTRIBUTION	STATUS
TERRESTRIAL LIZARDS AND SNAKES			
Iguana iguana Linnaeus	Green Iguana/ Common Iguana	Puerto Rico, Virgin Islands, Lesser Antilles, North, Central and South America	Possibly introduced to Tortola and the Virgin Islands. More genetic work is needed to determine the status of this species.
Sphaerodactylus macrolepis macrolepis Günther	Puerto Rican Eye-spot Sphaero/ Puerto Rican Eye-spot Gecko	Throughout the Virgin Islands	Common and widespread.
Sphaerodactylus parthenopion Thomas	Virgin Islands Least Gecko	Mosquito Island, Virgin Gorda and Tortola (?)	Endemic to the BVI; localised and believed to be rare.
Anolis cristatellus wileyae Cope	Virgin Islands Crested Anole	Culebra, Vieques and the British and US Virgin Islands	Common and widespread.
Anolis pulchellus Dumeril & Bibron	Puerto Rican Bush Anole	Virgin Islands and Puerto Rico	Common and widespread.
Anolis stratulus Cope	Puerto Rican Spotted Anole	Puerto Rico and the Virgin Islands	Common and widespread.
Anolis cuvierii Merrem	Puerto Rican Giant Anole	Puerto Rico, Vieques and Tortola	The record for Tortola is possibly an error.
Anolis roosveltii Grant	Culebra or Roosevelt's Giant Anole	Endemic to Culebra, Vieques, St. John and Tortola	Very rare and possibly extinct. Considered *Critically Endangered* by IUCN.
Hemidactylus mabouia Moreau De Jonnès	House Gecko	Throughout the Virgin Islands and the rest of the Neotropics	Introduced; common around residences and in the wild.
Spondylurus semitaeniatus Wiegmann	Lesser Virgin Islands Skink	British and US Virgin Islands	Considered uncommon to rare, and continues to decline due to the Mongoose, habitat destruction and development; Hedges, *et al*. (2012) consider this species, based on IUCN criteria, to be *Endangered*.
Ameiva exsul Cope	Virgin Islands Ground Lizard	Throughout the Virgin Islands (British and US)	Common and widespread.
Amphisbaena fenestrata Cope	Virgin Islands Worm Lizard	St. Thomas, St. John, Tortola, Virgin Gorda and some cays	Uncommon to rare; endemic to the Virgin Islands.
Chilabothrus grantii Zenneck	Virgin Islands Tree Boa	St. Thomas, St. John, Tortola, Virgin Gorda and some cays	Uncommon but widespread on Tortola; endemic to the Virgin Islands; considered *Endangered* by IUCN.
Borikenophis portoricensis anegadae Barbour	Puerto Rican Racer	British Virgin Islands	Relatively common and widespread.
Magliophis exiguus exiguus Cope	Virgin Islands Racerlet	Virgin Gorda, rest of the Virgin Islands and Puerto Rico	Uncommon to rare; possibly declining.
Typhlops richardii Dumeril & Bibron *richardii*	Virgin Islands Blind Snake/Richards Blind Snake	Culebra, USVI, Tortola, Guana Island and other islands	Rarely seen or observed; the conservation status of this species remains unknown.
TORTOISES AND TERRAPINS			
Chelonoidis carbonaria Spix	Red-legged/Red-footed Tortoise	Puerto Rico, the Virgin Islands, Lesser Antilles and South America	Rare and extinct in much of Tortola. Should be considered *Critically Endangered* locally.
Pseudemys nelsonii Carr	Florida red-bellied turtle	North America	Introduced; rare.
Trachemys scripta elegans Wied-Neuwied	Red-eared slider/ Red-eared Terrapin	Native to North America, widely introduced in many parts of the world, including Tortola and Virgin Gorda	Introduced; rare.
MARINE REPTILES			
Chelonia mydas Linnaeus	Green Turtle	Worldwide	*Endangered*
Dermochelys coriacea Vandelli	Leatherback Turtle	Worldwide	*Endangered*
Eretmochelys *imbricata* Linnaeus	Hawksbill Turtle	Worldwide	*Endangered*

The common and widespread **Puerto Rican Eye-spot Gecko** (*S. macrolepis macrolepis*) is a subspecies endemic to the Virgin Islands. Its most defining characteristic is the presence of two spots on the shoulder, hence the name. However, it is a variable species, with some populations having only faint or no spots, or sometimes only one spot. It inhabits the leaf litter of forests and woodlands, mostly in somewhat dry conditions. **Photo 48** shows a specimen from Long Bay on Beef Island.

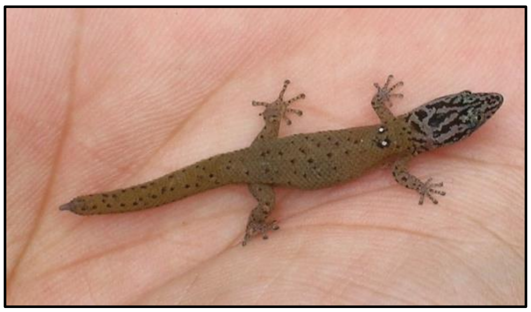


Photo 48.
Eye-spot Gecko with distinctive two spots on shoulder, from Beef Island, Tortola.

The smallest gecko reported for Tortola is one of the world's smallest reptiles, the **Virgin Islands Least Gecko** (*S. parthenopion*). Originally discovered on Virgin Gorda in the 1964, this dwarf of the dwarves is endemic to the British Virgin Islands and found nowhere else. It was collected at Zion Hill on the western end of the island in 1980 by R. Crombie and G. Pregill. The Virgin Islands Least Gecko is believed to be of more ancient lineage than the previous species, and perhaps its rarity is due in part to the more recent arrival of and competition from the Puerto Rican Eye-spot Gecko.

It prefers dry rocky ground with lots of leaf litter. It is so small, reaching only about 18 mm (0.71 in)—fitting on the tip of the average person's thumb with ease—and so is very easily overlooked. The species can be distinguished from its larger cousin by its smaller size, blunter head, absence of an eye-spot on the upper side, and the presence of a yellowish-to-white bar between the eyes and a similar light-coloured line behind the eye. It is quite rare, and though not yet assessed by IUCN, it should be considered *Critically Endangered* because its habitats throughout its distribution are threatened with development.

The other lizards of Tortola include between three to five species of *Anolis* (pronounced Ah-no-liss or sometimes Anno-lees). Anolis lizards are by far the most widespread and commonly seen species of lizards in the West Indies; perhaps more than any animal they symbolically characterise the wild of the region. The local species are:

- **Virgin Islands Crested Anole** (*Anolis cristatellus wileyae*)
- **Puerto Rican Giant Anole** (*Anolis cuvierii*)
- **Puerto Rican Bush Anole** (*Anolis pulchellus*)
- **Culebra or Roosevelt's Giant Anole** (*Anolis roosveltii*)
- **Puerto Rican Spotted Anole** (*Anolis stratulus*).

The **Virgin Islands Crested Anole**, **Puerto Rican Bush Anole**, and **Puerto Rican Spotted Anole** are all fairly common and widespread on Tortola, although the Bush Anole is often overlooked due to its peculiar characteristics and habits. It is found primarily in grassy and low bush habitats and readily disappears before most observers even know it is there. A brief description and image of each of the three species can be found in **Box 8**.

The situation for the other two species of Anole is far more precarious. The **Puerto Rican Giant Anole** (*Anolis cuvieri*) is the largest of its kind in Puerto Rico, representing a "crown giant" of this group of Caribbean lizards, meaning that it lives high in tree tops and on the upper branches and trunks of large forest and woodland trees, where it preys on other lizards, small birds, insects, frogs and eats fruit. It is overall bright green in colour with a large head, sometimes a crest on its tail, reaching about 41cm (16 in).

BOX 8
Tortola's Common Anoles

Virgin Islands Crested Anole (*Anolis cristatellus wileyae*): The largest of the three common VI Anoles, it is a pale greenish-grey to bright brown with white, yellow and orange markings; mature and dominant males often have a crest or fan on the tail. Usually found on rocks, tree trunks and fence posts. Females are duller and smaller, without the prominent tail fans.

Puerto Rican Bush Anole (*Anolis pulchellus*): The smallest of the common Anoles, this slender species resides in grassy and shrubby habitats, very often on the rigid stems of large grasses; it can be found at all elevations in suitable habitats. It is bright yellow to whitish below, brownish above with a lighter stripe down its back, and a more pointed snout and long thin tail.

Puerto Rican Spotted Anole (*Anolis stratulus*): This Anole is often found high up on the trunks and crowns of trees. In size, it falls midway between the two previous species. It is a yellowish-grey to greyish-brown, with traverse black and brown bands on the back and neck, speckled with large and small spots, hence the name.

Another giant, the **Culebra Giant Anole** or **Roosevelt's Giant Anole** (*Anolis roosevelti*), was first described from the nearby island of Culebra in 1931 by zoologist Chapman Grant, grandson of the US president, Ulysses Grant. The species was named for another US president, Theodore Roosevelt, who was then the governor of Puerto Rico.

It reaches lengths up to about 40 cm (15.7 in) and is described as brownish-grey, yellowish-brown to greenish above, and cream to yellowish below, and yellowish to greenish yellow about the eyes. Mature males have a crest or fan on the tail, reminiscent of the much smaller Crested Anole. Though the species was first reported as endemic to Culebra, subsequent studies (Gaa, 1987) turned up museum specimens that were taken from Vieques, St. John and Tortola.

It is an arboreal species that inhabits semi-deciduous to moist forests with tall emergent trees. Nevertheless, very little is known about the species since no live animals have been confirmed in the BVI since 1931. On Tortola, its habitat is believed to be on the steep slopes of Sage Mountain and possibly on the upper forested slopes of Mount Alma on Beef Island. There have been no systematic searches for this species in the BVI since it was first described, and such an effort is needed to determine its status.

Another species of lizards in Tortola is the **House Gecko** (*Hemidactylus mabouia*). Often called the "woodslave" in parts of the Caribbean, it is a relatively recent introduction, believed to be a stowaway on slave ships from the west coast of Africa. It is a nocturnal species, regularly found in homes, but is also common in the wild.

One of the most unusual of Tortola's reptiles is the **Lesser Virgin Islands Skink** (*Spondylurus semitaeniatus*). It is primarily a species of dry coastal woodlands, although it can be found on some of the moister higher slopes of Tortola. It has short limbs, and "snakes" its body from side to side, rapidly slinking along the ground. The skink is about 12 to 15 cm (5 to 6 in) long. Females are larger than males, with the upper side covered with shiny grey-brown scales and longitudinal dark brown stripes from the nose to just past the shoulders, on the top and along the sides. The underside is a silvery to silvery-brown colour. Juveniles have bluish tails. These features make the Lesser Virgin Islands Skink unlike any other lizard species on Tortola. **Photo 49** shows a specimen on Beef Island. This species is endemic to the US and British Virgin Islands.

Photo 49.
Lesser Virgin Islands Skink on Beef Island, Tortola.

The **Virgin Islands Ground Lizard** (*Ameiva exsul*) is widespread throughout much of the BVI (**Photo 50**). It lives on the ground and is primarily a species of open coastal areas, but is also found in towns, around homes, dry woodlands, forests, scrubby environments, beaches and swampy ground. On Tortola, it may be found high on moist slopes toward Sage Mountain, especially on the north coast. There it is found in farmers' fields, low shrubby habitats and along streams with low open woodland. The juveniles and young females have prominent whitish stripes, and the largest specimens may grow up to about 25 cm (10 in) in length. Males are larger than females.

The remaining species, the **Virgin Islands Worm Lizard** (*Amphisbaena fenestrata*), is perhaps the most unusual of all because it is so un-lizard-like (**Photo 51**). It is relatively small, reaching 25 cm (10 in), has no legs or arms, is fossorial in habit (lives in soil, below rocks, rotten logs, and leaf-litter), somewhat flesh-coloured—being a bright pink—and resembles a large worm; hence the common name. Its eyes are small, as it spends most of its life below ground, and it feeds mostly on small invertebrates. It is easily confused with the Virgin Islands Blind Snake, which is

Photo 50.
A large male Ground Lizard sunning itself high on the slopes of Brewer's Bay.

Photo 51.
The Virgin Islands Worm Lizard (photo courtesy of Renata Platenberg).

much darker in colour and does not have the characteristic rings of scales. The Worm Lizard is endemic to the US and British Virgin Islands.

There are four known species of snakes found in the wild on Tortola. They include the **Virgin Island Tree Boa** (*Chilabothrus grantii*), the **Puerto Rican Racer** (*Borikenophis portoricensis anegadae*), the **Virgin Islands Racerlet** (*Magliophis exiguus exiguous*), and the **Virgin Islands Blind Snake** (*Typhlops richardii richardii*).

The largest, the **Virgin Islands Tree Boa** (*Chilabothrus grantii*), formerly named *Epicrates monensis grantii*, reaches lengths of about one metre (about 3.4 ft) and is primarily nocturnal. The Tree Boa is an excellent climber and hunts lizards, amphibians, rodents, small birds and perhaps even large insects. It spends the heat of the day in small borrows, crevices, cavities, and is usually underground. It is widespread on Tortola, occurring from sea-level up to Sage Mountain.

The Boa has a relatively large head, with big yellow round eyes, which help its night vision. This subspecies is endemic to the Virgin Islands; however, the population in the BVI shows distinctive characteristics that distinguish it from those of St. John and St. Thomas. Nevertheless, morphological, genetic and ecological work is ongoing to determine the significance of these differences. The Tree Boa is non-venomous and completely harmless to humans.

The most commonly seen species is the **Puerto Rican Racer** (*Borikenophis portoricensis anegadae*), this subspecies being endemic to the Virgin Islands. It reaches lengths of up to 75 cm (2.5 ft), has a relatively small head with a blunt nose, yellow below the eyes, chin, the throat, and sometimes down to the tail, although it can also be a cream colour. The colour of this species may vary considerably, with some at one end of the spectrum being a pale greyish-brown on the upper side with small dark spots and speckles. Alternatively, some individuals may be dark brown to almost black. **Photo 52** shows a specimen that falls somewhere in-between this range.

Its prey is primarily lizards, but it will also take small birds, frogs and large insects. The Racer will also stalk its victim. It often ambushes its prey, lying in wait for long periods.

Photo 52.
Puerto Rican Racer Snake at Beef Island, Tortola.

A close relative of the Racer is the **Virgin Islands Racerlet** (*Magliophis exiguus exiguous*). It is smaller, reaching about 30 cm (12 in), has a more streamlined body, with a smaller head, narrow long tail, and is usually a rich shiny yellowish-mocha brown above. It is active by day and is much more of a ground-dwelling species than its cousin, rarely venturing into trees and shrubs, although it may do so on occasion to find prey and escape flooding. This subspecies is endemic to the Virgin Islands and is rarely seen by residents. It also prefers drier habitats than the Racer. **Photo 53** shows a specimen from Frenchman's Bay on St. Thomas taken in 2005.

Photo 53.
The Virgin Islands Racerlet.

The fourth species, the **Virgin Islands Blind Snake** (*Typhlops richardii richardii*) is the smallest of the species, reaching lengths of 5 to 25 cm (2 to 10 in). It is a fossorial species, living below ground in leaf litter, under rocks, rock piles, rotten logs and termite nests. It has a rounded blunt snout, small eyes that can only detect light and some movement. The colour on the upper side ranges from dark pink to purple-brown. It is paler on the underside. It forages on tiny invertebrates, including ants, termites and worms, on insect eggs and larvae, and can eat prey as large as freshly hatched tree frogs.

Although common and widespread, it is rarely seen by most residents, and, when encountered, it is readily dismissed as an earthworm. This subspecies is endemic to Culebra, the US Virgin Islands, Jost Van

Photo 54.
The Virgin Islands Blind Snake fits in the palm of a hand.

Dyke, Tortola and a few of the nearby cays. However, the populations throughout much of its range need to be thoroughly studied to determine their taxonomic relationships with each other. **Photo 54** shows a specimen from Beef Island.

4.3.4.1 Introduced and Invasive Snakes

One recent arrival is a cause for concern for conservationists because of the long-term prospects for the survival of the native species of reptiles and amphibians. The **Red Cornsnake** (*Pantherophis guttatus guttus*), native to the southeastern United States, has been introduced to parts of the Caribbean, including Tortola, through shipping and trade, especially via cargo from South Florida and from nearby St. John in the USVI, where the species may now be slowly establishing a foothold.

The Cornsnake has been recorded from Tortola on occasion (Giery, 2013; Petrovic, 2012), but these seem to be individuals arriving as a result of shipments from other commercial ports. They are sometimes sold in the pet trade due to their docile nature and attractive colours. It grows to about 2.4 m (8 ft), with reds, oranges, browns and yellowish-brown blotches along the length of its back. It feeds primarily on rats and mice, although it will take lizards, frogs and birds.

There is no indication that it is breeding in the wild, but it may only be a matter of time before it establishes a breeding population.

Other snake species may also be escaping as a result of some residents keeping exotic snakes as pets. These are either imported from reptile enthusiasts and pet stores in Puerto Rico, Florida, Europe or other Caribbean islands. Some of these may either escape or are released when owners cannot care for them. These animals usually stay around urban environments where rats, chickens and other prey are relatively easy and where they can find shelter. But some may find refuge in the wild. Most species cannot reproduce without the opposite gender to establish a breeding population.

However, with the increasing importation of snakes as pets, and with some animals arriving with cargo, wild populations of non-native species could become established. Snakes popular in the pet trade, among Caribbean countries or established in the wild in Florida, include the Burmese Python (*Python bivittatus*), the Red-tailed Boa (*Boa constrictor constrictor*), the Common Boa (*Boa constrictor imperator*) and the African Rock Python (*Python sebae*).

4.3.4.2 Tortola Reptiles of Special Conservation Concern

Table 34 provides a summary of Tortola's reptile species that are of Special Conservation Concern. Although some species are considered stable or relatively common and widespread, they are nevertheless included because so little is known about their actual population numbers.

Table 34.
Reptile species of Special Conservation Concern for Tortola.

SPECIES	COMMON NAME	HABITAT	STATUS
TERRESTRIAL LIZARDS and SNAKES			
Amphisbaena fenestrata Cope	Virgin Islands Worm Lizard	Damp and moist spots under rocks, in heavy leaf litter, under and in decaying plant matter, compost detritus, rotten logs and soil in all forest and woodland types once there is ample humidity and moisture.	Because so little is known about this species, including concrete taxonomic, biological and ecological data, this species should be considered *Vulnerable* and requiring critical conservation study.
Anolis cuvierii Merrem	Puerto Rican Giant Anole	Heavy mature and older forests and woodlands with large old emergent trees. If this species is indeed present, it would most likely be found at Sage Mountain and its surrounding forests, along moist ghuts, and at small areas of Mount Alma on Beef Island.	The record for Tortola is possibly an error, but, if present, this species warrants being declared as *Critically Endangered*, and a systematic assessment of this species needs to be done for the BVI.
Anolis roosveltii Grant	Culebra or Roosevelt's Giant Anole	Mature and stable seasonal forests and woodlands. The species should be looked for on seasonal forests and woodlands surround Sage Mountain and nearby peaks, along forested ghuts, and Mount Alma on Beef Island.	Very rare and possibly extinct. Considered *Critically Endangered*. Much about this species remains a mystery.
Spondylurus semitaeniatus Wiegmann	Lesser Virgin Islands Skink	Lowland and coastal seasonal forests, open woodland and urban areas with rock heaps, Agave plants, rotting wood and rocky outcrops.	*Endangered*. Extremely vulnerable to the Indian Mongoose, and rats.
Sphaerodactylus parthenopion Thomas	Virgin Islands Least Gecko	Lowland and coastal seasonal forests and open woodland areas with rocky outcrops. Patches of leaf litter with small boulders under the forest canopy seem to be their favourite habitat.	Endemic to the BVI; localised and believed to be rare. Should be considered as *Endangered*.
Borikenophis portoricensis anegadae Barbour	Puerto Rican Racer	Widespread on Tortola, occurring throughout a range of habitats, but little is known or understood about its ecology on Tortola or the impact of the Small Indian Mongoose.	Relatively common and widespread.

SPECIES	COMMON NAME	HABITAT	STATUS
Chilabothrus grantii Zenneck	Virgin Islands Tree Boa	Widespread on Tortola, occurring throughout a range of habitats, but little is known or understood about its ecology on Tortola or the impact of the Small Indian Mongoose.	Endangered. Little ecological, biological, and habitat information is available on this species on Tortola.
Magliophis exiguus exiguus Cope	Virgin Islands Racerlet	Similar to *B. portoricensis*, but found mostly in the lowlands. This is one of the least known and observed of the BVI snakes. Significant research is warranted to understand this species.	Uncommon to rare; possibly declining?
Typhlops richardii Dumeril & Bibron *richardii*	Virgin Islands Blind Snake/ Richards Blind Snake	Similar to the Worm Lizard; needs damp and moist spots under rocks, in heavy leaf litter, compost detritus, rotten logs and moist soil within forest and woodland cover. Data on this species is scare and further research is warranted.	Rarely seen or observed. The conservation status of this species remains unknown. Populations throughout much of the range may need genetic study to determine taxonomic relationships.
TORTOISES and TERRAPINS			
Chelonoidis carbonaria Spix	Red-legged/Red-footed Tortoise	Lowland evergreen and dry forests, woodlands and semi-wooded areas.	Rare and extinct in much of Tortola. Should be considered *Critically Endangered* locally.
MARINE REPTILES			
Chelonia mydas Linnaeus	Green Turtle	Marine environments. Forages seagrass beds. Nests on sandy beaches.	Endangered
Dermochelys coriacea Vandelli	Leatherback Turtle	Marine environments. Forages on jellyfish and other soft-bodied prey. Nests on beaches.	Endangered
Eretmochelys imbricata Linnaeus	Hawksbill Turtle	Marine environments, nests on beaches.	Endangered

Most of Tortola's native reptiles of Special Conservation Concern require stable and old-growth habitats, especially forests and woodlands along ghuts and along the coast, tall old trees in stable forests, large tracts of boulder fields, marshes, permanent water, streams, beaches, seagrass beds, and coral reefs to survive (the same is true for Tortola's amphibians of Special Conservation Concern). It may be impossible to maintain or protect all of these habitats to accommodate all of the species, but it is possible to restore, recreate or establish artificial environments that provide the most suitable conditions for them to thrive.

4.3.5 The Freshwater Fish of Tortola

Several species of native aquatic fish are known from the VI✦, wherever permanent streams and freshwater pools are available. Many of the species spend part of their life cycle in the sea, then at some point move back up into streams where they spend the rest of their lives. Some species live in the sea, in mangrove ponds and in streams, being able to live in saltwater, brackish water and freshwater.

The native species include the **Big Mouth Sleeper's** (*Gobiomorus dormitor*), whose juveniles spend part of their lives in the sea and then migrate upstream to grow and spawn. The **Mountain Mullet** (*Agonostomus monticola*) is primarily a freshwater fish, although it can spend short periods in the sea, especially during heavy floods, and can tolerate brackish environments. It is still found in some areas on the

✦ In the *Virgin Gorda Environmental Profile*, the IRF biodiversity team stated that "[T]here are no recorded native freshwater species of fish known from the BVI today." However, subsequent field research has shown that a few streams on Tortola do support freshwater fish.

Photo 55.
A school of Mountain Mullet in the freshwater pools at Brewer's Bay.

north of Tortola. **Photo 55** shows the Mullet in steams at Brewer's Bay. Another possible species is the **American Eel** (*Anguilla rostrata*), whose young travel to the distant Sargasso Sea in the mid-Atlantic before returning to the cool waters of island streams to mature. The Eel is present in the US Virgin Islands and Puerto Rico under conditions that are similar to those on the north coast of Tortola.

One of the most intriguing freshwater fishes of Tortola is the **River Goby** (*Awaous banana*). Its cryptic colours allow it to blend into the bed of a stream, and it has a peculiar adaption which permits it to stick to the surface of rocks. On the underside of this species, there are special adaptations or suckers, used to fasten the animal to hard surfaces. It also allows the fish to travel upstream even during floods. Like many of the species of tropical gobies, it spends part of its life cycle in the sea but migrates to freshwater streams to live most of its existence.

4.3.5.1 Species and Habitats of Special Conservation Concern

All of the native fish are of Special Conservation Concern. They occur in very limited habitat, there being only a few small seasonal streams on Tortola's north coast and far less so on the south and east coasts. The species of aquatic fish of Tortola require clear, unpolluted and unobstructed freshwater or brackish and saline ponds to survive. Many of the ghuts and natural water bodies of Tortola are polluted with sewage, garbage, silt, agricultural and residential runoff, and industrial waste.

Additionally, as the territory has attempted to control flooding by hardening, straightening, and diverting ghuts, as home construction on the higher slopes has increased, and as coastal development has disrupted and even destroyed natural drainage basins, these species have disappeared from most areas on the island in the past. Only a small area of their once widespread range and distributions now remains on Tortola.

4.3.6 The Invertebrates of Tortola

Invertebrates—a group that includes species such as butterflies, ants, earthworms, spiders, millipedes and scorpions—form the largest group of animals on Tortola and throughout the Virgin Islands. Invertebrates are defined as animals without backbone, but which wear their skeletons on the outside. This can be seen in such creatures as the beetle with its hard or chitinous outer shell, which protects the soft tissue on the inside.

But unlike most vertebrates, which have their skeletons on the inside and a defined backbone, many species of invertebrates must shed their outer shell in order to grow. Many species undergo this transformation such as when a moth or butterfly changes from a caterpillar to an adult. During the caterpillar stage, it may shed the soft outer skin on several occasions; then, one day, it spins a cocoon and in a matter of days or months, a winged-creature emerges, so vividly different to its previous form.

Like the caterpillar, other invertebrates do not possess a hard outer shell. Many worms and other similar animals, especially those living in the soil, are soft-bodied. Some grow throughout their lives, but do not shed their shells in order to do so. The earthworm for example, has bright red blood and a circulatory system similar in some respects to vertebrates, providing greater understanding of the common evolutionary links between invertebrates and their cousins, those with a backbone.

Tortola and indeed the rest of the Virgin Islands share a diverse range of invertebrates from small microscopic species of nematodes, crustaceans and mollusks to larger species, many of which can cause fear in residents—like centipedes, millipedes, scorpions, spiders and woodlice. There are also moths, butterflies, beetles, bugs, roaches, flies, mosquitoes, dragonflies, damselflies, lacewings, bees and wasps, ants, worms of various forms, crabs, crayfish, and snails. One small species with a big and bold form of "display" is the tree termite that builds giant "nests" in trees or near the ground. Although the actual animals are small, their home is so large that it is one of the most distinctive forms of display of any invertebrate.

(1) Worms

One of the most ancient of Tortola's invertebrates is a worm-like creature of dark and damp places, especially on the higher slopes of the island. This is the **Velvet Worm** (*Peripatus* sp.), a member of a group considered to be a "living fossil" in that its lineage goes back nearly 600 million years (based on fossil evidence). It is believed to be a transitional link (a "missing link") between invertebrates and crustaceans, and groups like the centipedes, some worms and nematodes. The first ancient marine Velvet Worms are said to be one of the earliest creatures to crawl out of the sea to live on land, and, from these, vertebrate animals eventually evolved.

Velvet Worms are voracious and skilled predators that eat other invertebrates such as roaches, worms and crickets. It crawls around the damp forest floor at night, using its sensitive antennae-like organs and legs to track animals. When it gets close, it uses two tube-like appendages to shoot a mucus-like stream, which gets the animal sticky and confused, and in that intervening and critical period, the worm devours its prey alive. **Photo 56** shows a recently caught specimen (February 2014) at the Chalwell Estate area, on the lower slopes of Sage Mountain.

Other worm or worm-like creatures avoid the light of day and the heat of the sun to live in the dark damp soil. **Earthworms** are members of the group called the Annelids or segmented worms. They are soft-bodied and have to live in humid environments to avoid desiccation. **Photo 57** shows an example of a native earthworm, possibly a *Lumbricus* sp., in a rotting log, found at Brewer's Bay.

Photo 56.
The Tortolan Velvet Worm. Notice the two antennae-like organs on the head.

Photo 57.
An Earthworm in an old rotting log at Brewer's Bay.

(2) Scorpions

Other ancient invertebrates roam the forest floors at night, although most Tortolans will live their lives without ever encountering any. These are the scorpions. At least three species are recorded, including the **Grey Bark Scorpion** (*Centruroides griseus*), (**Photo 58**). Scorpions are nocturnal, hunting prey in the dark by using very specialised and sensitive adaptations like the hairs on parts of their bodies that can detect minute movements of animals and distinguish between a slight breeze and potential prey.

Photo 58.
The Grey Bark Scorpion at Beef Island, Tortola.

They mostly hunt for spiders, roaches, and other small critters. Like all scorpion species, they possess a modified segment at the end of the tail containing a stinger that delivers venom. It is most often used to immobilise prey and defend against predators; males use it in fights with other males.

(3) Tailless Whip Scorpions

Related to scorpions and spiders are the **Tailless Whip Scorpions** or Amblypigids. These nocturnal arachnids have long legs, two large muscular arms in the front that are equipped with long spikes and barbs used to impale and secure prey, and two long whip-like legs that are used to detect potential prey moving about their habitats or to warn of impending danger. They are not dangerous and do not have venom, though the spiny legs may give a painful pinch if they are handled improperly.

They are extremely shy and quickly skitter off when disturbed. At least two species occur on Tortola and Beef Island, including the **Long-legged Whip-spider** (*Phrynus longipes*), the larger of the two. It can reach body lengths of up to about 3.5 cm (1.4 in), with whip-like legs reaching another 8 cm (3 in). This species hunts and feeds on spiders and other invertebrates including roaches and worms, but also lizards, small snakes, frogs and even small birds such as hummingbirds. **Photo 59** shows a medium-sized specimen at Beef Island. They spend the day hiding under rocks, in caves, under bark, in heavy litter and in the dead leaf bases of Agave plants.

Photo 59.
Long-legged Whipspider from Beef Island, Tortola.

(4) Spiders

Closely related to the Amblypigids are the true spiders. Many species occur on Tortola, some relatively large, although none are deadly. Like all wild animals, spiders should be handled with care. They are major predators of many pest species, including flies, mosquitoes, roaches and even other spiders.

Some of the more visible species on Tortola are the largest of the orb-weavers, the **Writing Spider** or **Golden Silk Spider** (*Nephila clavipes*). Females grow much larger than males, dwarfing them by many magnitudes. The male will often spend its life in the web of the female, with whom he may mate, after which he may be eaten by her. **Photo 60** shows a large and colourful female at Arundel near Sage Mountain. The term "writing" used in the common name refers to the patterns of "zig zags" created by the females toward the centre of the web, reminiscent of lettering or some foreign language script.

Photo 60.
A female Golden Silk Orb-weaver Spider, at Arundel, Tortola.

A more ancient cousin of the Writing Spider is the group often called tarantulas. Several species are present, although not all have been studied. Some are fairly large and live in holes in the ground. These holes are often lined with fine silk, which prevents the tunnel from collapsing inward, keeping it free of debris. The **Ground Tarantula** (*Cyrtopholis bartholomei*) is the largest of the Virgin Islands species, achieving lengths of up to 13 cm (5 in).

As with many spider species, females are bigger than the males and possess a larger and more rounded abdomen, which allows them to carry eggs and care for the young. **Photo 61** shows the Greater Antillean endemic, found in Hispaniola, Puerto Rico and the Virgin Islands. It builds shallow borrows below rocks, logs, roots, and leaf litter or tunnels in the ground, and prefers stable forested habitats. The Ground Tarantula is primarily nocturnal, and feeds on a variety of prey, including many types of invertebrates, other spiders, frogs, and small reptiles. It is sometimes arboreal where it may climb to escape floods, predators and other disturbances and to catch prey, including nestlings and small birds. Its bite can be painful but not serious.

Photo 61.
A female Ground Tarantula at Cane Garden Bay, Tortola, with enlarged abdomen, possibly pregnant.

One species of Spider, the **Tortola Goblin Spider** (*Stenoonops tortola*), is endemic to this island. It is very small, being less than a centimetre long. Little is known about this tiny obscure species.

(5) Termites

Another primitive group of invertebrates is the termite. The ancestry of this group dates back to about 145 to 66 million years before present and might even have had its origins in the Jurassic epoch over 200 million years ago. They are closely related to cockroaches and the praying mantis, two other very ancient groups of insects. Members of a termite colony form a social collective with a strict cast system in which a female queen reins over her colony of workers, soldiers, and a male mate. The workers usually maintain very specific roles for their entire lives, except when the queen dies and specialised members may be recruited to fill that role. After severe dry periods, winged termites, with large eyes and well-developed light-detecting organs, emerge from the colony and fly off to pair up and form new colonies. Many thousands of these insects often shed their wings.

Several species occur in Tortola, although quite a few are introduced; they are most common around human settlements. One of the most prominent species is the **Tree Termite** (*Nasutitermes costalis*), with its large bulky nest. They usually build nests above ground on the trunks of suitable trees and occasionally on or below ground, although they sometimes build nests on or near human structures, especially if they are made of untreated wood. Long covered trails may lead to or away from the nest and quite often may be the only evidence of the animal's presence.

(6) Aquatic Fauna

Some native species of invertebrates are found in freshwater environments. These are referred to as aquatic fauna, and some species are related to the more typical crabs that will be more easily recognised by residents. They are grouped as Crustaceans and include the more familiar ocean species such as lobsters and shrimps.

The native freshwater crustaceans live all or most of their lives in water; without it, they will go extinct (some species can survive in brackish environments, and eggs and hatchlings may survive periods at sea). Most of Tortola's aquatic invertebrates are found on the northern side of the island where more permanent pools are found along streams. As long as these areas maintain their thick forest with tall trees and are undisturbed, these animals will persist. However, many ponds have already been reduced or disappeared, as roads and human structures are built on the upper slopes and summits of the island.

At least three species of crayfish and one freshwater crab are known from Tortola. **Photo 62** shows the largest of Tortola's crayfish, the **Big Claw River Shrimp** (*Macrobrachium carcinus*) at Brewer's Bay.

Photo 62.
The Big Claw River Shrimp hunting the streams at Brewer's Bay, Tortola.

Other species of terrestrial crustaceans include a newly recorded species for the Virgin Islands, the small **River Crab** (*Epilobocera sinuatifrons*), a freshwater crab endemic to Puerto Rico, the Virgin Islands and the Lesser Antilles. It is extremely rare and in danger of extinction in the Virgin Islands. Only the shell of this animal was discovered, along a ghut at Great Carrot Bay (**Photo 63**).

Photo 63.
The River Crab, found at Great Carrot Bay, Tortola.

Other species of crabs are found in mangroves, along streams and embankments along the coasts, and even at the highest elevations of Tortola. These species include the **Caribbean Hermit Crab** (*Coenobita clypeatus*), a species that does not produce its own shell but obtains one from the surrounding environment to protect its more vulnerable parts. It prefers the shell of the marine **West Indian Top Shell** or **Welks** (*Cittarium pica*), a species that has been overharvested in the Virgin Islands because of its much-sought-after flesh.

The Hermit Crab spends much of its life in leaf litter and the low shrubbery and rocks of Tortola. When fully mature, males and females migrate en masse to the coast, taking weeks to do so, where they congregate in the thousands, spawn and then head back upslope to repeat this every year. Many thousands of these hermit crabs are collected by local fishermen to be used as bait.

Another local crab well known by residents is the **Giant Land Crab** (*Cardisoma guanhumi*). It is the largest of the native species, and is sought after as a delicacy. Over the years, coastal habitat destruction, predation by introduced rats and the Small Indian Mongoose, as well as over-harvesting, have substantially reduced the numbers of this species.

Other fairly large land crabs are also found on Tortola, including the **Purple Land Crab** (*Gecarcinus ruricola*) and the **Blackback Land Crab** (*Gecarcinus lateralis*). The Purple Land Crab is the second largest of the native terrestrial species and prefers upland moist riparian environments. It has a reddish-purple, violet, bluish-purple to an almost black colour upper side with lighter undersides. The Blackback Land Crab is a bright red, orange to yellowish crab with a black-to-dark-reddish back. It is found along the coast where it builds small tunnels in sandy areas or below large rocks and other heavy debris.

Within mangroves, several species of crabs thrive, but only as long as healthy coastal wetlands continue to exist. These include three species of fiddler crabs: the **Saltpan Fiddler** (*Uca burgersi*), the **Mudflat Fiddler Crab** (*U. rapax*), and the **Atlantic Mangrove Fiddler Crab or Thayer's Fiddler Crab** (*U. thayeri*). These species are found on the damp and shallowly submerged mudflats of mangrove ponds and marshes. Another species, somewhat similar to the fiddler crab is the **Mangrove Crab** (*Aratus pisonii*). It lives among the stilt roots of Red Mangrove trees, and also climbs up on the roots and moves about the branches and leaves where it finds food, shelter and protection from predators.

Along the sandy shore, the **Atlantic Ghost Crab** (*Ocypode quadrata*) builds small narrow tunnels and feeds on small algae and other materials, which it filters from the beach. When disturbed, it suddenly dashes down the hole, and all that one may see is the blur of ghostly yellow disappearing from view.

(7) Millipedes and Centipedes

Back of the beach, among the rocks, bushes and the humid spots, the **Arboreal Millipede** (*Rhinocricus arboreus*) finds its home. This multi-legged animal reaches lengths of up to 9 cm (3.5 in) and will climb into trees to find food. It is one of the most conspicuous of Tortola's native species, often occurring around homes and gardens. Some individuals of this species are the typical black, but may also be brown, reddish-brown to brownish-black in colour. Females are usually slightly larger, when mature, having 50 to 54 segments with a pair of legs to each. **Photo 64** shows a specimen at Great Carrot Bay.

Photo 64.
Arboreal Millipede from Great Carrot Bay, Tortola.

Photo 65.
Scolopendromorph Centipede attempting to hide, Chalwell Estate, Tortola.

Related to the millipede is the much maligned centipede. Several species are native to Tortola, although most are quite small. All species prefer decaying vegetation, heavy leaf litter, rock piles, below rocks, behind dead bark, and even at the damp leaf bases of bromeliads in tree tops. They hunt mice, tarantulas, crickets, roaches, and small lizards. They are nocturnal in habit.

The largest of the local species is the **Scolopendromorph Centipede** (*Scolopendra alternans*), reaching lengths of up to 15 cm (6 in). They can deliver a very painful bite and the venom may cause a severe allergic reaction in the immediate vicinity of the injury. They are exceedingly shy and wary of humans.

Photo 65 shows a specimen attempting to escape from the IRF field team, so its head is buried in the grass. Centipedes typically have far fewer legs than millipedes, and, in the case of this species, it possesses 21 to 23 pairs. They are also much flatter and with fewer segments. One species of centipede, *Polycricus bredini*, is endemic to Tortola, first reported for Sea Cow's Bay (Crabill, 1960). Virtually nothing is known about this species, and the IRF team did not encounter it during its many weeks of field assessments.

(8) Flying Insects

In the sky, winged denizens dominate, some with spectacular aerial acrobatics and many with brilliant colours. Dragonflies, bees and wasps, moths and butterflies are but a few of the many species of flying insects.

Butterflies are perhaps the most loved of the group. With their brilliant and bright colours and patterns, people cultivate gardens to attract them. About 31 species are recorded for the island of Tortola, although the number may be higher. This does not include their more drab cousins, the moths, whose numbers may be over 100, but are often overlooked because of their less colourful appearance and primarily nocturnal habits.

One of the most common of the Tortola's butterflies is the **Zebra Long Wing** (*Heliconius charithonia*) (**Photo 66**). It is instantly recognisable by the alternating pattern of black and yellow (or yellow and green) on the wings. It is a slow flier, often seeming to hover as it moves about the forest undergrowth or along open bush and in gardens. Its slow movement is due the fact that is has few predators, so it can be as non-chalant as it desires. The caterpillars feed on the leaves and stems of passion fruit plants, which contain a cocktail of unpallatable chemical compounds. These chemicals are transferred to the adults when they morph into butterflies.

Photo 66.
The Zebra Butterfly at upper Arundel near Sage Mountain.

Some butterflies are quite small and are easily overlooked. The Hairsticks are some of the smallest of all species, and several occur on Tortola. These are usually a drab grey on the underside of the wing and with a hair-like extension at the base of the back wings. **Photo 67** shows **Hewitson's Hairstreak** (*Strymon columella columella*) on the eastern end of Tortola.

Photo 67.
Hewitson's Hairstreak seeking nectar from the flowers of *Waltheria indica*.

The Hymenoptera—the order that includes bees, wasps and ants—carry stingers and pinchers and can inflict severe pain as a means of defence or to subdue prey. There are many species of bees, ants and wasps found on Tortola. The **European Honey Bee** (*Apis millfera*) was introduced from Europe well over a century ago to provide honey and to help pollinate crops. Today, the species is widespread throughout the Virgin Islands, and busy bees can be seen collecting pollen and nectar in many gardens and wherever suitable flowers are available.

There are many native bees, but most remain obscure, especially because of their size, the small amounts of honey they produce, and the small colonies they develop. The largest species of bee in these islands is the **Antillean** or **Greater Antillean Carpenter Bee** (*Xylocopa mordax*), which can grow to over 2.5 cm (1 in) in length. Females of this species are shiny jet black; males are bright orange-yellow with black bands, similar to the Honey Bee, but it is rarely seen. This bee commonly visits the flowers in gardens throughout Tortola. The Carpenter Bee is so named because the females use their large and powerful mandibles to chip away at dead wood, creating tunnels to build their nests and raise their young. This species is endemic to parts of the Greater and Lesser Antilles.

Wasps are a close cousin to bees and are also common. Bees and wasps differ from each other in very noticeable ways—for example, most wasps have very narrow "waists" and can sting multiple times, whereas a bee can only use its stinger once, after which it dies. Bees usually have hairy legs, are bulkier in appearance, and are less aggressive. They typically feed on pollen and nectar.

One of the more visible species of wasps on Tortola is the **Paper Wasp** (*Polistes crinitus*). It occurs even around urban areas but prefers tangled brush where the paper nests are placed underside large leaves such as those of the Heliconia and on the thin stems of shrubs, the overhangs of rocks, and the trunks of trees. It makes its nest using chewed up bark and plant material, creating a pulp and fashioning each cell within which it lays an egg. It is a colonial species, so several females attend to the nest. It is a voracious hunter and is always on the defence; when a nest is approached, they swarm out and readily sting repeatedly. It is one of the most respected and feared of the local insects.

(9) Mollusks

From aerial wanderers we move on to those creatures that carry their homes with them wherever they go. The mollusks (snails and slugs) are diminutive in size and nature. The snails possess a defined hard shell, and the slugs have little or no distinct shell. There are several species of snails on Tortola, but little is known about the number of species and their habitats, distributions and ecological needs.

Nevertheless, a tour of Tortola would reveal some of the more visible species of the island, including the **Palm Snail** (*Hemitrochus nemoralinus*), endemic to the Virgin Islands and also found on Guana Island. It is a small species, less than a centimetre (0.4 in) in width. The round spiral shell varies in colour in live animals, from a dark deep brown to chestnut and reddish-yellow, or a combination of many colours and small blotches and striations. **Photo 68** shows a mature specimen at Great Carrot Bay. They prefer very damp areas near the ground, and will often come out during the day in fairly large concentrations. They sometimes associate with another native species, such as the **Operculate Land Snail** (*Choanopoma* sp.). Both may share space and habitat, although the latter species prefers to stick closer to the ground and to rocks and soil.

Photo 68.
The Palm Snail making its daily rounds at Carrot Bay, Tortola.

The **Round Tree Snail** (*Polydontes incertus*) is another species with a conical shell similar to the Palm Snail, but it grows much larger, to about 4 cm (1.5 in) in diameter. It climbs high up into trees and can be observed on shrubs; during the day, it may be found on the sheltered sides of branches, tree trunks and rocks, protected from drying winds and the heat of the day. The Round Tree Snail is a Virgin Islands endemic. **Photo 69** shows this species on a rock searching for food and moisture.

Photo 69.
The Round Tree Snail at Great Carrot Bay, Tortola.

Other species of snails include the **Twig Drymaeus** (*Drymaeus virgulatus*), and, as the names suggests, it is commonly observed on the narrow stems of small trees and shrubs, resting there during the day. It is primarily a nocturnal species with a conical shell, and comes in several colours and mixes, including white, tan, yellow, brown, reddish, mahogany and sometimes a mix swirl of many colours. It is found in Puerto Rico and the US and British Virgin Islands, Florida and the Dutch Windward Islands.

Along undeveloped rock coasts, the **Bearded Periwinkle** (*Cenchritis muricatus*) is found stuck to rocks and trunks of trees well above the high water mark. It feeds on algae and other materials stuck to rocks, soil and trees just out of reach of the splash of the waves. It is recognisable by its bright white, whitish-blue to pale pinkish-white colour and the "bumpy" protrusions of the shell. They often congregate in huge numbers. **Photo 70** shows a specimen at Belmont.

Photo 70.
The Bearded Periwinkle spending the day "sleeping" along the coast of Belmont Bay, Tortola.

A mollusk known to many gardeners is the slug. Several species occur in the Virgin Islands, but the largest is the **Dappled Leatherleaf Slug** (*Leidyula kraussii*), growing to about 9 cm (3.5 in), although most are much smaller. They are a dappled medium-brown colour above, and a yellow to yellowish-green or yellowish-brown below. It is native to the Caribbean region, although it is likely to have been inadvertently introduced to many areas through human actions. It is a species of damp dark places, and it comes out to feed at night, sometimes in large numbers.

4.3.6.1 Invasive Invertebrates

Because of their relatively small size, numerous invertebrate species have entered the territory unnoticed and caused serious problems afterwards. Some are severe pests that prey on agriculture; others may destroy structures and cause diseases. These species have been introduced to the Virgin Islands since the arrival of the first Europeans, but such introductions continue even today.

The **Common House Fly** (*Musca domestica*), so often a pest in our homes, can also spread diseases such as typhoid, cholera and dysentery. It is believed to have originated in the Middle East, but was spread throughout the world through human movements and came to the Caribbean with early Europeans.

Similarly, the roaches so commonly associated with filth and disease—including the **American Cockroach** (*Periplaneta americana*) and the **German Cockroach** (*Blattella germanica*)—arrived during the colonial period. The American cockroach is the largest of the species commonly found around homes. Some call them "mahogany birds." Despite the name, they are believed to be native to parts of Africa and perhaps the Middle East but spread to other parts of the world through trade and human movement. The German roach is in fact not German at all and is believed to have originated in northern Ethiopia.

Relatives of cockroaches, termites (see also subsection (5) above), cause considerable amounts of damage and destruction to human structures, gardens and urban trees. But the species most commonly found in timber and furniture are believed to be introduced from other parts of the world.

The **Agave Snout-nosed Weevil** or the **Agave Borer Weevil** (*Scyphophorus acupunctatus*) is an invasive species native to Mexico; it was introduced to the Virgin Islands sometime in the early 2000s. At about 28 mm long (1 in), the black, long-snouted weevil attacks the heart of the native Century Plant (*Agave missionum*), an iconic species of the Virgin Islands with its spikey rosette of green leaves and lofty central inflorescence and bright yellow flowers borne in the dry season. The arrival of the Weevil has resulted in a rapid crash of the native Century Plant, whose numbers declined to such an extent, it almost became extinct locally.

Agricultural pests such as scale insects and their relatives infest crops and gardens, destroying produce and reducing sustained food security. An example of a recent arrival is the **Pink** or **Hibiscus Mealybug** (*Maconellicoccus hirsutus*). This tiny insect infests a host of plants, causing growth problems, secondary infestations, disease, deformity and death. The issue of agricultural pests is increasing. Kew scientists with the help of the UK's Food and Environmental Research Agency (FERA) have identified at least 50 new species of plant pests in recent years (*pers. comm*., Nancy Pascoe, NPT, 10 April 2015).

Without proper safeguards, management, awareness and education, many invasive invertebrates will continue to cause considerable damage and related economic issues.

4.3.6.2 Invertebrates and Habitats of Special Conservation Concern

Because relatively little is known about Tortola's native invertebrates, it is difficult to assess which species are in need of special attention and management. Therefore, it is important that surveys and assessments are carried out to determine the island's species and their conservation status and what management requirements need to be put in place to ensure healthy and sustainable populations, including protection of their habitats.

Issues, Conflicts, and Areas of Concern	Impacts of No Action/No Change	Short-term Options Long-term Recommendations
ISSUE ONE **Loss of Integrity and Size of the Sage Mountain Rainforest** The existing boundaries of the Sage Mountain National Park include only a small area of the unique rainforest system described by Beard in 1949. The surrounding lands have regrown to some extent, but, in the last decade or so, development has encroached into the area, with new roads and pathways. The protected area is becoming increasingly vulnerable to development pressures along its perimeter. In non-park areas abutting Sage Mountain National Park, it is a common cultural practice to clear-cut land prior to applying for development approval as people want to "see" their property before deciding where to build. This results in more habitat and species loss in the Park's buffer areas, even before a development plan is approved.	If development pressures continue along the Park's borders, it will become increasingly difficult to maintain the Park's unique characteristics, as well as its cultural and economic value. The following impacts will also increase: – Lower species diversity; – Loss of ecosystem integrity and increase in instability; – Loss of ecological, economic and cultural values; – Increase in invasive species. Additionally: – The increasing number of roads in the area can disrupt hydrology and moisture availability and can increase runoff, soil loss and erosion. – Increasing development projects will fragment habitats and create more instability, especially when the forest is impacted by disasters.	**SHORT-TERM OPTIONS** **1.** The NPT should undertake a comprehensive ecological survey and study to determine the optimum size that is needed for a stable and sustainable ecosystem at Sage Mountain National Park. **2.** Continuing programmes by the NPT to increase ecological awareness about the rainforest and its cultural and economic value to the BVI should be expanded and strengthened as opportunities and resources are available. **LONG-TERM RECOMMENDATIONS** **1.** In cooperation with the Department of Town and Country Planning and ongoing implementation of the community development plan for the Carrot Bay watershed (see Sections 2.2.2.4 and 8.5.2), the NPT should explore opportunities to increase the size of the Sage Mountain National Park and to more effectively manage land use practices within and around the National Park. Options should include the purchase of private property to increase the size and integrity of the Park.
ISSUE TWO **Invasive Species: Feral and Free-roaming Livestock** Feral and free-roaming livestock contribute to land deterioration through overgrazing and trampling, thereby increasing soil exposure, compaction and loss, as well as increased runoff. *(continued)*	The presence of feral and free-roaming livestock will increase biodiversity loss, soil erosion, and the degradation and reduction of wildlife habitats.	**SHORT-TERM OPTIONS** **1.** The Department of Agriculture, perhaps in cooperation with the Department of Conservation and Fisheries, could create demonstration programmes to assist farmers and others maintaining small herds of livestock on Tortola, including a focus on improved livestock management and sustainable livestock production in limited spaces. Ideally, a demonstrative area could be established to show the difference between a livestock-degraded landscape and a natural landscape free of livestock. *(continued)*

Issues, Conflicts, and Areas of Concern	Impacts of No Action/No Change	Short-term Options Long-term Recommendations
Feral and free-roaming livestock also cause biodiversity reduction through habitat deterioration, particularly, coastal vegetation cover. On the coastal roads along the Sir Francis Drake Highway from Road Town to West End, the Blackburn Highway from Road Town to East End, and along the Fahie Hill Road, livestock have significant advantage and control of landscape dynamics. Controlled, but free-roaming, livestock, especially cows, are creating property and traffic nuisances and hazards, especially along roads in the central highland areas of Tortola.		**SHORT-TERM OPTIONS (continued)** **2.** The dimensions of the problem need to be better understood, a task best undertaken by the Department of Agriculture by accomplishing the following: - Identification of areas and circumstances where feral and free-roaming livestock are an environmental concern, focusing on the issues that have shaped the dynamics of this long-term problem. - Providing GIS mapping for the areas identified, as a precursor to developing a conservation management plan to better control livestock farming on Tortola. **LONG-TERM RECOMMENDATIONS** **1.** The Department of Agriculture, in cooperation with the DCF, needs to increase public awareness about the short- and long-term impacts of livestock on the environment of BVI islands, including Tortola, and the consequences of inaction. **2.** Government needs to develop a territory-wide livestock management plan, which encourages sustainable livestock farming that will not damage the environment.
ISSUE THREE **Other Invasive Species Issues** The presence of introduced mammals, including rats, the house mouse, the mongoose, and feral cats, poses a threat to native ecosystems, native plants, amphibians, reptiles, and the many species of native birds. The introduction of invasive plants species and cultivars, via the horticultural trade for landscaping, is potentially harmful to native plants and agriculture.	If kept unchecked, rodent, mongoose and cat populations will continue to rise, thereby increasing the threat to ecosystems and native wildlife. If kept unchecked, imported plant species (see Table 28) pose a threat to native plants by directly competing with them, by changing ecological dynamics and processes, and by encouraging the introduction of other invasives.	**SHORT-TERM OPTIONS** **1.** The DCF and NPT need to cooperate on preparation of a threat assessment of feral cats, rats and mongoose on Tortola. The assessment should propose remedial actions to deal with this ongoing issue over time. **2.** The DCF, NPT and DOA need to prioritise which invasive plants require immediate attention. Educational programmes focusing on invasives for landscapers, backyard gardeners, and others would also be useful. **LONG-TERM RECOMMENDATIONS** **1.** Following completion of a threat assessment as proposed under the short-term option above, the DCF and NPT should prepare a long-term strategy to control the population of primary invasives (animals and plants). **2.** With the Humane Society, the DCF and NPT should develop a public awareness campaign focusing on domestic pets and feral cats. A strategy should be developed in collaboration with the Department of Agriculture on ways to reduce the number of stray animals.

<table>
<tr><th>Issues, Conflicts, and Areas of Concern</th><th>Impacts of No Action/No Change</th><th>Short-term Options Long-term Recommendations</th></tr>
<tr><td>ISSUE FOUR

Loss of Native Freshwater Habitats

Most of Tortola's freshwater aquatic habitats are found along ghuts and at the bottom of these drainage systems. However, because of road construction; land clearing; and home, touristic, and commercial developments, many of these areas are now fragmented, compromised, degraded, or have entirely disappeared.

Compounding this issue is the deterioration and loss of the vegetation cover surrounding these water bodies, due to encroaching development, including road construction.

These areas are of critical importance for native freshwater fish, birds, bats, invertebrates, and mollusks.</td><td>If these trends continue (e.g., runoff pollution, uncontrolled sewage, livestock activity, erosion and sedimentation), most freshwater habitats will be under increasing threat.</td><td>SHORT-TERM OPTIONS

1. The freshwater habitats of Tortola need to be better studied, beginning with research to:
- Identify the status of freshwater habitats, including hydrological and ecological data.
- Inventory native and introduced plants and animal species.
- Map major freshwater habitats.
- Identify optimal ecosystem protection needs.

LONG-TERM RECOMMENDATIONS

1. Preparation of a recovery plan to restore viable natural freshwater habitats in Tortola should eventually be part of the long-term planning schedule of the Department of Conservation and Fisheries. This might be part of a national strategy for watershed management and protection.

2. Government should consider development of more "natural" options for controlling riparian and coastal flooding and for removing hardened drainage and flood control measures in favour of more environmentally friendly options, including restoration of aquatic habitats and migratory causeways.</td></tr>
<tr><td>ISSUE FIVE

Limited Habitat for the Red Fig-eating Fruit Bat and Other Bats

Due to habitat fragmentation and degradation, native habitats for the island's only native mammal (the bat) are becoming increasingly rare.</td><td>Most of the bats of Tortola require intact, stable and continuous habitats to function and be sustainable, including the presence of roosting sites such as caves, freshwater for drinking, and biodiversity that provides foraging opportunities. Without these, most species will become vulnerable and in some cases eventually disappear from the island.</td><td>SHORT-TERM OPTIONS

1. More systematic surveys need to be undertaken for Tortola (and the BVI) to determine the presence and location of specific bat species and their habitat requirements.

2. As part of a survey effort, scientists need to determine important habitat corridors for flyways, communication, feeding, roosting, and sustainable populations.

LONG-TERM RECOMMENDATIONS

1. A territorial bat conservation strategy and management plan should be developed.

2. The BVI should work with conservation agencies in the nearby USVI to coordinate bat conservation activities and options.

3. Local scientists should be trained in bat survey techniques and conservation strategies.</td></tr>
</table>

<table>
<tr><th>Issues, Conflicts, and Areas of Concern</th><th>Impacts of No Action/No Change</th><th>Short-term Options
Long-term Recommendations</th></tr>
<tr><td>ISSUE SIX

Impact of Road Construction

In the last 10 to 15 years, many natural areas of Tortola—including boulder field vegetation at Balsam Ghut and areas along the southern and northeastern coasts—have been compromised by poor road design and construction.

When Best Management Practices have not been employed in the construction of roads, adverse consequences for the natural terrestrial environment are all too likely.</td><td>If the responsible authorities (principally those in the Department of Public Works and the Ministry of Communications and Works) do not establish a uniformly applied and consistently monitored policy for the design and construction of roads (both public and private), then a reduction in biodiversity is inevitable with each new project.</td><td>SHORT-TERM OPTIONS

1. The Department of Public Works needs to work more closely with the DCF and the DTCP in order to review and assess the environmental impacts of road cuts and construction <u>prior</u> to road building. Critical habitats and species need to be identified to determine if they will be adversely impacted by road construction; protection and restoration strategies need to be put in place to safeguard sites and species.

2. Road design guidelines and construction practices must be a part of the EIA process for all road projects, including Government-sponsored road construction.

LONG-TERM RECOMMENDATIONS

1. The BVI Government needs to prepare a "construction design manual," adapted to Tortola's conditions but applicable to the territory.</td></tr>
<tr><td>ISSUE SEVEN

Limited Conservation and Management of Native Fauna

The BVI lacks a comprehensive territorial policy, strategic framework, and updated legislative authority for wildlife research, a rapid conservation response, and management of wildlife.</td><td>Native wildlife will continue to decline, with attendant loss and extinction, if the BVI does not take steps to provide appropriate research, policy, legislation and commitment to the management and conservation of its native faunal species.</td><td>SHORT-TERM OPTIONS

1. The BVI needs to develop a national conservation strategy for wildlife conservation, including invasive species control.

2. Legislative authority is also needed, in part to bring the BVI into compliance with the international Convention on Biological Diversity. Note that this may be forthcoming in the comprehensive environmental management legislation currently being drafted by Government (see Section 2.2.3.6 of Chapter 2).

LONG-TERM RECOMMENDATIONS

1. Expanded training for BVIslanders needs to be provided in wildlife management, biology, ecology, wildlife veterinary medicine, and related disciplines.

2. A position of National Wildlife Biologist might be considered for the Department of Conservation and Fisheries, with this individual to be responsible for developing endangered species conservation plans, among other duties.</td></tr>
</table>

5. COASTAL AND MARINE RESOURCES[5]

5.1 Overview

Given that Tortola is the largest, most populated, and extensively developed of the British Virgin Islands, it is not surprising that its coastal and surrounding marine environments have been significantly impacted by change over time. Modern development on the island's steep slopes and along its coasts has resulted in substantial sedimentation and pollution of Tortola's nearshore waters. Numerous reclamation projects have altered the coastline and offshore marine environments. Critical habitats, such as mangroves and salt ponds, have been dredged or filled for development projects like marinas.

The impact of humans on Tortola's marine environment is not only of modern duration but dates to pre-Columbian times as excavations at Paraquita and Belmont Bays have revealed. It is not surprising that these settlements were on the coast in sheltered bays, near to abundant sources of marine life that could be easily harvested for food and other needs. Following establishment of European settlements, exploitation of marine life continued, and anecdotal reports suggest animals such as the West Indian Manatee, Caribbean Monk Seal, and cetaceans were hunted for food by colonisers (see also Section 4.3.2.4, Chapter 4).

After more than four centuries of harvesting nearshore marine resources, coupled with pollution and other degradations associated with human development, the marine environments around Tortola have been transformed. Many edible marine animals that were once abundant are now scarce, and most marine organisms of commercial value have been exploited to such an extent that some are virtually extirpated from local waters.

Tortola's marine habitats are determined by oceanographic conditions (see Section 5.1.1 below) and the structure of the shoreline. The primary oceanographic feature influencing coastal habitats are waves associated with open sea conditions. The south coast of the island is sheltered from open sea conditions by the Sir Francis Drake Channel and the southern "sister" islands lying offshore of Tortola. While there are rock headlands and a few sand beaches, most of the southern coast contains bays, lagoons and sheltered shorelines.

Tortola's north coast however is exposed to ocean waves, particularly during the winter season when large ground seas batter the shoreline. Most of the north shore consists of rocky headlands and sandy beaches. Coral reefs comprise the nearshore marine habitats along most of this coast. Particularly off rocky headlands, the depth increases rapidly with large boulders and rocks encrusted with corals, sponges and a variety of sessile organisms. Sea fans, gorgonians and soft corals tend to dominate in these areas.

The rock habitats extend offshore quite some distance and gradually change to a flat sand bottom. The sandy substrate extends north several miles to the edge of the Puerto Rican Plateau. Beyond lies the Puerto Rican Trench, the deepest part of the Atlantic Ocean. The trench affects ocean currents and the distribution of pelagic species and ultimately inshore marine life.

The habitat descriptions in this chapter represent a summation of present-day conditions; and while it is useful and necessary to document current conditions, the historical environment was quite different. This is especially true in the marine environment because our exploration and scientific studies of these systems span only the last few decades. Nevertheless, documenting "state-of-the-environment" conditions is useful because it does provide a starting point—and perhaps future research, and especially future attempts at habitat restoration, may benefit from the data and the insight provided by this chapter of the environmental profile.

[5] The authors of Chapter Five are Dr. Shannon Gore and Clive Petrovic.

5.1.1 Physical Features

The islands of the British Virgin Islands are separated into two distinct island chains by the Sir Francis Drake Channel, which is, approximately, a 6 km (3.75 mi) wide channel with a maximum depth of 50 m (164 ft). The southern island chain includes all the islands between Norman and Necker Islands and the northern chain includes those islands that extend between Little Tobago up to the Dog Islands (see Figure 1, Chapter 1).

The physical coastal features of these separate Islands vary throughout the territory but primarily include coral reefs, seagrass beds, beaches made of marine and/or terrigenous materials, and mangroves. These features are a product of the archipelago's underlying geology and climatological, oceanographic, and ecological settings.

The steep-sloping, high volcanic islands that make up a majority of the BVI originated during different geologic time periods but are basically mountaintops on a vast geological structure known as the Puerto Rican Plateau (see also Section 1.1.2 in Chapter 1). The plateau extends from the large island of Puerto Rico east to Anegada and the Horseshoe Reef, and both north and south of the island chain. It is surrounded by deep ocean trenches.

Major ocean currents pass around and over the plateau. The islands disrupt the flow of this enormous water mass, resulting in a general east-to-west flow of ocean current, but with a large number of eddies, countercurrents, and small variations in flow. When combined with the effects of tides and wind-driven surface currents, there is considerable variation and mixing of surface waters that exert significant impacts on shallow water marine communities.

The Puerto Rican Plateau is seismically active. Earthquakes and seismic activity that span millions of years have altered the topography. This has affected the type of bedrock and mineral composition of the underwater substrates on which coral reef organisms settle and grow. The shape of the shoreline has also been affected, as well as the movement of currents and water chemistry. In more recent geological periods, global ice ages have altered sea levels. Habitats that today are on the coast may have been high and dry, or completely submerged, only a few thousand years ago.

Coastal processes and natural habitat succession also affect the marine environment. Open bays that are affected by storms or wave action may develop berms of rock and coral rubble. Such natural berms may accumulate material until the bay is closed from the sea and water circulation. The bay then transforms into an enclosed lagoon and then a salt pond. The pond may pass through various hypersaline stages while gradually accumulating organic matter. Eventually, the accumulation of matter transforms the wetland into a dry upland habitat. These are natural processes that may occur over centuries, and their impacts on ecological communities can alter coastal mangroves, seagrasses and coral reefs.

While the underlying geologic framework determines the physical boundaries in which coastal features form, climatology and oceanographic processes acting on tropical coasts also influence the formation of physical features.

These influences include the prevailing easterly trade winds that vary in direction from the north-northeast during the winter (December-February), east during the spring (March-May) and southeast during the summer and fall (June-November). Maximum wind speeds occur during the winter months while minimum wind speeds occur during the fall (see also Section 1.1.6 in Chapter 1).

An additional influence is the offshore wave climate, dominated by persistent north-easterly to south-easterly waves. From October to April, large south-running swells, locally called "ground seas," are generated from storms in the North Atlantic Ocean. These long-period, high-energy waves commonly have wave heights greater than one metre (3.3 ft) and reach up to five metres (16 ft). However, extreme swell events other than from tropical storms or hurricanes are rare and are considered 20-year events. The last two extreme swell events occurred in 1991 and 2008.

Additionally, the BVI lies within the Atlantic hurricane belt. The hurricane season extends from June to November, with August and September being the most active. Hurricanes most commonly pass the BVI from the southeast in a northwest direction. High-energy waves and winds generated from these storms may approach the islands from any direction.

Finally, the archipelago's tropical maritime climate, with a wet/dry seasonal cycle, results in variations in rainfall and therefore in the amount of runoff into the marine environment. This will affect nearshore water chemistry and nutrient cycles. Just as terrestrial plants and animals adapt their life cycles to changing seasons and rainfall patterns, so do the creatures living close to shore in the marine environment. The variation in physical conditions is especially pronounced in sheltered bays or lagoons where landforms restrict water flow and the mixing of surface waters is reduced. Clearly, the flora and fauna must adapt to these variations in physical conditions. The physical features will then determine the type of ecological community that can survive in a given location.

5.1.2 Critical Habitats: Coral Reefs, Beaches, Seagrasses, Coastal Mangroves

The basic coastal and marine habitat types for Tortola are the following (see also **Figure 29**):

1. Coral Reefs
2. Seagrasses
3. Beaches
4. Coastal Mangroves

Section 1.1.3 of Chapter 1 also provides a further discussion of Tortola's wetlands, including salt ponds.

5.1.2.1 Coral Reefs

Typical reef form or structure (morphology) in the Caribbean has been described as comprising: (a) a backreef or shallow lagoon, (b) a reef crest, and (c) a forereef with the forereef often being dominated by spur and groove formations. Cross-sectional reef morphology shows a strong correlation between reef ecology and degree of exposure to waves. Variable wind and wave exposure as well as the close proximity of neighbouring islands do not allow for a clear distinction between windward and leeward reefs around the BVI's high volcanic islands like Tortola.

The majority of reefs in the BVI are fringing reefs, found along Tortola's southern coast; these reefs have developed nearshore on a shallow shelf that extends from the beach seaward (up to) 500 m (1,640 ft) and in a depth of 20 m (65 ft). However, there are distinct differences among the fringing reefs, which can be described as: (a) headland-attached linear reefs, (b) terrace flats, and (c) graded reefs (Gore, 2012).

Headland-attached linear reefs are shore parallel and extend from a headland across an embayment (**Photo 71**). In Tortola, these reefs are found in Cane Garden Bay, Red Bay (East End), and Sea Cow's Bay. They have a distinct reef crest, mostly composed of Elkhorn Coral (*Acropora palmata*) or dead remnants of Elkhorn Coral. The forereef often has the highest coral coverage since it is furthest from land-based sedimentation and is exposed to higher wave energy for flushing. The reef crest may be partially exposed on extremely low tides, and depth between the reef and shoreline may exceed 5 m (16 ft). These reefs intercept much of the incoming wave energy, but secondary waves and wind waves form on the inside of a linear reef closer to shore.

A *terrace flat reef* is a broad shallow bank that extends seaward no more than 200 m (656 ft) from the shore and is generally composed of sand, seagrasses, algae, small patch reefs and/or—most often—coral rubble (**Photo 72**). Wave energy is first dissipated over the forereef but is further reduced through the shoaling process over the shallow flat. Terrace flat reefs are most common on the north shore of Tortola between Carrot Bay and Capoons Bay.

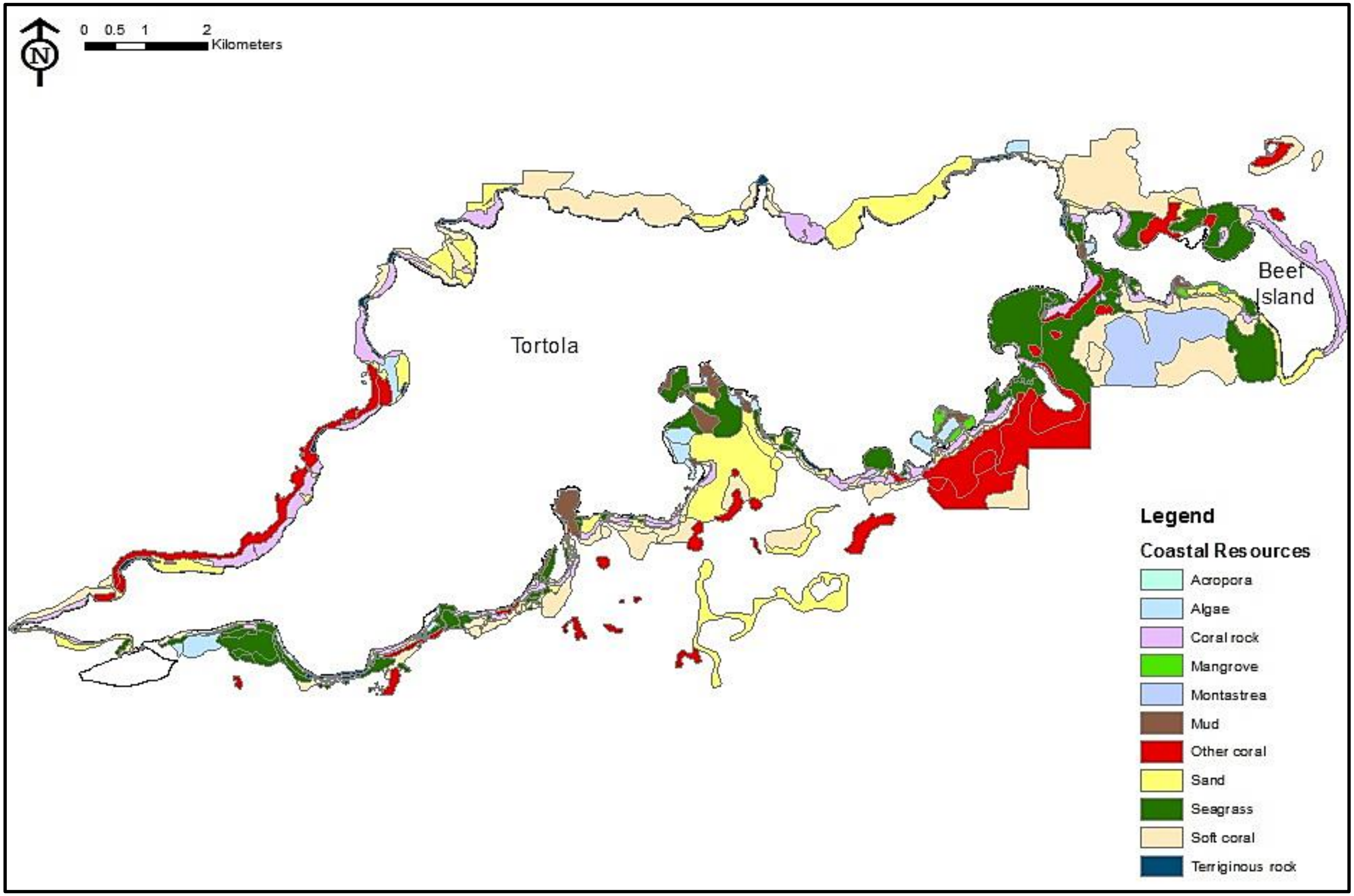


Figure 29.

The coastal and nearshore marine environment of Tortola.

Source: Data collected by the National Parks Trust of the Virgin Islands and the Department of Conservation and Fisheries as part of an OTEP-funded project, "Assessment and Improved Management of New and Existing Marine Protected Areas in the British Virgin Islands, 2004-2006."

Graded reefs (**Photo 73**) are continuous reef slopes that differ from reef flats in that the profile deepens quicker from the shoreline and so waves do not shoal. Coral height (relief) and coverage may be higher than reef flats, but these reefs do not exhibit a distinctive reef crest. From a birds-eye view, the reef may extend from the shore seaward uniformly or may have sand channels (spur-and-groove formations).

Patch reefs exist within the Sir Francis Drake channel as well as to the north of Tortola where some of the most popular fishing grounds are located.

Coral reefs in the BVI, and throughout the Caribbean, have severely declined since the outbreak of white-band disease in the late 1970s and the region-wide, disease-induced mass mortality of spiny sea urchins (*Diadema antillarum*) in the early 1980s. (Because sea urchins help control algae coverage over corals, the loss of sea urchins allowed algal overgrowth and ultimate smothering of live coral.) Combined with the impacts of several hurricanes, coral reefs have transformed from Elkhorn Coral (*Acropora palmata*) dominated reefs to reefs dominated by Boulder Star Corals (*Montastraea annularis*). Coral reef ecosystems are further threatened by the effects of climate change, such as increased pH in water chemistry that results in ocean acidification and increased mean water temperatures that cause coral bleaching.

The most recent coral bleaching event occurred in September 2005 (**Photo 74**). Bleaching was widespread and severe (95 percent of all Stony Corals) throughout the territory with water temperatures reaching 32.4 degrees C (90.3 degrees F). A consequent outbreak of white band disease (only found in Acroporid species) and white plague disease (found on all other coral species) continued to reduce coral cover by a total of 60 percent in the BVI (Hime, 2008) and the neighbouring USVI (Miller, *et al*., 2009). In one scenario, the loss of coral cover was translated into economic loss figures based on the willingness of tourists to pay for guided diving and snorkeling tours before and after a bleaching event that had reduced the extent of live coral. The economic loss was calculated at $1,050,000 for dive tours and $220,000 for snorkeling tours (Hime, 2008).

Photo 71.
A headland attached linear reef system at South Sound, Salt Island (sister island to Tortola).

Photo 72.
A terrace flat reef system at Palm Bay, Scrub Island off Tortola's eastern end.

Photo 73.
Graded reef system found off Beef Island, Tortola.

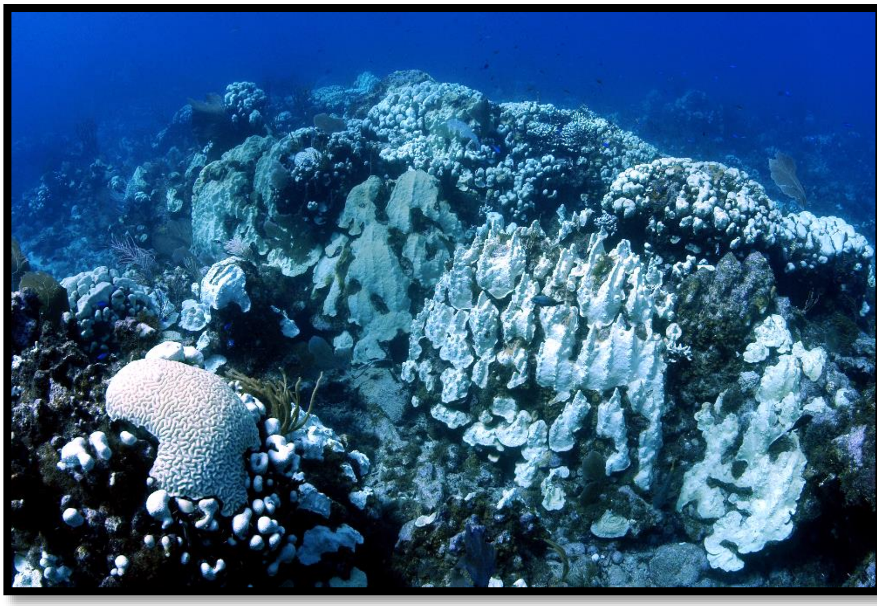


Photo 74.
Coral bleaching in 2005 (photo courtesy of Amando Jenik).

While climate change cannot be stopped, its effects can be mitigated through measures such as building resiliency, particularly through the establishment of marine protected areas. In 2005, the National Parks Trust was awarded funding through the Overseas Territories Environment Programme for a project entitled the "Assessment and Improved Management of New and Existing Marine Protected Areas in the British Virgin Islands" (see also Section 8.3.3.1, Chapter 8).

This project assessed the efficacy of the BVI's existing MPAs, marine habitat maps were updated, and a marine protected area (MPA) network was proposed to encompass 30 percent of each habitat type. At this writing, three of the proposed protected areas are well on their way to becoming official MPAs. A management plan for the NPT's Marine Conservation Programme was also developed that incorporated adaptive management techniques throughout the system of MPAs to ensure conservation practices and sustainable stakeholder use. This project also established seven coral reef monitoring sites; however, monitoring ended shortly after the project was completed.

Coral monitoring is a way to measure management effectiveness but only two long-term monitoring programmes exist in the BVI, partly due to lack of funding and local expertise. Reef Check was a programme first established by a local NGO, the Association of Reef Keepers (ARK), in 1997. Monitoring continued at four dive sites until 2012 (Bronco Billy off George Dog near Virgin Gorda, Pelican Island, Spyglass Wall off Norman Island, and Diamond Reef off Great Camanoe).

Guana Science (see Section 2.3.2) has the longest running dataset on coral reefs in the BVI, having documented monitoring around Guana Island for nearly 30 years. Based on data collected from both monitoring initiatives, trends on the overall health of BVI reefs parallel those throughout the Caribbean, with a decline in live coral coverage, increase in algae, and a decline in fish diversity and abundance.

Several applications have been submitted to Government for development of coral nurseries in the territory, including a two-nursery initiative supported by ARK and local dive groups, with funding from The Nature Conservancy. Because coral transplantation is relatively new to the territory and without appropriate in-house guidance, Government has delayed approval of coral nurseries in the past.

The issue of concern has not only been the management and monitoring of restoration efforts, but also the approval process itself, which is cumbersome. The latter includes acquiring a seabed lease from the Ministry of Natural Resources and Labour, securing permission from the Planning Authority (since anything placed on the seabed is considered "development") and obtaining approval from the Chief Conservation and Fisheries Officer to handle corals. A policy and management strategy was recently prepared to help guide Government, but it must be presented to Cabinet for approval. The policy includes a streamlined application approach and a framework for the management, monitoring, and maintenance of coral nurseries.

Coral reefs in the BVI, including those around Tortola, are significantly threatened by the presence of one of the highest concentrations of yachts in the world. There are currently just under 1,000 vessels that operate in the territory. Anchor damage, groundings, garbage disposal by yachters, and sewage from open septic tanks are the primary threats posed by marine vessels. To alleviate potential anchor damage to fragile coral reefs and seagrass beds, the National Parks Trust has installed over 200 mooring buoys since 1991 for day-time use at most BVI dive sites. This programme is financially self-sustaining as yachters are required to pay a fee for use of the moorings. The fees are then used for mooring repair and installation of new moorings. (See also Section 8.3.4.4, Chapter 8.)

Vessel groundings are becoming more common in the territory. However, many vessel groundings go unreported or Government officials are not notified until a damaged vessel has been hauled for repairs. In the case of the latter, damages to the vessel also signify substantial damages to the reef (see **Photo 75**).

There have been several major groundings (within the range of this Profile) where legal action was pursued. The grounding of the fuel tanker *Sichem Princess* in August 2008 miraculously did not result in the spillage of any oil but did crush a patch reef (approximately an area 60 m x 12 m [200 ft x 40 ft]), leaving anti-fouling paint on most of the crushed corals. Although legal action was initially pursued, the lack of technical resources in support of the case prevented further action.

Photo 75.
A piece of coral stuck in the bottom of a vessel that was hauled after a grounding.

The 111 m (363 ft) cargo vessel *Tropic Sun* grounded at Salt Island in August 2011, within a marine park near the popular dive site of the *RMS Rhone* (**Photo 76**). Damage to the marine environment was limited, and the historic underwater wreck site was unharmed. Because this grounding occurred within a declared marine park, legislation under the National Parks Trust Act of 2006 provided clear penalties, and the legal action was settled.

Photo 76.
Grounding of the *Tropic Sun* off Salt Island (photo courtesy of Amando Jenik).

The worst grounding incident in the BVI was the 2013 grounding of *Parsifal III* off the coast of Peter Island in which 30 tons of lead shot spilled into the sea over a coral reef after the vessel's keel hit a submerged ridge (**Box 9**). The damage caused by the keel to the rock ridge was a secondary concern to the amount of lead introduced into the marine environment (**Photo 77**).

Photo 77.
Lead shot (blue colour) on a ledge following the grounding of the sailing vessel *Parsifal III* (photo courtesy of Laura Hiesinger).

The lack of legal definitions for terms such as "toxic," "harmful" or "noxious" substances is a fundamental flaw of BVI legislative authority for the protection of marine resources. While the discharge of a substantial amount of lead is rare, other "harmful" discharges into territorial waters are more common.

For example, there currently is no law requiring the use of holding tanks on vessels in BVI waters, although one is under consideration by Government (perhaps as part of comprehensive environmental management legislation currently being drafted by Government), and the BVI Marine Association supports informal guidelines and voluntary compliance. One of the results of sewage discharge in the marine environment is the disease white pox in the *Acroporid* coral species (Sutherland, *et al*., 2011).

Although the BVI lacks strong legislation for pollution control in the marine environment, there are legal frameworks that could be incorporated into BVI law, such as the International Convention for the Prevention of Pollution from Ships (MARPOL).

5.1.2.2 Beaches

Tourism is a key driver of the BVI economy, and the territory's beaches are one of the most valuable natural resources supporting tourism. However, beaches are multi-dimensional systems with environmental, socio-cultural, and economic characteristics that are mutually dependent on each other. Degradation of Tortola's beaches is a loss of economic benefits for the tourism-based economy, but it is also a loss of the cultural importance beaches bring to the community.

The complex interrelationship between ecological (*e.g.*, coral reef growth) and physical (*e.g.*, wind and waves) processes as they impact tropical beaches complicates our understanding of these dynamic systems, although beaches are better understood today than they were 30 years ago. It is the gap between our understanding of beach processes and the reality of how beach resources are managed that is promoting accelerated degradation of the resource. For example, impacts from climate change, such as sea level rise, are not a direct threat to beaches themselves; however, climate change is a threat to the preferred development of tropical beaches and the infrastructure employed on such beaches.

Once tourism became a catalyst for economic growth during the 1960s, a number of beaches became a focal point for tourism or for sand mining for construction material, with neither activity initially controlled or the resource initially protected.

The most impacted beach in Tortola from sand mining is at Josiah's Bay. At this site, it has been estimated that 7,685 m^3 (10,051 yd^2) of sand was legally mined between 1982 and 1996 (Lettsome and Potter, 1997). While the precise amount of sand mining in the territory will never be fully accounted, the long-term effects of this activity have been dramatic (see **Figure 30**).

The Beach Protection Act (1985) requires permits for mining, but because the impacts of sand mining are well recognised today, few permits are issued by Government.

BOX 9

The Grounding of Parsifal III

On 2 January 2013, the sailing vessel *Parsifal III* ran aground on Carrot Shoal, a submerged rock ridge and popular dive site off the southern coast of Peter Island. The collision of the keel of the 54 m (177 ft) luxury mega-yacht with the solid rock ridge (three m [10 ft] below surface waters) resulted in several of the forward sections of the vessel's 100-ton winged-keel to rupture and spill approximately 30 tons of unconsolidated bluish-coloured lead shot (2-4 mm in diameter), covering a total area of approximately 6210 m^2 (1.5 ac) including a coral reef habitat (**Photo 77**).

Primary impacts to the dive site included both shattered boulder rock fragments that fell onto the surrounding coral reef habitat and direct smothering of associated reef species from shattered rock, several aluminum pieces of the keel, and 30 tons of unconsolidated lead shot. Because of strong currents through the area, some of the lead shot along the upper sections of the tiered southwest side of the ridge cascaded down the ridge face, scouring the underlying substrate and further scattering debris from the original point of deposition. A rapid assessment of total live (stony) coral coverage adjacent to and directly over the most concentrated area of lead shot indicated a 47-48 percent loss of live (stony) coral. Additionally, the physical stress and potential change in water chemistry, due to the presence of lead, caused many corals in the area to bleach. This will presumably result in the percentage of live coral coverage to decrease over time.

The immediate loss of coral reef habitat caused by the grounding of *Parsifal III* may only be negligible compared to the secondary impacts resulting from 30 tons of lead shot deposited into the marine environment. The potential hazard of lead in fish, wildlife and invertebrates is described in a review completed for the US Fish and Wildlife Service:

> ***All credible evidence indicates that lead is neither essential nor beneficial to living organisms, and that all measured effects are adverse—including those on survival, growth, reproduction, development, behavior, learning and metabolism*** (Eisler, 1988).

While scientific literature regarding the adverse impacts of lead on various organisms is exhaustive, there is limited information regarding the impact of lead in a solid state—such as shot 2-4 mm in diameter—when transported, transformed and/or exposed through a ***marine*** ecosystem. The deposition of 30 tons of lead shot into a BVI marine environment is globally unprecedented.

Several studies have shown exposure pathways of lead in various marine organisms (*e.g.*, coral, sponges, fish, invertebrates). Species that do not die directly from acute lead exposure may face sub-lethal effects of chronic lead exposure that could contribute to their inability to survive. At Carrot Shoal, some species of fish have been observed directly consuming the small shot, an activity *not* discussed in published literature.

One exposure pathway of lead that is of ecological concern, and which was the catalyst to banning lead shot and fishing sinkers in some countries, is the ingestion of lead pellets by birds. It takes as little as the ingesting of one pellet of lead to kill a bird. The hazards of lead poisoning in birds became well recognised in the 1970s, and by the 1980s Britain and some jurisdictions within the United States and Canada began placing restrictions on the use of lead shot and fishing sinkers. Several species of breeding seabirds, including several considered to have regionally significant breeding populations, have been seen foraging within close proximity of Carrot Shoal, raising the question of whether birds may be eating fish that have consumed the shot.

By the end of 2014, approximately 5-15 tons of lead shot remained on the sea floor, covered in bottom sediments or lost between crevices. While an on-going legal case resulting from this vessel grounding may take years to conclude, the Virgin Islands Government has acted quickly to bear the financial burden of removing as much lead shot as possible. Equally expedient actions were forthcoming from local yachting and diving organisations in identifying the vessel that had caused the initial damage.

Beaches are very active and can naturally change from season to season; either sand erodes during the winter swells or the beaches are rebuilt again during the summer. During major storm events, eroded beaches may take a few years to recover (see **Photo 78**). However, when a solid physical structure blocks sand movement, this can, and in most cases will, lead to accelerated beach erosion, or the narrowing of a beach. When a built structure is threatened by waves coming in closer or by sand that has eroded, it is the built property that is threatened; the beach is merely adjusting to human impacts.

Beach management is essentially non-existent in the BVI, and the effects of this lack of management are best seen at Cane Garden Bay on Tortola's north side (**Photo 79**). Community stakeholder

Figure 30.
Arial views of Josiah's Bay, Tortola, over time.
From Top: 1953, 1992, and 2002.
Note the significant reduction of sand on the beach over the almost 50-year time span (*source*: BVI Government, Survey Department).

Photo 78.
Lambert Beach, Tortola.
Top photo depicts the eroded beach after a 2008 swell event, and the bottom photo, taken in 2014, shows a "recovered" beach. After the swell event in 2008, waves reached the retaining stones and stairs; several years later, there is approximately 30 feet of beach in front of the stairs.

meetings, hosted by the Department of Conservation and Fisheries in 2011, identified management issues requiring immediate attention, ranging from over-crowding by beach-goers and unregulated beach vendors to flooding caused by the filling of wetlands. While environmental neglect has resulted in severe degradation of an area once proposed as a national park site, socio-economic issues continue to threaten the future of tourism at Cane Garden Bay. The uncontrolled use of the beach by cruise ship passengers has caused over-night visitors to avoid the area when cruise ships are in port. While a beach management policy has been developed under the leadership of DCF, it has yet to be implemented (see Section 2.2.4.10 in Chapter 2).

Photo 79.
Cane Garden Bay on a day when cruise ships were visiting Tortola.

5.1.2.3 Seagrass Beds

The highly productive functions and services provided by seagrass beds make them one of the most valuable ecosystems in the biosphere (Costanza, *et al*., 1997). Seagrasses are flowering plants that form meadows in shallow marine and coastal environments. They are key components of coastal and marine systems because they provide food, shelter and water quality for marine animals, including juvenile fish. Yet, despite their importance, seagrasses are currently being lost globally at a rate of up to two football fields per hour. Unlike coral reefs, the plight of seagrasses has so far only received minimal attention, including in the BVI (Darwin Initiative, 2013).

Anchor damage and prop scarring are common where seagrass beds are located, although moorings have been established in some areas such as Trellis Bay, Beef Island, Manchioneel Bay, West End, Cane Garden Bay, and Cooper Island. Nevertheless, inexperienced yachters are often observed at these same sites attempting to anchor in seagrass. Such yachters are usually asked to leave, not because of the threat of anchor damage to the seagrass beds but because of the close proximity of the anchored vessel to a moored vessel.

The management of the Cooper Island Beach Club, south of Tortola, has made a significant effort to educate visiting yachters about the extensive seagrass beds that front its shoreline. An underwater camera is located just off the beach at the Beach Club and provides a live feed to the resort and to its website of nearshore coral and seagrass habitats (*www.cooperislandbeachclub.com*). While this does not provide monitoring data such as long-term changes in the abundance and distribution of seagrass in the bay, it does raise awareness.

Monitoring for long-term changes of seagrasses has been limited in the BVI. During the early 1990s and again in the early 2000s, several sites were established for monitoring by the Department of Conservation and Fisheries, but initiatives were discontinued due to a lack of resources.

Dredging of seagrass beds in Tortola has been limited to a few areas such as the harbour in Road Town, Scrub Island, and Trellis Bay, but the potential for future marina development could likely see significant loss of these habitats. Because of the ability of seagrasses to stabilise and filter sediments, their removal results in turbid water conditions.

Mitigation measures, such as transplanting seagrasses, have been successful in some areas such as Florida, but it is costly. Approval for development of a marina at Scrub Island, east of Tortola, required seagrass transplantation as a part of its environmental management plan (**Photo 80**), but no long-term monitoring was established to measure its success. Future environmental impact assessments for BVI coastal developments need to address the potential loss of seagrass beds, whether for marina or beach development.

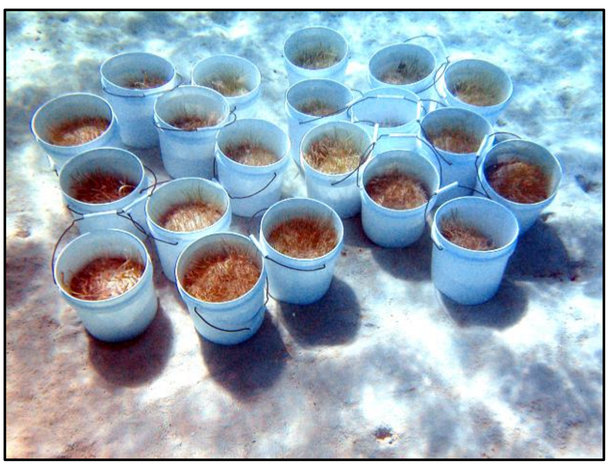


Photo 80.
Seagrass from Scrub Island about to be transplanted near Great Camanoe Island.

5.1.2.4 Coastal Mangroves

There are four species of mangrove occurring in Tortola and found along the island's coasts: Red Mangrove (*Rhizophora mangle*), Black Mangrove (*Avicennia germinans*), White Mangrove (*Laguncularia racemosa*), and the Buttonwood (*Conocarpus erectus*). The most common coastal mangrove is the Red Mangrove that tends to be the visible species characteristic of a mangrove-lined shoreline. On Tortola, mangrove communities occur in specific locations that vary in physical features. Examples include:

- Coastal mangroves such as those found in sheltered bays at Sea Cow's Bay, Road Harbour, and East End.
- Mangroves that line salt ponds, such as those at Cane Garden Bay and Beef Island.
- Mangroves at the mouth of ghuts, such as those found at most bays on the south coast where mangroves have extended inland from the coast along the watershed.
- Mangroves lining channels, such as those between Tortola and Beef Island.

While the Red Mangrove may be found in each of these habitat types, environmental conditions will be different depending on location. Depending on salinity, water movement, periods of inundation (flooding) as well as other factors, a mangrove community may be a very narrow strip on the shore or an extensive forest that also includes Black Mangrove and White Mangrove in distinct zonation patterns. Faunal associations will vary with the extent and diversity of the mangrove forest.

Mangroves play a role in the natural succession from open bay to dry upland ecosystem. This is visible at a number of locations on Tortola where the successional stage is apparent, such as at Paraquita Bay, Josiah's Bay, Cane Garden Bay, Brewer's Bay, and Belmont Bay. Archaeological excavations at Paraquita Bay, well inland from the current mangrove forest, have revealed mangrove peat deposits, indicating that the shoreline has changed considerably over time.

Photo 81.
Sedimentation in Cane Garden Bay after a heavy rainfall.

Photo 82.
Image of the Paraquita Bay Hurricane Shelter
(photo courtesy of George and Luana Marler).

Photo 83.
Mangrove Boardwalk at the HLSCC Marine Studies Centre.

BVI coastal mangroves and associated wetlands have declined considerably over the past 60 years, primarily because of increased coastal development (see also Section 1.1.3, Chapter 1). The importance of these wetlands in filtering sediment runoff before it reaches the sea and in protecting the shoreline from incoming wave energy was not initially appreciated as the territory began to modernise in the 1960s. The immediate need was to dispose of excess materials resulting from hillside development, and the filling of wetlands became a common practice. The consequences were flooding in low-lying areas during periods of heavy rainfall, deterioration of coastal habitats, and poor water quality from sedimentation, as illustrated in **Photo 81**.

While most wetlands on the southern side of Tortola have been filled, mangroves continue to fringe parts of this coastline. However, like the wetlands, many of these mangroves have been lost to development, *e.g.*, at Nanny Cay, Sea Cow's Bay and Road Reef. Even mangroves at Paraquita Bay have deteriorated due to development activities, despite the area's importance as a shelter for almost 400 vessels during hurricane season (**Photo 82**).

Paraquita Bay is managed as a hurricane shelter by the National Parks Trust, and the mangroves at Witches Brew near Fat Hogs Bay are part of a proposed protected area under the BVI's *Protected Areas System Plan, 2007-2017*. The mangroves between Tortola and Beef Island, as well as those in Hans Creek, are protected under the Fisheries Regulations (2003) and are part of a Fisheries Protected Area. However, all mangroves in the BVI should be protected (see also Section 8.3.4.6, Chapter 8)—because of the services they provide as a coastal defence, for their potential educational value, and as an attraction for residents and visitors to partake in nature walks and bird watching. Such an experience is currently available at the Mangrove Boardwalk at the H. Lavity Stoutt Community College's Marine Studies Centre located at Paraquita Bay (**Photo 83**).

5.1.3 Fisheries Resources and Critical Species of Special Concern

The numerous marine habitat types of the British Virgin Islands provide a diverse range of commercial and recreational fishery resources. These include nearshore flats with mangroves and seagrass beds and extensive nearshore fringing reef systems. Fishing banks on the broad shelf north of Tortola include the Barracouta, Kingfish, Turtle Head and Whale Banks as well as the Barracuda Bank southeast of Virgin Gorda, also known as the Sea Mount. The offshore North and South Drops are pelagic zones along the territory's shelf edges, also considered part of the eastern most side of the Puerto Rico/Virgin Islands Platform, defined by the 183 m (100 fathoms) depth contour (Rogers and Teyaud, 1988; Rankin, 2002). The territory's entire fishing area covers 80,336 km^2 (31,018 mi^2) and includes the territory's Exclusive Fishery Zone (EFZ) (VLIZ, 2014; see **Figure 31**).

The main types of fisheries operating in the BVI are categorised as (1) commercial (artisanal) or (2) recreational (sub-divided into pelagic sport and pleasure), but a third offshore pelagic long-line fishery also exists. The commercial fishery makes up the largest sector within the fishing industry, while the recreational fishery has potential to develop into a major economic sector of the BVI economy. In contrast, the offshore pelagic long-line (horizontal) fishery is limited to one operator out of Anegada, and since 1990 the BVI does not permit foreign long-lining vessels. However, vertical long-line fishing is becoming more popular with local fishermen on Tortola as a means to diversify commercial fisheries within the territory.

Governance of all fishery resources is regulated by the Fisheries Act, 1997 and the VI Fishery Regulations, 2003 (see Section 2.2.3.1 in Chapter 2). All vessels, local and foreign, used for fishing in territorial waters require registration through the Department of Conservation and Fisheries under the Ministry of Natural Resources and Labour and, further, are subject to requirements either of the VI Shipping Registry or of the country in which the vessel is flagged. Secondly, anyone fishing in territorial waters requires a fishing license which may be granted through the Minister of Natural Resources and Labour.

There are three types of licences:

1. A commercial fishing licence to fish for profit.
2. A pleasure fishing license that entitles the licensee to fish for personal consumption up to a maximum of 30 pounds per boat, per day.
3. A sport fishing license that entitles the licensee to fish for sporting purposes either on a catch-and-release basis or for personal consumption up to a maximum of 30 pounds per boat, per day.

All licences are conditional, depending on the type of licence requested.

There are seasonal closures for species of special concern, which applies for all types of licences. Under BVI regulations, it is illegal to fish for, remove from the fishery waters, give, have in possession, expose for sale, sell or purchase a species during its closed season. These species and closed seasons are:

- Margate (*Haemulon sp.*): Closed January 1 to March 31.
- Red Hind (*Epinephelus guttatus*): Closed January 1 to March 31.
- Nassau Grouper (*Epinephelus striatus*): Closed March 1 to May 31.

Only a commercial fishing license holder is allowed to take sea turtle, lobster, conch or whelk. However, these species have size restrictions and are also regulated by closed seasons. These include:

- **Sea Turtles**: Closed April 1-November 30. Shell length may not be less than 61 cm (24 in) for Green turtles (*Chelonia mydas*) or 38 cm (15 in) for Hawksbill (*Eretmochelys imbricata*). A full moratorium exists on Leatherbacks (*Dermochelys coriacea*), Loggerheads (*Caretta caretta*), and all sea turtle eggs.

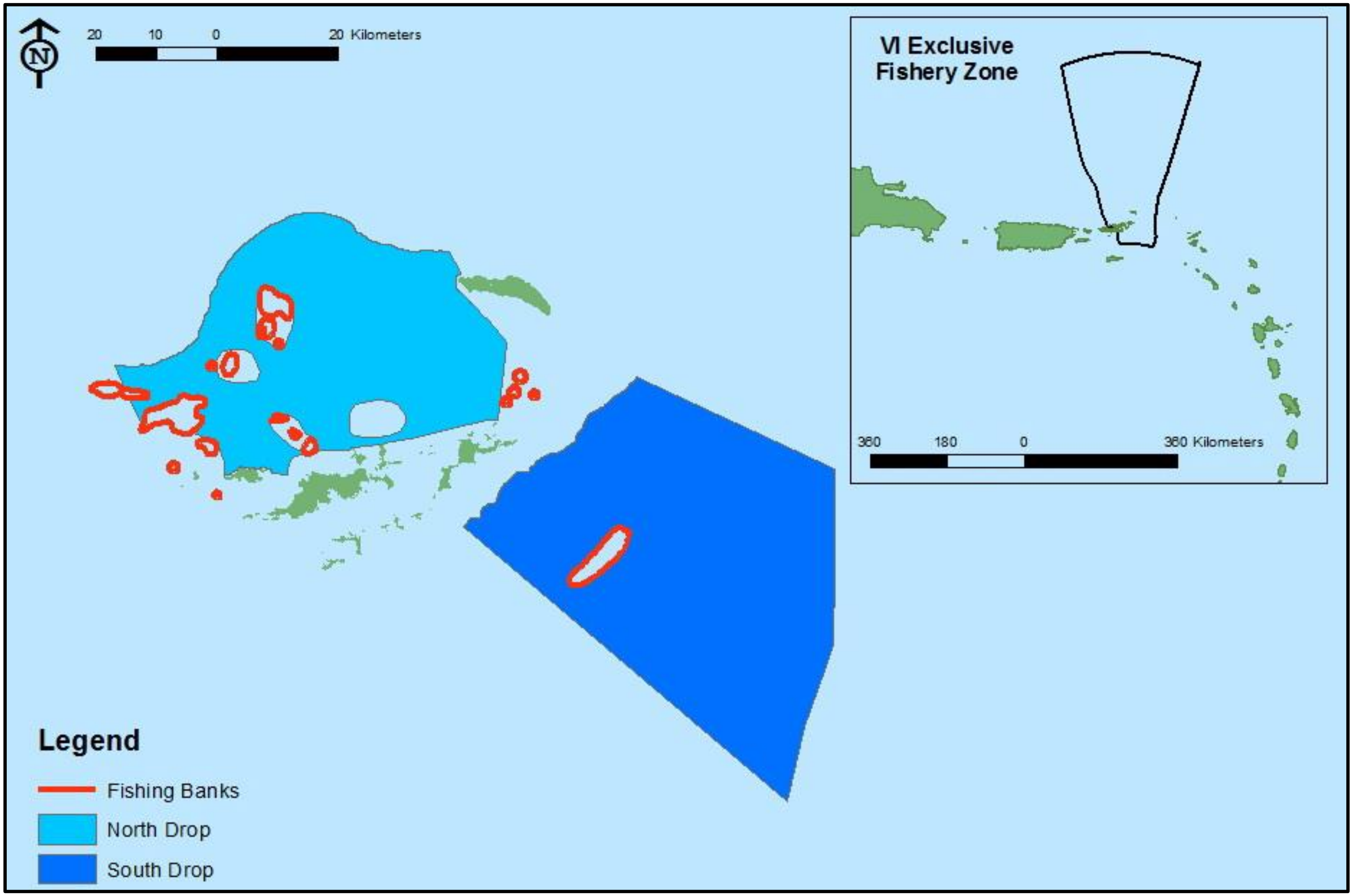


Figure 31.
Major fishing banks of the British Virgin Islands, and the BVI's Exclusive Fishery Zone (inset).

- **Lobster** (*Panuliris argus*): Closed July 31-October 31. Carapace length may not be less than 9 cm (3.5 in), tail weight may not be less than 0.4 kg (12.8 oz); lobsters with eggs may not be removed; and spearing, hooking or impaling lobsters is illegal.
- **Conch** (*Strombus gigas*): Closed August 15-October 31. Conch shell may not be less than 17 cm (6.7 in), shell must have a flared lip, and meat weight cannot be less than 0.2 kg (6.4 oz).
- **Whelk** (*Cittarium pica*): Closed August 15-October 31. Shell length may not be less than 5 cm (2 in).

Additionally, there are several Fisheries Priority and Fisheries Protected Areas around Tortola (**Figure 32**) as well as proposed marine protected areas (see Table 51 in Chapter 8). The *priority areas* do not allow any recreational activities such as anchoring, diving or snorkeling. The *protected areas* do not allow diving, anchoring or any development to occur in or where an adverse impact may occur on the protected area. However, neither the protected or priority areas have specific management plans.

5.1.3.1 Tortola's Commercial Fishery

The commercial fishery in Tortola is the largest in the territory and can be geographically sub-divided into five districts:

(1) West End

(2) North Shore

(3) Road Town

(4) East End

(5) Outer islands
(Cooper Island and Peter Island).

Based on each district's proximity to various types of habitats, target fishing locations, preferred methods, and key landing sites are identified in **Table 35**. Fishing methods (and legal restrictions) include:

- hook and line fishing,
- use of beach seine nets, not less than 0.5 cm (0.2 in),
- trolling,
- vertical long-lining, and
- use of traps, the most common fishing method, with a mesh size greater than 5.08 cm (2 in) and requiring the use of a biodegradable panel.

Target species of each fishing method are identified in **Table 36**.

Current legislation requires 60 percent of a fisher's catch to be landed through the BVI Fishing Complex located in Baugher's Bay (**Photo 84**). This complex was established in 1983 to meet a growing need for a ready market for local fishers to sell their catch to the general public (Alimoso and Overring, 1996). However, despite major upgrades in 2013, such as improved packaging capabilities and increased storage space, a minority of fishermen use the Complex. This is partly due to unregulated variability in market rates, prompting a fisherman to sell to the highest buyer, usually a restaurant or hotel.

Photo 84.
BVI Fishing Complex at Baugher's Bay, Tortola.

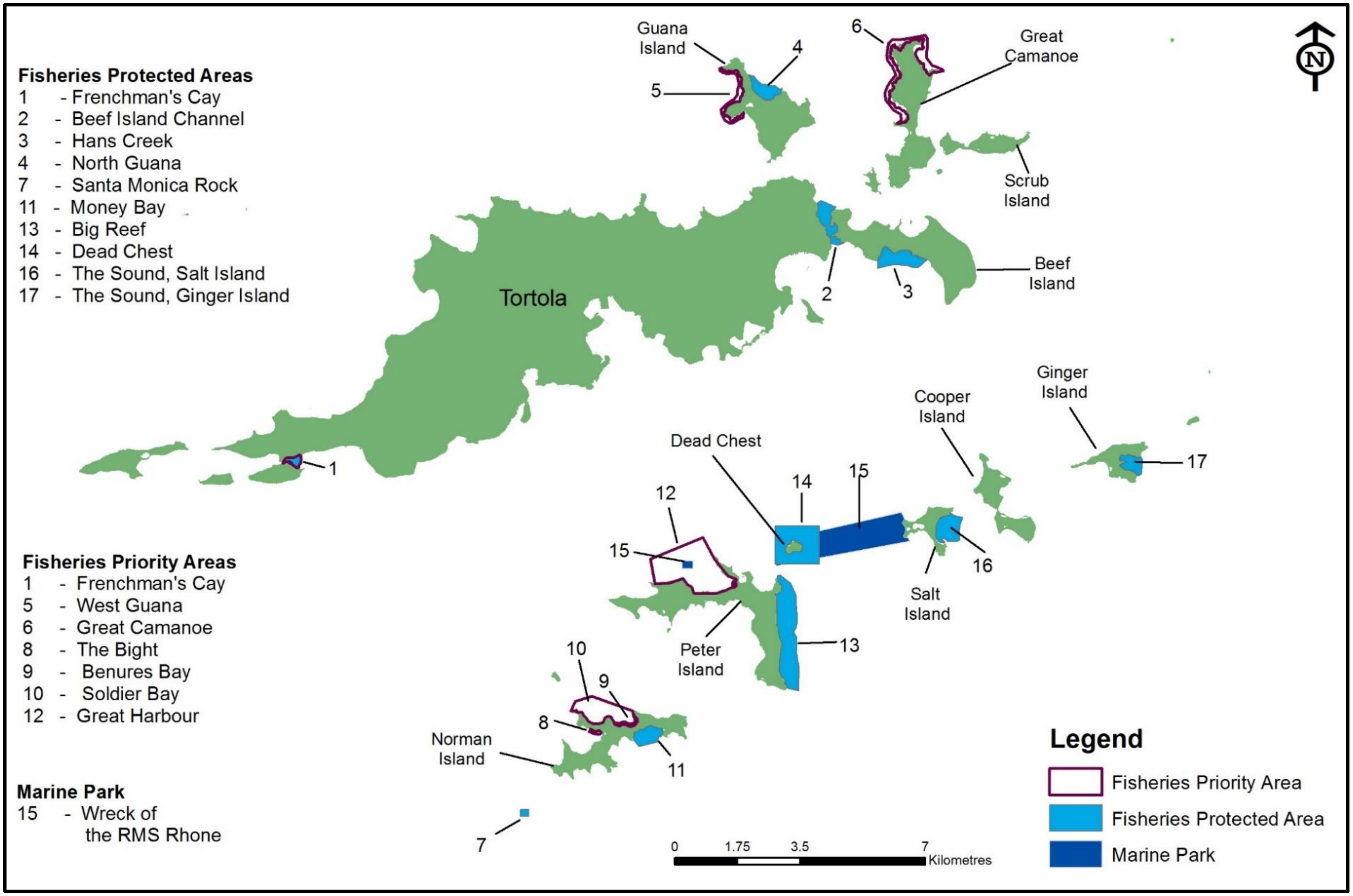


Figure 32.

Existing Fisheries Priority Areas, Fisheries Protected Areas, and Marine Parks.

(See Figures 41-44 in Chapter 8 for proposed marine protected areas.)

Table 35.
Fishing districts of Tortola, fishing methods and key fishing locations.

DISTRICT/LANDING SITES	METHOD	LOCATIONS
West End Towers Frenchman's Cay Soper's Hole	**Hook and Line**	Great Thatch and Little Thatch Jost Van Dyke Norman Island Great and Little Tobago
	Net	Great Thatch and Little Thatch Jost Van Dyke Norman Island Great and Little Tobago
North Shore Carrot Bay (Ramp) Little Apple Bay Cane Garden Bay Brewer's Bay	**Hook and Line**	Great Thatch and Little Thatch Jost Van Dyke Great and Little Tobago Guana Island Great and Little Camanoe Islands
	Net	Great Thatch and Little Thatch Jost Van Dyke Great and Little Tobago Guana Island Great and Little Camanoe
	Trolling	North Banks
Road Town Kingstown Baugher's Bay Wickham's Cay (Village Cay) Road Town Jetty (Clean Hole) Sea Cow's Bay Nanny Cay Fishing Complex	**Hook and Line**	Peter Island to Norman Island
	Net	Norman Island Great and Little Camanoe Island Guana Island
	Trap	Cooper Island to Norman Island North Banks
	Trolling	North Banks / South Drop
	Vertical Long-line	South from Dead Chest to Anegada
East End Red Bay Beef Island Bridge Pond Mouth Fat Hogs Bay Paraquita Bay	**Hook and Line**	Great and Little Camanoe Islands Guana Island Scrub Island The Dogs
	Net	Great and Little Camanoe Islands Guana Island Northeastern Coast of Tortola
	Trap	North Banks
	Trolling	North Banks
	Vertical Long-line	South Drop to Northern Anegada
Outer Islands Cooper Island (Coral Bay) Peter Island (Great Harbour and Sprat Bay)	**Hook and Line**	Norman Island to Cooper Island
	Trap	Southern Islands (Norman to Anegada)
	Net	Norman Island to Cooper Island

Table 36.
Target species for commercial fishing.

Hook and Line	
Serranidae	
Nassau Grouper	*Epinephelus striata*
Yellowmouth Grouper	*Mycteroperca interstitialis*
Red Hind	*Epinephelus guttatus*
Rock Hind	*Epinephelus adscensionis*
Coney	*Epinephelus fulvus*
Lutjanidae	
Yellowtail Snapper	*Ocyurus chrysurus*
Balistidae	
Queen Triggerfish (Ole' wife)	*Balistes vetula*
Holocentridae	
Squirrelfish	*Holocentrus spp.*
Haemulidae	
Grunts	Haemulidae
Sparidae	
Porgies	*Diplodus sp.*
Ostraciidae	
Trunkfish (Boxfish)	

Net	
Scombridae	
Bonito	*Euthynnus alletteratus*
Carangidae	
Blue Runner (Hardnose)	*Caranx crysos*
Bar Jack	*Caranx ruber*
Crevalle	*Caranx hippos*
Bigeye scad	*Selar crumenophthalmus*
Permit	*Trachinotus falcatus*
Palometa	*Trachinotus goodei*
Lutjanidae	
Yellowtail Snapper	*Ocyurus chrysurus*
Hemiramphidae	
Ballyhoo	*Hemiramphus brasiliensis*

Trap	
Acanthuridae	
Surgeonfish	
Balistidae	
Queen Triggerfish (Ole' wife)	*Balistes vetula*
Sparidae	
Porgies	
Pomacanthidae	
Angelfish	
Scaridae	
Parrotfish	
Haemulidae	
Grunts	
Lutjanidae	
Yellowtail Snapper	*Ocyurus chrysurus*
Serranidae	
Groupers	
Ostraciidae	
Trunkfish (Boxfish)	

Trolling	
Scombridae	
Bonito	*Euthynnus alletteratus*
Cero	*Scomberomorus regalis*
Wahoo	*Acanthocybium solandri*
Blackfin Tuna	*Thunnus atlanticus*
Carangidae	
King Mackerel (Kingfish)	*Scomberomorus cavalla*
Spanish Mackerel	*Scomberomorus maculatus*
Coryphaenidae	
Dolphin (Mahi mahi)	*Coryphaena hippurus*

Vertical Long-line	
Lutjanidae	
Queen Snapper	*Etelis oculatus*
Red Snapper (Gold-eye)	*Lutjanus vivanus*
Blackfin Snapper	*Lutjanus buccanella*
Serranidae	
Misty Grouper	*Epinephelus mystacinus*

The most comprehensive existing report on the BVI commercial fishery (Pomeroy, 1999) reported that the total number of commercial fishermen had grown from 166 (including crew) in 1974 (Peacock 1974) to over 300 by 1998, of which 50 percent owned their own fishing vessel and 35 percent were full-time fishers.

Based on a 1997 report by the Department of Conservation and Fisheries, the Gross Domestic Product (GDP) contribution from fisheries from 1981-1993 ranged between 2.2 percent and 3.3 percent and was derived from commercial fishing, long-line pelagic fishing, recreational fishing and vessel licence fees. From 2000 to 2004, the estimated GDP ranged between 0.70 percent and 0.61 percent, with a total estimated landing of 1,342 metric tonnes in 2004 (Chan A Shing, 2005).

Although a Fishery Advisory Committee is supported and encouraged by legislation, only one Fisherman's Association is fully functional on Virgin Gorda (*pers. comm*., Ken Pemberton, Fisheries Officer, DCF, 2014). The delineation of fishery districts on Tortola indicates some organisational basis for developing associations, which have been historically accepted as a means to work with Government to better manage the fishery (Pomeroy, 1999). However, this will require capacity building to further structure a functioning group.

5.1.3.2 Tortola's Recreational Fishery

The recreational fishery in the BVI is divided into two types based on the fishing licence: pleasure fishing and sport fishing (**Table 37**). Both licences are valid for either one year or one month. Although both licences are limited to a 13.6 kg (30 lb) catch per boat, all billfish are catch-and-release only and include blue marlin (*Makaira nigricans*), white marlin (*Tetrapturus albidus*), sailfish (*Istiophorus albicans*), and swordfish (*Xiphias gladius*). Additionally, permits for hosting sport fishing tournaments are required, and events must observe the rules and regulations of the International Game Fishing Association.

The primary difference between pleasure and sport fishing is that "sport fishing" is defined under the BVI Fisheries Regulations (2003) as fishing occurring when one or more persons hire a vessel with a skipper (usually from a charter company) for the purposes of fishing. Fishing licenses are required and can be obtained either by the individual fisher or the charter company, but the charter company is responsible for the vessel having a fishing registration certificate.

Visitors that hire a vessel without a captain through a charter company (*i.e*., a "bareboat") may obtain a pleasure fishing license, but the vessel may not necessarily have a fishing registration certificate as required by law for fishing. Therefore, visitors with a pleasure fishing license may not be fully legal to fish.

Registering all charter vessels for fishing may not be feasible for a charter company. However, the registration processes could be adapted for the tourism industry and would be a large source of revenue for Government, given that over 700 pleasure fishing licenses were granted in 2003 (Chan A Shing, 2005).

In addition to regularizing registration of charter vessels for fishing, there is also a need to collect catch data for this particular fishery.

The sport fishery for billfish in the USVI and Puerto Rico began in the 1950s (Erdman, 1968) and within a few years, the USVI was recognised as one of the premier locations in the world for Atlantic blue marlin (*Makaira nigricans*) fishing (Friedlander, 1991). Friedlander (1995) suggested the majority of fishing effort occurs on the "North Drop" in the British Virgin Islands. Both Atlantic blue marlin and white marlin (*Tetrapturus albidus*) are also caught in BVI territorial waters on the "South Drop" as well as the seamount south of Virgin Gorda, which indicates the potential for further development of sport fishing in the BVI.

However, with the majority of sport fishing vessels located in the USVI (DCF, 1997), the use of traditional BVI fishery grounds for this form of tourism, namely billfishing, has led to political tension between the BVI and USVI (Abednego, *et al*., 2000), and the legal issues of territorial waters and boundaries need to be resolved (Gillet, *et al*., 2007).

Table 37.

Target species for pleasure and sport fishing licences (fly fishing, trolling, hook and line).

KEY SPECIES	SCIENTIFIC NAME	HABITAT TYPE	SEASON/PEAKS
Atlantic Blue Marlin	*Makaira nigricans*	Shelf Edge	May-October/June and July
White Marlin	*Tetrapturus albidus*	Shelf Edge	April-May
Sailfish	*Istiophorus platypterus*	Shelf Edge	October-March
Yellowfin Tuna	*Thunnus albacares*	Shelf Edge	October-April
Blackfin Tuna	*Thunnus atlanticus*	Shelf Edge	year-round/June and July
Skipjack Tuna	*Euthynnus pelamis*	Shelf Edge	June-Sept.
Dolphin (Mahi mahi)	*Coryphaena hippurus*	Reef, Banks, Shelf Edge	October-January, May, July
Wahoo	*Acanthocybium solandri*	Reef, Banks, Shelf Edge	September-May
Bonito	*Euthynnus alletteratus*	Reef, Banks, Shelf Edge	January-May
Baracuda	*Sphyraena barracuda*	All types	all year
Blue Runner (Hardnose)	*Caranx crysos*	Reef and Banks	April-September
Bar Jack	*Caranx ruber*	Reef and Banks	all year
Crevalle Jack	*Caranx hippos*	Flats, Reef and Banks	all year
Rainbow Runner	*Elegatis bipinnulata*	All types	April-September
Yellowtail Snapper	*Ocyurus chrysurus*	Reef and Banks	all year
King Mackerel (Kingfish)	*Scomberomorus cavalla*	All types	February-May
Cero	*Scomberomorus regalis*	All types	all year
Bonefish	*Albula vulpes*	Flats	March-September
Permit	*Trachinotus falcatus*	Flats and Reef	April-October
Tarpon	*Megalops atlanticus*	Flats, Reef and Banks	March-October
Snook	*Centropomus undecimalis*	Flats and Reef	all year
Mahogany snapper	*Lutjanus mahogoni*	Flats, Reef and Banks	all year

5.2 Environmental Issues Affecting the Coastal/Marine Environment

5.2.1 Water Quality

Caribbean currents generally move large volumes of water westward through the islands of the BVI, providing a considerable amount of flushing of bays and inlets and generally allowing for good water quality. However, within a small tidal range and in individual embayments around Tortola, flushing is minimal, resulting in localised water quality issues.

There are primarily three causes for poor water quality in the BVI.

(1) The first (and most damaging to coastal habitats) being sedimentation from the erosion of landside soils that are carried by storm water into the sea.

(2) Secondarily, untreated waste water from either land-based sources or from yachts without (or not using) holding tanks.

(3) Lastly, the use of toxic and other hazardous materials that enter the marine environment, including oil spills.

5.2.1.1 Sedimentation

The underwater substrates of many of Tortola's bays contain large areas of fine silt deposits that are easily re-suspended by even slight wave action or surge. The impacts of these sediments on marine environments include the smothering of seagrasses and algae and injury to corals, sponges and other marine life. Additionally, the fungi associated with sediments from land are a major contributor to coral disease and accelerate mortality and the degradation of reef ecosystems.

Vegetation helps hold soils in place, particularly on steep hillsides, and removal of vegetation is well documented as a primary cause of sediment runoff into coastal waters. Historically, Tortola is similar to other eastern Caribbean islands in that the island was originally densely forested with minimal disturbance by early settlers. Later, as recorded in neighbouring St. John in the USVI, approximately 90 percent of the forests were replaced by sugarcane fields during the 1700s and 1800s (Tyson, 1987). Tortola's hillsides may have been similarly impacted during the peak of sugarcane production, but it is unknown how much forested acreage was actually cleared.

There are no historical records of water quality during the period of sugarcane production on Tortola. However, an early, small-scale reef die-off was possible as this was identified elsewhere by linking European settlement to a previously undetected historical collapse in nearshore coral communities on the Great Barrier Reef in Australia (Roff, *et al*., 2012).

After Tortola's sugarcane fields were abandoned, regrowth of vegetation occurred, although, with time, other agricultural endeavors may have contributed to contemporary water quality. Today, agriculture is limited on Tortola, with little use of fertilisers and pesticides and therefore minimal risk of large-scale contamination from toxic, inorganic chemicals and heavy metals from agriculture practices.

As the economy and population of Tortola grew, so did the clearing of both hillside and coastal land for physical development projects. This may well have been the precursor to the observed decline in coral reefs around Tortola because during the growth decades of the 1970s-1990s, no effective erosion-control measures were in place. Additionally, many wetlands were filled to make room for physical developments. Such destruction of wetlands subsequently reduced the ability of storm water to filter out sediments prior to entering coastal waters and has resulted in significant sediment loss to the sea following major rain events. Sediment loads are heavy and repeated often.

With developments in the coastal areas of Tortola continuing today, erosion control measures are now generally required, although too little monitored. Thus, sedimentation continues to be a major contributor to poor water quality (**Photo 85**). After periods of heavy rainfall, sedimentation is clearly visible in areas such as Road Harbour, Sea Cow's Bay, and East End, all of which have experienced visible water quality issues for many years.

Photo 85.
Brewer's Bay after a heavy rainfall when the bay was discoloured with heavy sedimentation.

5.2.1.2 Wastewater Discharges

According to former Permanent Secretary of the Ministry of Natural Resources, Eugenie Todman-Smith (*pers. comm*., June 2014), disposal of human waste on beaches and coastal waters was a common practice prior to the 1960s as there was no means to dispose of waste at the time (**Photo 86**). With the launch of modern development in the 1960s, septic tanks with drainage fields became the preferred method of waste disposal. With a small and widely dispersed population, septic tanks are a satisfactory means of disposal and the resulting effluents are minimal and quickly absorbed by the natural vegetation (see also Section 7.2.1 in Chapter 7).

Photo 86.
Outhouses along the coast were common prior to the development of tourism in the 1960s (photo courtesy of P. Haycraft).

However, as the population continues to grow and residential density and coastal development expand, septic systems are increasingly inadequate. Some systems designed for a single family are overburdened with multiple-family use, and septic system failure is an increasingly serious problem. Today, many Tortolan communities continue to experience such failures, with overflowing septic systems discharged on surfaces as open sewers. The island's main public sewerage facility does not treat sewage; instead raw sewage is pumped directly out to sea at Slaney Point on Tortola's southern coast (see Section 7.2.1.1, Chapter 7). The consequences of these faecal coliform concentrations are a serious health concern to those exposed, particularly where septic system failure is near bathing waters.

Government responded by initiating wastewater collection and treatment projects where population density is greatest and the need most urgent. A treatment plant was built at the airport during the airport expansion project in 2000, and both Road Town and East End have such projects currently underway (see also Section 7.2.1.2, Chapter 7).

The minimal use of holding tanks on boats in the BVI has been an ongoing concern. Vessels are not required to use holding tanks, and most charter yachts dispose waste directly into the sea. Many charter companies intentionally lock the tanks closed so they are not used and thereby reduce mechanical problems with blockage. The lack of adequate legislation and a means to dispose of holding tank contents has meant the problem continues to go unaddressed. Although there are a few pump-out stations, *e.g*., one at Nanny Cay, the amount of sewage pumped out at these stations is unknown. Government has been considering legislation to regulate discharges by vessels in BVI waters and to ensure that landside facilities are in place to handle vessel waste, but, as of this writing, such legislation has not been introduced.

The impacts of human sewage have been specifically identified as the cause of at least one coral disease, white pox disease in Elkhorn Corals (*Acropora palmata*) (Sutherland, *et al*., 2011). In addition, sewage contributes to algal blooms. In February 1997, Cane Garden Bay experienced a highly noticeable (due to its bright green colour) algal bloom that was tested and identified as directly linked to high levels of the bacteria E. coli, a common water quality indicator for sewage. This subsequently prompted development of the territory's first publicly operated sewage treatment plant in Cane Garden in 1999. Since the economy of Cane Garden Bay depends on tourism, water quality is a serious concern for the business community.

5.2.1.3 Use of Toxic Materials and Oil Spills

The only major industrial activity that emits or discharges toxic materials is the incinerator at Pockwood Pond, which can impact the marine environment from runoff or seepage. However, the accumulative impact of localised uses of toxic materials is far more damaging than what most Tortolans assume. For example, O'Neal, *et al*. (2011) found in areas of elevated boat activity—such as Road Harbour, Nanny Cay and Trellis Bay—a relationship between the concentration of tributyltin (TBT), often used in anti-fouling paint, and the severity of imposex in the tissues of queen conch (*Strombus gigas*). Imposex is an abnormality in gastropods which causes both male and female reproductive organs to exist on a single organism.

The use of cleaning agents, oils, and anti-fouling paints near to the coast, as well as activities such as fibreglassing or sanding vessels, all contribute to concentrations of elements such as (but not limited to) lead, arsenic, cadmium, mercury, nickel, aluminum and copper. These elements will never breakdown and disappear and can be absorbed by the tissues of humans, marine organisms and carbonate sediments. Since the BVI does not have an official listing of prohibited chemicals or activities, such as in the US and Europe, Tortola's boatyards continue to use these toxic chemicals. While some marinas, such as Nanny Cay, have been working towards best management practices, many boatyards would likely fail any testing for toxic chemicals within the ground soils of their properties.

Oil spills have also contributed to the deterioration of water quality in localised areas. Reyes (2003) reported that 91 percent of land-based oil spills in the BVI had occurred within 300 m (984 ft) of the high water mark (**Photo 87**), and of those spills in the marine environment, 83 percent were within 300 m of the high water mark. The study demonstrates that the majority of BVI oil spills have been concentrated near the coastline where critical habitats are concentrated; for those based on land, the potential of spills reaching the marine environment was high. Given this evidence, the need for modernised legislation to control pollution in the marine environment is obvious. Updated laws should include consistent and uniform procedures for reporting and monitoring oil and other toxic materials spills, as well as provisions that ensure the costs of clean-up and environmental damages are borne by the polluter.

Photo 87.
Oil spill in Pockwood Pond, 2008.

5.2.1.4 Site Specific Examples

As the largest population centre in the territory, Road Town has experienced the most significant water quality issues. After even a moderate amount of rain, the bay discolours with sediments, while trash and debris washed from the ghuts are visible floating in the harbour. Unfortunately, the impacts on the benthic flora and fauna, although likely severe, are not visible from the surface.

Given the size of the watershed, pollutants associated with domestic waste water are substantial. The hillsides surrounding Road Harbour contain many residences with septic systems. Drain fields associated with these systems will concentrate nitrogen compounds and various organic materials. During extended dry periods, water evaporates and the nutrients will be concentrated in the ground with incomplete decomposition. Thus, when heavy rains saturate the ground, these nutrients will be washed into the sea with potentially devastating consequences for marine life (**Photo 88**).

Photo 88.
Road Harbour algal bloom in 2010 caused by excessive amounts of sewage within a marina.

The water quality in Sea Cow's Bay has gradually deteriorated. Once surrounded by a mangrove fringe that acted as a natural filter, the shoreline now lacks this protective fringe. Development has paralleled the growth of the population. Numerous small-scale reclamation projects have degraded or completely covered most of the mangroves, with development encroaching into the bay at a number of locations. The watershed is large, and, following heavy rains, sediment, debris and invisible nutrients are washed into the bay with negative consequences for the marine environment.

Reduced water quality has been measured at the Nanny Cay Marina, just down-current of Sea Cow's Bay (Econcerns, 2011). The sediment plumes washing out of the bay can be seen along the entire south coast of Tortola, with negative impacts on all nearshore habitats within this zone of influence.

5.2.2 Overfishing

The inconstancy of data for recreational and commercial landings, coupled with inadequate stock assessments and a lack of fishery-associated habitat data, means that the extent of overfishing is not known. Nevertheless, the BVI's fishery resources are considered overexploited, and all commercially important species are overfished (Newton, *et al.,* 2007). The British Virgin Islands 1998 Fisheries Management Plan specifically targets overfishing in nearshore and shallow banks as well as overfishing of conch and lobster. Additionally, loss of parrotfish from overfishing is known to significantly contribute to the decline of coral reef habitats (Jackson, *et al.,* 2014).

Photo 89.
A lost and abandoned fish trap, also known as ghost traps.

One of the contributors to overfishing in BVI waters is illegal fishing, especially because of the close proximity of the USVI and limited resources for enforcement of BVI laws. The presence of foreign boats in territorial waters has always affected the commercial fishermen, where the main problem has been not only the large number of foreign fishing boats arriving to fish, but also that the fish catch are not landed at the BVI Fishing Complex (Pomeroy, 1999).

The trap fishery is also a contributor to overfishing in several ways. Lost traps (known as ghost traps) continue to catch fish even when abandoned, particularly if they lack the required biodegradable panel (**Photo 89**). Although there are no estimates of the total number of ghost traps currently existing in BVI waters, an estimated 4,000 traps were lost in in a single year, 1998, most during hurricane Georges (Pomeroy, 1999). Traps are also lost when markers are cut off by passing vessels.

Traps are not inspected for the biodegradable panel during the licensing process, and the total number of traps per fisher is not currently regulated. Additionally, traps are known to be set by fishers from the USVI around neighbouring BVI islands such as Great Thatch and Norman Island.

Although regulations like licensing, registration, closed seasons and protected areas are meant to help manage overfishing, better catch data and improved monitoring of stocks is still very much needed. Without an understanding of the extent of fishing in the BVI, fishery management plans will remain ineffective and the development of fisheries as a major economic pillar may not be sustainable.

5.2.3 Coastal Development Trends

Development in Tortola, and in the BVI archipelago, is a post-World War II phenomenon. The BVI economy was based on subsistence fishing and farming prior to the 1960s, with few opportunities for the economy to raise the standard of living. The Virgin Islands Hotels Aid Ordinance (1953) provided incentive for foreign investors to help develop the tourism industry, which was first manifested with the construction of the BVI's first major luxury hotel, Laurance Rockefeller's Little Dix Bay Resort, opening on Virgin Gorda in 1964. The Rockefeller project represented an historical change in economic thinking. During subsequent decades marked by intense growth, a paradigm shift occurred as the territory moved away from economic strategies to preserve natural resources for local subsistence toward exploitation of natural resources for economic gain. And the natural resources that were to be "exploited" for economic benefit were primarily those located in the coastal and marine environments of the BVI.

5.2.3.1 Development of Resorts and Hotels

Following Rockefeller's initiative in Virgin Gorda, smaller hotels and resorts were developed in and around Tortola in the 1960s, such as the Peter Island Resort to the south of Road Harbour and the Long Bay Beach Resort on Tortola's north coast. In the 1970s, the Prospect Reef Resort was developed along the southern coast of Tortola.

Additionally, the Wickham's Cay I development reclaimed approximately 28 hectares (69 acres) of land in Road Harbour to assist in accommodating a growing tourism-oriented economy (see also Section 1.2.3.2 of Chapter 1). With newly available shorefront land, the Village Cay Hotel and Marina was developed in 1974 to accommodate a growing yacht charter industry.

In the years to follow, small hotel development continued but slowed during the late 1980s and 1990s, due in part to the global economic recession. Nevertheless, the Lambert Beach Resort was completed in 1997, and in 2005 ground broke for the Scrub Island development offshore of the airport on the island's eastern end.

All of these developments, and their related infrastructure, were located along Tortola's once undeveloped coastline. In turn, this trend toward coastal development in support of tourism created a variety of separate, but related, environmental issues, all resulting from the physical transformation of the coastline.

5.2.3.2 Development of the Yachting Industry

In 1969, the BVI's yacht chartering industry commenced in Tortola with the start-up of two companies, Caribbean Sailing Yachts and The Moorings. This marked the beginning of an industry that would eventually result in the greatest concentration of charter yachts in the world (Spalding, *et al.*, 2007).

As the yachting sector of the territory's tourism product expanded, the BVI eventually emerged as a world centre for visitors wanting to charter a yacht. The climate and topography of the archipelago facilitated development of the industry, which also required development of marinas, related services, and recreational amenities. Such development placed increasing pressure on coastal wetlands; virtually all the sheltered bays on the south coast of Tortola have been impacted.

In 1980, a report on the BVI pleasure boat industry (Jackson, 1980) detailed the growth of the industry since its beginnings in 1969 by Caribbean Sailing Yachts and The Moorings. Jackson reported that the two companies collectively had a total of 31 bareboat yachts available for chartering. By 1980, there were 12 charter companies and 320 yachts in the BVI. During the same time period, the crewed yacht sector had grown to a total of 45 crewed yachts. In the USVI, there were 190 crewed yachts and nearly 2,000 more boats (of all vessel types) registered in the USVI than in the BVI (Cohen, 2010). With a growing industry, Jackson identified emerging concerns regarding the carrying capacity of boats in BVI waters and recognised the need for governmental regulations to ensure protection of the environment along with promotion of sustainable economic growth.

In 1993 the USVI implemented the Passenger Vehicle Safety Act, which limited the number of paying passengers that could be carried aboard uninspected vessels that were less than 100 tons in size. When the law was put in place, the USVI lost a majority of its yachts, along with millions of dollars in revenue, to the BVI, which had less stringent inspection standards. The loss for the USVI was a major gain for the BVI.

On Tortola's southern coast, between West End and Beef Island, there are at least eight different locations and bays where yacht-centred development has occurred. Most locations have several marinas or services catering to recreational boating. Tortola provides the marinas, dockage, and essential services for yachting tourism, a sector on which all of the territory depends. The result has been that no wetlands on the south coast of Tortola are intact and free of negative environmental consequences. Most wetlands are completely developed or degraded, and they barely functionl ecologically (see also "Wetlands" in Section 1.1.3 of Chapter 1).

Today the BVI boasts a total of 12 charter companies with nearly 800 yachts and approximately 110 crewed yachts. However, with the recent enactment of what is called the "6-pack" bill in the USVI, which would allow charters in the USVI carrying up to 12 passengers to be exempt from stringent U.S. Coast Guard inspections, the question has been raised as to whether BVI-crewed yachts and charter companies will remain in the BVI, especially when ancillary services (such as provisioning) are less expensive in the neighbouring US Virgin Islands and direct travel to St. Thomas is much easier than to Tortola.

5.2.3.3 Development of Cruise Tourism

In 1960, the first cruise ship arrived in Tortola, but it was not until 1994 that a cruise ship pier would be developed in Road Harbour to accommodate a small but growing industry. Cohen (2010) identified that 73 percent of total visitors to the BVI in 1994 were yacht charterers or other overnight visitors and 20 percent from cruise ships, with the remaining 7 percent day trippers from the USVI. By 2003, cruise ship visitors outnumbered charter yachts and other overnight visitors, 46 percent to 44 percent, respectively.

Since 2000, the cruise ship sector has led the tourism industry in terms of tourist arrivals (**Figure 33**) followed by the charter yacht and hotel sectors. However, cruise ship tourism has always generated the lowest tourist expenditure rate (**Figure 34**), while the yachting and hotel sectors have provided the highest visitor expenditures (DPU, 2007).

One of the biggest threats to the natural environment from cruise tourism is that it brings a large volume of people—sometimes 2,000+ visitors per day—to the beaches of Tortola (**Photo 90**). Overcrowding, increased garbage, unregulated beach vendors and low per-visitor expenditures at local bars and restaurants are but a few of the concerns that have been articulated since cruise tourism has increased, particularly at Cane Garden Bay.

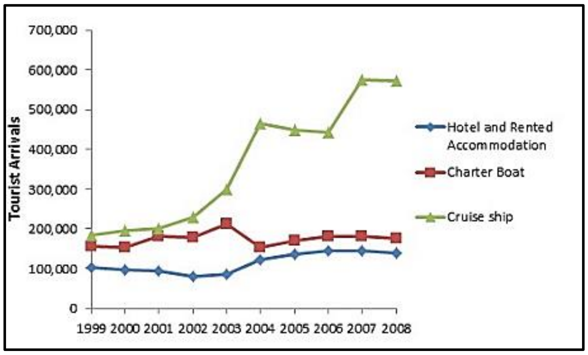


Figure 33.
Growth in BVI tourist arrivals, 1999-2008.
Numbers for 2004 forward are estimates (source: DPU, 2009).

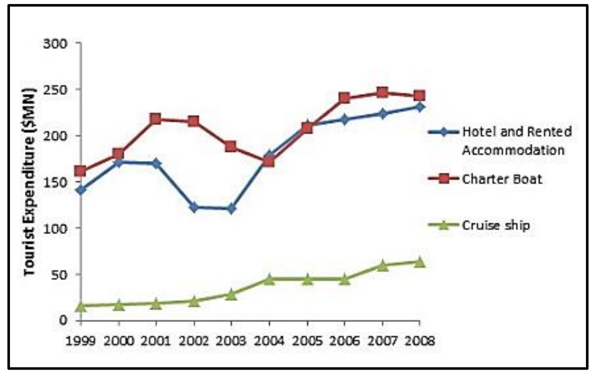


Figure 34.
Growth in BVI tourist expenditures, 1999-2008.
Numbers for 2004 forward are estimates (source: DPU, 2009).

Photo 90.
As many as four cruise ships may port in Road Town.

In 2011, the Department of Conservation and Fisheries carried out a series of stakeholder meetings in Cane Garden Bay designed to improve understanding of the issues surrounding cruise tourism and to assist the Department in preparing a beach management strategy. However, the resulting Framework for Beach Management in the Virgin Islands (Gore, 2013a and b) has not yet been implemented. With a lengthened and widened cruise ship pier scheduled to be completed in Road Town in 2015, designed to accommodate larger vessels (up to 4,000+ passengers per ship), the need for beach management is even more crucial to ensure the future sustainability of Tortola's beach resources and amenities.

5.2.3.4 Twenty-first Century Development

In 1984, the International Business Companies Act was put in force, a forward-looking piece of legislation that offered tax and asset protection for offshore financial businesses. It introduced a new economic engine that, along with tourism, is currently a significant driver of the territory's contemporary economy (see also Section 1.2.3.3 in Chapter 1). As the economy expanded in the 1980s and 1990s and into the twenty-first century, the population also grew, with immigration expanding the work force (see Section 1.2.1, Chapter 1) and subsequently creating more demand for housing, roads, and a variety of services for residents.

With perhaps too little time and experience to effectively manage growth, development in the territory has surged forward, relatively unchecked. This phenomena has been most evident on the island of Tortola. In time, however, attitudes have shifted as the Government and community alike have begun to recognise the social and environmental costs of unrestrained growth. (See the introduction to Chapter 2, Section 2.1.)

Since the territory lacks zoning or a comprehensive physical development plan, it has largely been left to the Department of Town and Country Planning to manage the development process, which was strengthened through enactment of the Physical Planning Act in 2004 (See Chapter 2, Sections 2.2.2.4, 2.2.3.2, and 2.2.4.5). Large development projects, which are mostly located in the coastal zone, now require an environmental impact assessment, a process that includes evaluation of proposed developments by several government agencies. Public hearings are also required for projects that are likely to result in substantial environmental impacts, particularly to the coastal and marine environment. Overall, a process in now in place that should, if properly implemented, encourage continued development and economic expansion without compromising the integrity of the BVI's natural resources and the well-being of the community.

However, despite the fact that tourism in the BVI is largely based on a healthy coastal and marine environment, corresponding legislation to protect and manage these resources has not kept pace with the scope of physical development. As detailed in Section 2.2.3 of Chapter 2, the BVI can boast a modern and comprehensive Physical Planning Act (although it still lacks regulations) and National Parks Act. But there is only limited legal authority for protecting critical ecosystems or habitats that lie outside of the boundaries of formally protected areas. Furthermore, there is no legislated authority for managing the coastal zone. These oversights may be integrated within comprehensive environmental management legislation, which has been under discussion since 2008 (see Section 2.2.3.6, Chapter 2).

The growth of tourism has stimulated exploitation of the valuable resources supporting the tourism sector, particularly in the coastal and marine environment. Resort tourism has focused on development around white sandy beaches, while the physical infrastructure (marinas and boatyards) for yacht chartering has required flat coastal lands that were once fringed with mangroves. Such development has resulted in disproportional impacts on the shoreline and adjacent marine habitats.

Fragmentation of critical coastal habitats is perhaps the most significant impact from tourism development. The loss of wetland habitats (salt ponds and mangroves) has been a catalyst for deterioration of nearshore habitats such as coral reefs and seagrass beds. During intense development at the close of the twentieth century, these essential habitats were too often regarded as land to be used for additional coastal development. With new roads being cut and land cleared on hillsides, extraneous material was often dumped in wetlands to increase available land. The connectivity between storm water flowing from hillsides, increasingly unfiltered by destroyed wetlands, would not be realised until coastal communities were flooded during periods of heavy rainfall, sometimes years later.

The loss of mangroves and salt ponds has also affected fauna that depend on coastal habitats. The most visible are the birds—both residents and migrants—that feed, nest, or find shelter in coastal systems. In particular, migrating ducks and shorebirds depend on wetlands along their route where they can stop, rest, and refuel. As the wetlands gradually disappear, the impacts on migrants can be severe with increased mortality. Evidence may be found in historical bird records where species once common in the BVI are now rare or non-existent.

Today, these impacts are most prevalent in Cane Garden Bay (**Figure 35**). The loss of adjacent wetlands has resulted in heavy sedimentation in the bay, which has further deteriorated the coral reef fronting the beach. As the reef continues to lose its structure and ability to act as a protective barrier from incoming waves, the chain of events that started with the infilling of wetlands years ago will most likely eventually degrade and even destroy the beach—the very reason why people visit Cane Garden Bay today.

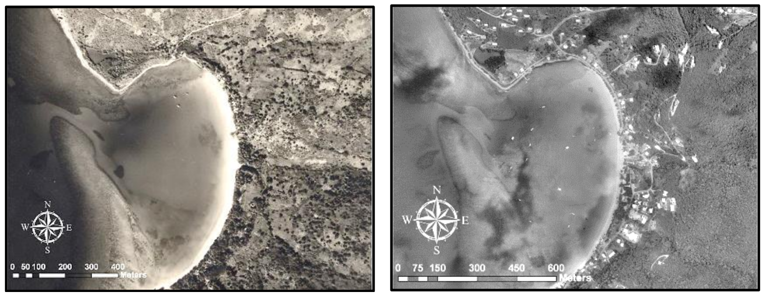


Figure 35.
Images of Cane Garden Bay, 1953 (l) and 2002 (r), showing development over a 50-year period (*source*: BVI Survey Department).

Issues, Conflicts, and Areas of Concern	Impacts of No Action/No Change	Short-term Options Long-term Recommendations
ISSUE ONE **Limited monitoring of the fishery resource and associated habitats** The current Fisheries Priority and Fishery Protected Areas have little baseline data to support their designations and are not monitored on a consistent basis. Additionally, there are no management plans for any of the areas.	Continued lack of data on fish species abundance and associated habitat health diminishes the likelihood of sound management practices to ensure the future sustainability of the fisheries.	**SHORT-TERM OPTIONS** **1.** The development of a simple and relatively inexpensive, territory-wide habitat monitoring protocol should be determined and approved by public sector reef managers. Minimum requirements (based on findings from Jackson *et al*., 2014) should include: - Percent coral and macro-algae coverage, - Abundance and biomass of parrot fishes and sea urchins, - Amount of coral recruitment (<4 cm), - Amount of coral disease, - Water quality (at a minimum, employing the use of a Secchi disk). **2.** The format of fishermen logbooks (commercial) and data forms (pleasure and sport) needs to be updated to include more detailed data not previously required. This is necessary for data to be easily entered into the National Geographic Information System (NGIS). Basic information should include: - Catch data (species, location caught, size/weight, total amount landed and where landed); - Type of extraction methods used (traps, hook and line, etc.); and - Profile of fishers (type of licence, size and type of boat used, nationality, age, time spent fishing). **3.** The lack of technical and financial resources is the primary reason monitoring has not been consistent. Seeking assistance outside of Government and developing partnerships with universities, non-profit organisations or even private businesses will better ensure monitoring is maintained and capacity is enhanced. **LONG-TERM RECOMMENDATIONS** **1.** Management plans for Fisheries Priority Areas and Fisheries Protected Areas need to be developed, focusing on existing conditions. **2.** Implementation of monitoring protocols is needed on a regular basis, and this should be a high priority of the Department of Conservation and Fisheries. **3.** Management plans, as well as monitoring protocols, need to be regularly reviewed and assessed for effectiveness.

Issues, Conflicts, and Areas of Concern	Impacts of No Action/No Change	Short-term Options Long-term Recommendations
ISSUE TWO **Need to strengthen fishery regulations to reduce illegal overfishing** Overfishing is often due to illegal fishing activity from foreign vessels. The vast area of BVI territorial waters and the close proximity between the BVI and USVI make it fairly easy to fish illegally in BVI waters without being prosecuted. Additionally, BVI pleasure and sport fishing licenses are often obtained by visitors, but the vessel from which such visitors are fishing is not registered.	Weak regulations for the BVI's fisheries sector will continue to result in reduced accuracy of catch data and ultimately poor sustainable management of a species. There will also be a loss of Government revenue from unregistered fishing boats.	**SHORT-TERM OPTIONS** **1.** Any visitors on a chartered yacht (bareboat without a hired captain) who have obtained a temporary pleasure fishing licence should be required to provide their catch data to the charter company. In turn, charter companies should obtain a temporary fishing vessel registration certificate that is valid for all vessels in their fleets. **2.** For commercial fishers, logbooks need to be carefully reviewed and signed by an authorised Fishery Officer when fish catches are landed. If the logbooks do not have authorised signatures or are not submitted at all during the renewal process, the fishing licence should not be renewed. **3.** For sport or pleasure fishers, lack of data forms should also be a cause for non-renewal of a licence or a fine could be executed. **LONG-TERM RECOMMENDATIONS** **1.** The total number of traps used in the fishery needs to be reduced per fisher to a maximum allowable number that can be registered by any commercially licensed fisherman. **2.** Implementation of "trap identification tags" on all registered traps would provide a clear indication of ownership. Any traps without official tags could be removed from BVI waters (or destroyed). Additionally, registration of tagged traps should be inspected each year, and loss of any traps should result in a fine. **3.** The process for fishing vessel registration for charter companies should be streamlined with an option to purchase, at a discounted rate, an annual certificate of registration for all company vessels to comply with BVI Fisheries Regulations. Catch data should still be required, and failure to supply data to DCF would "black-list" a charter vessel within a fleet.

Issues, Conflicts, and Areas of Concern	Impacts of No Action/No Change	Short-term Options Long-term Recommendations
ISSUE THREE **Outdated, fragmented or non-existent legislation for the protection of coral reefs, seagrass beds, beaches and mangroves** Much of the legislative base for the protection of coastal and marine resources dates to the 1950s or earlier. Even more recent legislation does not fully reflect advancement of scientific knowledge or recognise current best management practices.	Lack of adequate legal protection for these critical resources will ensure continued environmental degradation by: - reducing marine productivity, - reducing shoreline protection, - reducing nearshore water quality, - reducing the availability of storm shelters for boats, - increasing coastal erosion, and, - increasing sediment runoff to coastal environments.	**SHORT-TERM OPTIONS** **1.** Government should give priority attention to initiating a comprehensive review of extant legislation for the protection of marine resources, some of which is outdated (*e.g.*, Beach Protection Act of 1985) or does not protect resources outside of the boundaries of designated protected areas. Of particular importance is the current drafting of a comprehensive environmental management law, which could encompass protection for coastal and marine resources under its legislative framework. It is important that proposed legislation be ecosystem-based to ensure connectivity is maintained between species and habitats. **2.** See also Issues Table in Chapter 2, Issue One, Short-term Options. **LONG-TERM RECOMMENDATIONS** **1.** Government should consider a five-year review of legislation protecting critical coastal and marine species, to ensure that advancement in scientific knowledge, climate change, and regional/international laws are embodied in Virgin Islands laws. **2.** See also Issues Table in Chapter 2, Issue One, Long-term Recommendations.
ISSUE FOUR **Vessel Impact on the Marine Environment—influenced by limited data on the BVI's yacht charter industry** With the increase in the size of the BVI yachting fleet, damage to coral reefs and seagrass beds by vessel anchors and chains is also increasing. Additionally, damage to reefs and seagrasses from fish traps, seines, and other fishing gear continues to occur. Smaller vessels and power boats damage seagrasses with prop scars when they run aground, especially near the shore. *(continued)*	Continued anchoring by boats in sensitive environments will degrade marine resources and make them less productive while also reducing the important ecosystem services they provide. The problem is likely to worsen as larger yachts, particular mega-yachts, become more common. The dimension of increases in numbers and size of yachts in the BVI has not been contemporarily studied or linked to a clear understanding of moorings requirements. *(continued)*	**SHORT-TERM OPTIONS** **1.** Government needs to consider development of a vessel grounding policy, which, among other things, identifies a chain of command when a grounding occurs and a communication strategy that covers the event from the initial incident through prosecution. **2.** Additional moorings should be placed in popular anchorages and dive destinations to reduce the need for anchoring. **3.** Additional educational efforts by the marine industry and the BVI Government (*e.g.*, Tourist Board, DCF, and NPT) need to be implemented to inform boaters about proper anchoring techniques, including no anchoring in coral areas. **4.** Fishermen should be encouraged to avoid placing traps and nets directly onto coral reefs. *(continued)*

Issues, Conflicts, and Areas of Concern	Impacts of No Action/No Change	Short-term Options Long-term Recommendations
Numerous groundings have occurred in the waters around Tortola and its sister islands. Most have not resulted in legal action, primarily due to limited maritime law expertise within Government and a lack of adequate communication between the marine industry (vessel operators, charter companies, salvage companies, etc.) and the applicable agencies of Government. The yacht charter sector of the BVI's tourism product was last assessed in 1981. Today, neither the industry nor Government has accurate or contemporary data to fully understand vessel carrying capacity as it relates to the maintenance of a healthy marine environment.	Without a better understanding of the yacht charter sector and its requirements, damage to the sea floor from unregulated, anchored vessels will continue to occur.	**5.** Improved navigational aids should be installed in areas frequented by visiting boaters. **LONG-TERM RECOMMENDATIONS** **1.** The 1981 study of the BVI's yachting industry (Jackson, 1981) needs to be updated, perhaps as a joint effort by Government and the marine industry. **2.** A BVI anchoring plan needs to be put in place to designate both safe anchorages and no-anchor zones. **3.** Moorings for larger vessels and mega-yachts should be installed at popular recreational sites. **4.** Sensitive reef areas should be identified and declared "no fishing zones" to reduce coral damage from traps. **5.** A change needs to be implemented relative to the limit of liability provisions under the territory's Merchant Shipping Act (2004) to reflect UK legislation that increases the limit of liability for damages caused by vessels in BVI waters from $250,000 to $1.5 million, and allows for unlimited liability for negligence, toxic substance spillages, impacting species identified as threatened under IUCN criteria, or damages within an area legally defined as protected. The BVI law profession needs training in maritime law as it relates to vessel groundings.
ISSUE FIVE **Diminishing Water Quality** Decreasing coastal water quality in Tortola results, in part, from the lack of adequate pollution control legislation, standards, and legal definitions for dangerous and harmful pollutants. Additionally, Tortola has long tolerated land-based development activities that result in the pollution of coastal waters. Insufficient attention is paid to implementing and monitoring best management practices for land development. *(continued)*	Without changes in the territory's pollution control legislation, regulations, standards and practices—including long-term monitoring of coastal areas—pollutants will continue to degrade coastal water quality. Unrestrained land development practices will continue to result in erosion and uncontrolled sediment runoff into nearshore marine environments. Sediments and pollutants in nearshore habitats will increase disease rates and mortality in coral and other marine life. *(continued)*	**SHORT-TERM OPTIONS** **1.** Erosion and sediment control guidelines need to be approved and implemented for the BVI. Such guidelines can draw upon the expert guidance already available in published documents such as Gore and Leoniak, 2013 (for the BVI); University of the Virgin Islands, 2002, a/b (for the USVI); and Anderson, 1994 (for the Caribbean). **2.** Yachts in BVI waters should be required to use holding tanks. Discharge should not be permitted in sheltered bays, critical marine habitats, and other sensitive nearshore environments. This might best be accomplished if Government would designate "no discharge" areas and provide pump-out facilities and treatment. **3.** All "earth-moving" development activities should be required to submit an erosion prevention plan (not simply a drainage plan) as part of the development approval process. *(continued)*

Issues, Conflicts, and Areas of Concern	Impacts of No Action/No Change	Short-term Options Long-term Recommendations
Water quality standards from the World Health Organisation and the US Environmental Protection Agency are used in the BVI as general guidelines but do not have the force of law.	Localised risks to human health could also result. Water quality testing at beaches in the neighbouring USVI is carried out at regular intervals. Seven beaches were recently closed following heavy rains (*Virgin Islands Daily News*, 21 February 2015). The beaches were found to be unsafe for swimming and fishing. Regular testing in the BVI might yield comparable results.	**4.** More effective monitoring of development projects is required, including issuance of "stop work" orders when evidence of erosion, sedimentation or water pollution is observed. **LONG-TERM RECOMMENDATIONS** **1.** See Issues Table for Chapter 7, Issues 7, 8, and 9. **2.** As discussed in Section 2.2.3.7, Chapter 2, the BVI's environmental pollution legislation needs major revision and modernisation in the BVI. Enforceable standards for water quality, pollution control, and waste management are required. **3.** More stringent penalties need to be available to authorities to fine development projects that cause visible erosion, sedimentation or pollution in coastal waters. Perhaps such penalties could be included as part of the forthcoming Regulations to the Physical Planning Act. **4.** A water quality monitoring programme, perhaps under the framework of the proposed beach management strategy (see Section 2.2.4.10 of Chapter 2), needs to be put in place in the BVI. Results from monitoring and water quality analysis need to be publicly posted at popular BVI beaches.
ISSUE SIX **Inadequate Planning for Beach Resources** Development in the coastal areas of Tortola, especially for tourism infrastructure and tourism amenities, has potential for habitat loss along the island's beaches. This risk is increased because the territory lacks a comprehensive management plan for its beach resources, which comprise one of the BVI's most important assets for tourism. Holistic planning is required to address the environmental, social, and economic issues that can threaten the very resource that brings visitors to the BVI.	With the loss of associated wetlands, coupled with increased coastal development of tourism infrastructure and cruise ship tourism, the risk of unsustainable environmental and socioeconomic conditions within a beach community will be increased.	**SHORT-TERM OPTIONS** **1.** The Framework for Beach Management, created by the Department of Conservation and Fisheries (Gore 2013, a/b), needs to be reviewed within Government and by the public. The policy requires Government approval and implementation. **2.** A pilot project using the beach management strategy could be implemented for at least one beach community, probably Cane Garden Bay. **LONG-TERM RECOMMENDATIONS** **1.** The Beach Protection Act (1985) needs to be updated and modernised. A draft has been prepared by the DCF and should receive early consideration by Government. **2.** Resorts on Tortola and its sister islands should be encouraged, and perhaps required, to develop site-specific beach management plans, *e.g.*, at Lambert, Nanny Cay, Long Bay, Cooper Island, Peter Island.

6. HISTORICAL HERITAGE RESOURCES[6]

6.1 Sites and Monuments Registry

In February of 2003, Dr. Michael Kent, of the Virgin Islands Studies Institute at H. Lavity Stoutt Community College, and Nancy Woodfield Pascoe, of the National Parks Trust, presented a public lecture for the Rotary Club of Tortola. On this occasion, the two introduced a sites and monuments recording form, which was designed to be completed by volunteers visiting historic sites on the island of Tortola. Subsequently, over a two-year period, members of the Rotary Club—in collaboration with the HLSCC, the NPT, and the DCF, began visiting sites and recording their features for compilation of a Sites and Monuments Registry. Ultimately, over 100 sites were inventoried and mapped for the Registry (see **Table 38** and **Figures 36** and **37**).

Since the initial survey work, the Registry has been maintained by the National Parks Trust, where data is stored and shared among government agencies (such as the Department of Town and Country Planning); upon request, the NPT also provides data from the Registry to others interested in the project. The Trust maintains a GIS layer for sites in the Registry for integration in the National Geographic Information System.

The Registry comprises a one-page checklist for each site with data stored within four broad categories:

(1) Location of Site;
(2) Historic Use;
(3) Type of Site, and
(4) Current Status.

For this chapter of the *Tortola Environmental Profile*, six sites have been selected from the larger inventory for more detailed focus.

It may appear that some of Tortola's more significant historic sites have been omitted from the discussion. However, a number of such sites are already being utilised by their owners or fall under the jurisdiction of a committee or organisation charged with their curatorial protection. Examples of private ownership include:

- The Josiah's Bay Sugar Works
- The Callwood Rum Distillery
- Fort Recovery Hotel
- The Sugar Mill Hotel and Restaurant
- The 1748 Long Bay Restaurant.

Likewise, the Old Government House Museum, which is operated by a board nominated by the Governor and approved by Cabinet, and St. Phillips Church, which is being restored by the Association for the Preservation of Virgin Islands Heritage (see Chapter 2, Section 2.3.2), have not been highlighted on the basis that they are safeguarded by recognised custodial bodies.

The following sites have been selected because of their potential as heritage parks, keeping in mind that the British Virgin Islands will need to continue to develop its tourism product while also safeguarding Virgin Islands heritage for future generations. All of these sites are either on private land or Crown Land and presently have not been developed as heritage parks or heritage sites. The six sites highlighted (see **Figures 36** and **37**) are:

1. Fort Charlotte
2. Fort Purcell
3. Cooten's Bay Plantation Complex
4. Brewer's Bay Sugar Works
5. Her Majesty's Prison on Main Street
6. The Old Administration Building

[6] The author of Chapter Six is Dr. Michael D. Kent.

Table 38.
Tortola's Historic Sites as recorded on the Sites and Monuments Registry.

#	Name of Site	Location	Historic Use	Current Status	Overall Condition
1.	**Apple Bay Boiling House**	Apple Bay	Estate/Plantation	Occupied/Inhabited	Good
2.	**Gate House**	Apple Bay	Estate/Plantation	Ruin/Abandoned	Fair
3.	**Great House**	Apple Bay	Estate/Plantation	Ruin/Abandoned	Poor
4.	**Mill Round (Sugar Mill Hotel)**	Apple Bay	Estate/Plantation	Occupied/Inhabited	Good
5.	**Sugar Mill (Smith Residence)**	Apple Bay	Estate/Plantation	Occupied/Inhabited	Good
6.	**Arundel Great House**	Arundel	Estate/Plantation	Ruin/Abandoned	Poor
7.	**Will Robertson Boiler House**	Ballast Bay	Estate/Plantation	Ruin/Abandoned	Fair
8.	**Will Robertson Store House**	Ballast Bay	Estate/Plantation	Ruin/Abandoned	Poor
9.	**St. Michael's Anglican Church**	Ballast Bay, Windy Hill	Place of Worship	Ruin/Abandoned	Fair
10.	**Quaker Burial Ground**	Bar Bay	Religious		Poor
11.	**Belmont Plantation Sugar Works**	Belmont	Estate/Plantation	Ruin/Abandoned	Fair
12.	**Amerindian Ball Court**	Belmont	Village	Archaeological Site	Poor
13.	**Belmont Estate House**	Belmont	Estate/Plantation	Ruin/Abandoned	Good
14.	**Belmont Plantation**	Belmont	Estate/Plantation	Ruin/Abandoned	Fair
15.	**Belmont Plantation Boiler Room**	Belmont	Estate/Plantation	Ruin/Abandoned	Fair
16.	**Belmont Plantation Cistern**	Belmont	Estate/Plantation	Ruin/Abandoned	Fair
17.	**Belmont Plantation Store Room**	Belmont	Estate/Plantation	Ruin/Abandoned	Fair
18.	**Belmont Plantation, Part of Great House**	Belmont	Estate/Plantation		Good
19.	**Watts' Ruin, Belmont Plantation**	Belmont	Agricultural Production	Ruin/Abandoned	
20.	**Brewer's Bay Cattle Dip**	Brewer's Bay	Place of Production	Ruin/Abandoned	Good
21.	**Brewer's Bay Mill**	Brewer's Bay	Estate/Plantation	Ruin/Abandoned	Good
22.	**Martin Sugar Plantation and House**	Brewer's Bay	Estate/Plantation	Ruin/Abandoned	Fair
23.	**New Bush**	Brewer's Bay	Estate/Plantation		Good
24.	**Callwood's Distillery, Boiler Room**	Cane Garden Bay	Estate/Plantation	Occupied/Inhabited	Good
25.	**Callwood's Distillery, Mill Round**	Cane Garden Bay	Estate/Plantation	Ruin/Abandoned	Good
26.	**Callwood's Distillery, Well**	Cane Garden Bay	Estate/Plantation	Ruin/Abandoned	Good
27.	**Cane Garden Bay Methodist Church**	Cane Garden Bay	Place of Worship	Occupied/Inhabited	Good
28.	**Cannon Point Battery**	Cane Garden Bay	Fortification	Ruin/Abandoned	
29.	**Hodge's Family Sugar Works**	Cane Garden Bay	Estate/Plantation	Ruin/Abandoned	Good
30.	**Hodge's Plantation (Ole Works Inn)**	Cane Garden Bay	Estate/Plantation	Ruins reused as Inn	Fair
31.	**Shannon's Plantation**	Cane Garden Bay	Estate/Plantation	Ruin/Abandoned	Fair
32.	**Hetherington's Plantation**	Carrot Bay	Estate/Plantation	Ruin/Abandoned	Fair
33.	**Carrot Bay Boiler House**	Carrot Bay	Estate/Plantation		Fair
34.	**Carrot Bay Cistern**	Carrot Bay	Estate/Plantation		Good
35.	**Carrot Bay Gate House**	Carrot Bay	Estate/Plantation	Ruin/Abandoned	Poor
36.	**Carrot Bay Methodist Church**	Carrot Bay	Place of Worship	Occupied/Inhabited	Good
37.	**North Shore Road Building**	Carrot Bay	Estate/Plantation		
38.	**Fort Charlotte**	MacNamara Hill	Fortification	Ruin/Abandoned	

#	Name of Site	Location	Historic Use	Current Status	Overall Condition
39.	**East End Methodist Church**	East End	Place of Worship	Occupied/Inhabited	Good
40.	**The Hermitage**	East End	Place of Dwelling/Burial	Ruin/Abandoned	Good
41.	**Fort George**	Fort Hill	Fortification		
42.	**Quaker Meeting Place**	Greenland	Place of Worship	Ruin/Abandoned	Poor
43.	**Fort Chalwell**	Hannah's Estate	Fortification		
44.	**George Leonard Plantation**	Hawks Next	Estate/Plantation	Ruin/Abandoned	Fair
45.	**Fort Defiance**	Hogs Valley Point	Fortification		
46.	**Fort Shirley**	Jean Hill	Fortification		
47.	**Well**	Johnson's Ghut	Water Works		Fair
48.	**Isaac Pickering Estate/Plantation**	Josiah's Bay	Estate/Plantation	Occupied/Inhabited	Good
49.	**Todman Estate**	Little Apple Bay	Estate/Plantation		Fair
50.	**Todman Estate Boiler House**	Little Apple Bay	Estate/Plantation		Fair
51.	**Todman Estate Manager's House**	Little Apple Bay	Estate/Plantation	Ruin/Abandoned	Fair
52.	**McBean and Robertson Plantation**	Little Bay	Estate/Plantation	Ruin/Abandoned	Fair
53.	**Well**	Little Bay	Waterworks		Good
54.	**Long Look Methodist Church**	Long Look	Place of Worship	Occupied/Inhabited	Good
55.	**Fletcher Bay**	Luck Hill	Estate/Plantation	Ruin/Abandoned	Poor
56.	**Cuthbert Soper Grave and Headstone**	Mount Sage	Place of Burial	Ruin/Abandoned	
57.	**MacNamara Estate Plantation**	Mount Sage	Estate/Plantation	Ruins incorporated into modern dwelling	Poor
58.	**Tamarind Tree**	Mount Sage	Vegetation/Landscape		Good
59.	**Tower Fort, The Barracks**	Mount Sage	Place of Dwelling	Ruin/Abandoned	Poor
60.	**Well**	Mount Sage	Water Works	Habitation Informal	Good
61.	**Mt. Healthy Mill**	Mt. Healthy	Estate/Plantation	Ruin/Abandoned	Fair
62.	**William Thornton Estate**	Pleasant Valley		Ruin/Abandoned	Fair
63.	**Fort Purcell ("The Dungeon")**	Pockwood Pond	Fortification	Ruin/Abandoned	Good
64.	**Well**	Purcell	Water Works		Good
65.	**Fort Recovery**	Recovery	Fortification		
66.	**HMS Nymph**	Road Harbour	Shipwreck		Poor
67.	**Adina Donovan House (Nurse's Residence)**	Road Town	Place of Dwelling	Occupied/Inhabited	Good
68.	**Agricultural Experimental Station**	Road Town	Agricultural/Educational	Habitation Informal	Fair
69.	**Botanic Garden Well**	Road Town	Water Works	Occupied/Inhabited	Fair
70.	**Britannic Hall (Smiths Gore)**	Road Town	Place of Dwelling	Occupied/Inhabited	Good
71.	**Cholera Burial Site**	Road Town	Commemorative		
72.	**Cotton Ginnery (Lower Estate Museum)**	Road Town	Place of Production	Occupied/Inhabited	Good
73.	**De Castro's, #91 Main Street**	Road Town	Shop with Dwelling	Occupied/Inhabited	
74.	**Donovan's House, #55 Main Street**	Road Town	Place of Dwelling	Occupied/Inhabited	Good
75.	**Fireproof Building**	Road Town	Place of Commerce	Occupied/Inhabited	Good
76.	**Former Courtyard Coffee Shop**	Road Town	Place of Dwelling	Occupied/Inhabited	Good
77.	**Fort Burt**	Road Town	Fortification	Occupied/Inhabited	
78.	**Fort Leigh (Bougainvillea Clinic)**	Road Town	Fortification	Occupied/Inhabited	Good

#	Name of Site	Location	Historic Use	Current Status	Overall Condition
79.	**Georges House, #201 Main Street**	Road Town	Place of Dwelling		Good
80.	**Government House**	Road Town	Place of Dwelling/Civil	Occupied/Inhabited	Good
81.	**Guesthouse, #203 Main Street**	Road Town	Place of Dwelling	Occupied/Inhabited	Good
82.	**Harrigan House**	Road Town	Place of Dwelling		Fair
83.	**Her Majesty's Prison**	Road Town	Civil		Good
84.	**Hetherington House**	Road Town	Place of Dwelling	Ruin/Abandoned	Fair
85.	**J.R. O'Neal Ltd. Office**	Road Town	Shop with Dwelling	Occupied/Inhabited	Good
86.	**JEW Georges House**	Road Town	Place of Commerce	Occupied/Inhabited	Good
87.	**McKetney's House, #31 Main Street**	Road Town	Place of Dwelling		
88.	**Methodist Church**	Road Town	Place of Worship	Occupied/Inhabited	Good
89.	**Nibbs House**	Road Town	Place of Dwelling	Occupied/Inhabited	
90.	**Norman House, #48 Main Street**	Road Town	Place of Dwelling	Occupied/Inhabited	Good
91.	**Old Post Office Building**	Road Town	Civil		Good
92.	**Peebles Hospital**	Road Town	Civil	Occupied/Inhabited	Fair
93.	**Penn House**	Road Town	Place of Dwelling	Occupied/Inhabited	Good
94.	**Shirley House**	Road Town	Place of Dwelling	Ruin/ Occupied	Fair
95.	**Sir Olva Georges House**	Road Town	Place of Dwelling	Occupied/Inhabited	Good
96.	**Smith House (Serendipity), #151 Main Street**	Road Town	Place of Dwelling	Occupied/Inhabited	Good
97.	**Social Inn (Sunny Caribbee)**	Road Town	Place of Dwelling	Occupied/Inhabited	Good
98.	**St. Georges Anglican Church**	Road Town	Place of Worship	Occupied/Inhabited	
99.	**Sunday Morning Well**	Road Town	Commemorative		Good
100.	**Titley House**	Road Town	Place of Dwelling	Occupied/Inhabited	
101.	**Well**	Road Town	Water Works		Good
102.	**Rogues Bay Battery**	Rogues Bay	Fortification	Ruin/Abandoned	Good
103.	**Brimstone Hill Gun Battery**	Smuggler's Cove	Fortification	Ruin/Abandoned	Poor
104.	**Cattle Round**	Smuggler's Cove	Estate/Plantation	Ruin/Abandoned	Poor
105.	**Dawson Estate Boiler House**	Smuggler's Cove	Estate/Plantation		Good
106.	**Dawson Estate Gate**	Smuggler's Cove	Estate/Plantation	Ruin/Abandoned	Fair
107.	**Dawson Estate Plantation**	Smuggler's Cove	Estate/Plantation	Ruin/Abandoned	Poor
108.	**Dawson Estate Storage Room**	Smuggler's Cove	Estate/Plantation	Ruin/Abandoned	Poor
109.	**Dawson Estate Well**	Smuggler's Cove	Water Works	Ruin/Abandoned	Fair
110.	**Grave**	Smuggler's Cove	Place of Burial	Ruin/Abandoned	Fair
111.	**Tortola Sloop, Dawson Estate**	Smuggler's Cove	Shipwreck	Ruin/Abandoned	Poor
112.	**Turnbull Estate**	Trunk Bay	Estate/Plantation	Ruin/Abandoned	Good
113.	**Dan Donovan's Estate**	West End	Estate/Plantation	Ruin/Abandoned	Poor
114.	**Long Bay Mill**	West End	Estate/Plantation		Good
115.	**Long Bay Round House**	West End	Estate/Plantation	Ruin/Abandoned	Fair
116.	**Mathew Donovan Grave**	West End	Place of Burial		Fair
117.	**Melvina Hodge House (Rudolph Smith House)**	West End	Place of Dwelling	Occupied/Inhabited	
118.	**Methodist Church Rectory**	West End	Religious	Occupied/Inhabited	

#	Name of Site	Location	Historic Use	Current Status	Overall Condition
119.	**Patrick Romney Grave**	West End	Place of Burial		Good
120.	**Sailors' Cemetery**	West End	Place of Burial		Fair
121.	**Smith's Plantation**	West End	Estate/Plantation	Ruin/Abandoned	Fair
122.	**Sugar Mill - Still**	West End	Estate/Plantation	Habitation Informal	Good
123.	**Water Tank**	West End	Estate/Plantation	Habitation Informal	Good
124.	**Zion Hill Methodist Church**	West End, Zion Hill	Place of Worship	Occupied/Inhabited	Good
125.	**Fort Abraham**	Whelk Point	Fortification		
126.	**Windy Hill Battery**	Windy Hill	Fortification	Ruin/Abandoned	Poor

Source: Table compiled by Island Resources Foundation from data sheets in the *Tortola Sites and Monuments Registry* maintained by the National Parks Trust.

Note: Some of the sites listed on Table 38 may no longer survive. It was not possible to ground truth the sites for the Tortola Profile.

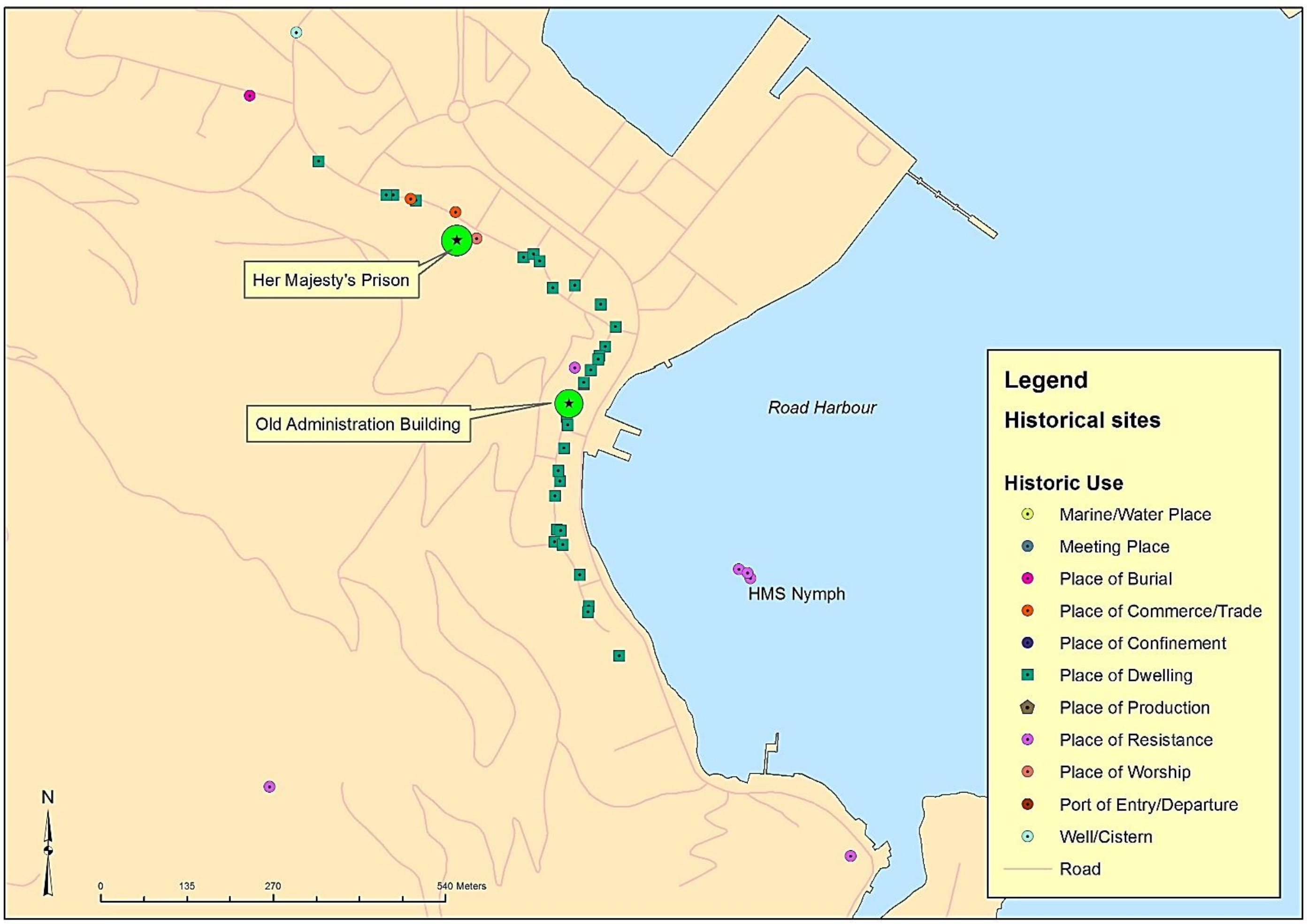


Figure 36.

Historic sites on Main Street, Road Town, Tortola. The two highlighted sites are described in the text.

(*Source*: Map provided by the National Parks Trust from the Historic Sites Census, 2003-2014.)

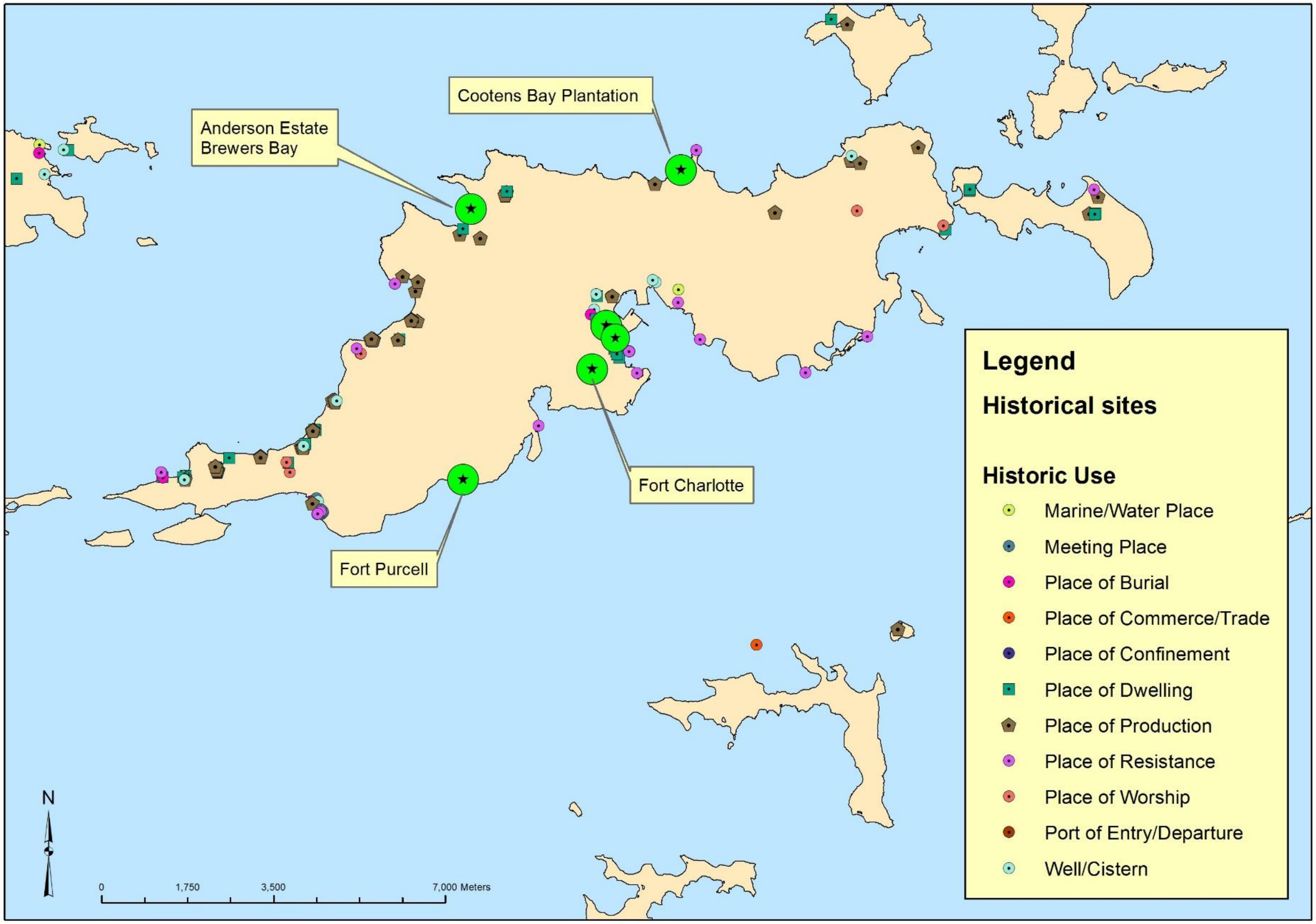


Figure 37.
The historic sites of Tortola. The four highlighted sites are described in the text.
(*Source*: Map provided by the National Parks Trust from the Historic Sites Census, 2003-2014.)

6.2 Selected Heritage Sites for Tortola

6.2.1 Fort Charlotte

Fort Charlotte is a citadel overlooking Road Harbour at Sea Cow's Bay which, during the French and Napoleonic Wars (1792-1815), provided the inhabitants of Road Town and Sea Cow's Bay with a deodand or place of retreat. Named after Charlotte of Meklenburg Strelitz (1744-1818), Queen Consort to George III (1738-1820), the emplacement was ideally situated on the highest point above Road Harbour at 286 metres (938 feet), which negated the possibility of receiving enemy naval bombardment from ships below. In fact, the only way to approach the fort is by following a thin volcanic ridge which is surrounded on all sides by sheer slopes (**Photo 91**).

Not unsurprisingly, half way up to the fort along this ridge, an area was flattened to accommodate a gun platform, which today is clearly discernable from the modern capital below (**Photo 92**). A series of two dry stone walls were constructed on the northwest portion of this battery, suggesting that as well as being able to fire into Road Harbour, the resident ordnance could be repositioned to fire down the ridge at an advancing enemy, thus providing the first line of defence for the non-combatants above.

Further up the ridge, a flattened area revetted by a low mortar-bound, field stone wall probably once also accommodated a single piece of ordnance whose purpose was to defend the approach to the fort entrance, providing the second line of defence.

A short distance away from this small platform, the dry stone walls of the deodand's single bastion can be found, which project away from the main platform in an angular fashion. From here, militia members could strafe an enemy below, providing a killing ground around the immediate perimeter of the fortification entrance (**Photo 93**).

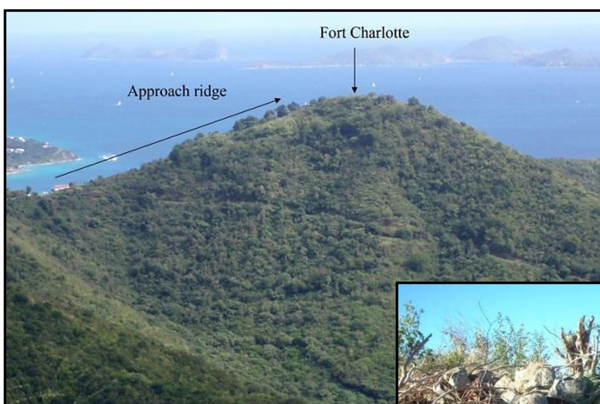


Photo 91.
The approach to Fort Charlotte, Tortola, from the northwest.

Photo 92.
Fort Charlotte's lower battery from the southeast.

Photo 93.
Wall remains, Fort Charlotte's northeast bastion.

Should an enemy make it past these first three lines of defence, they would find themselves in a cul-de-sac surrounded by high earthworks where they would become trapped and an easy target.

To the rear of the cul-de-sac through a gap in the earthworks is an entrance to the main platform, which—in common with the plateau upon which it sits—is irregularly shaped. Another battery retained by a dry field stone wall (**Photo 94**) lies close to the entrance; its purpose was to bombard any enemy below that may have slipped past the fortifications guarding the harbour entrance.

Contiguous to this battery is the subterranean powder magazine, whose entrance pit has been inundated with mobile earth transported by heavy rain (**Photo 95**). Above the doorway, the familiar outline of a vaulted roof may be seen on top of which has been built a mortar bound wall, capped with earth. The interior of this magazine measures 3.6 m x 2.13 m (11.8 ft x 7 ft) and has a height at the vault apex of 2.33 m (7.6 ft) (**Photo 96**). The walls inside the magazine have a series of beam sockets on two different levels. The considerable beams that sat in these sockets would have supported the shelving upon which the barrels of powder were placed, thus keeping them off the ground and consequently dry.

Fort Charlotte was subdivided into two sections with the northeast portion providing the offensive capacity while the southwest portion provided shelter for non-combatants. Behind the magazine are the remains of the blockhouse accommodation, today discernable only as a pile of rocks, while at the southwest edge of the perimeter is a subterranean cistern with a vaulted roof. The interior of this cistern is intact and substantial (**Photo 97**) with the date 1782 carved into the rendering and providing a year of construction (**Photo 98**).

Photo 94.
Dry stone battery wall,
Fort Charlotte.

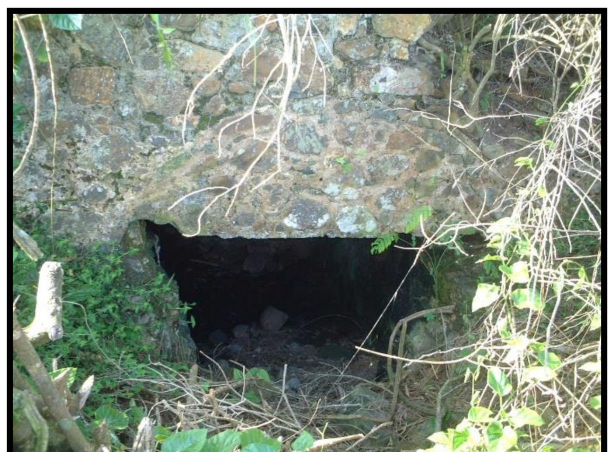


Photo 95.
Entrance to the magazine
at Fort Charlotte.

Photo 96.
Magazine interior, Fort Charlotte.

Photo 97.
Interior of the cistern at Fort Charlotte.

Photo 98.
Date carving (1782) in the interior of Fort Charlotte's cistern.

Approximately eight years ago, a road was cut to the fort with the intention of placing a communications relay station on the summit of the hill, but this was halted leaving a reliable means of connection with the main road below. Based on the fact that this site is on Crown Land, with a passable road to the summit of what is the finest view of Road Harbour, Fort Charlotte lends itself as an ideal candidate for excavation, interpretation and display as a heritage park.

6.2.2 Fort Purcell

Fort Purcell, commonly known as "The Dungeon," is named after the founder of the BVI's fortification network, James Purcell, upon whose plantation it was originally located. The monument today lies contiguous to the main coastal road five miles west of Road Town in an area known as Pockwood Pond. There is clear physical evidence to suggest that a small citadel once occupied the site and was later absorbed into a much larger emplacement where a considerable number of soldiers were barracked.

The site was privately built by the former Lieutenant-Governor and in 1777 was described as being "the property of an individual." Little else is mentioned among documentary resources about the fort, but sometime during the early nineteenth century the site was transformed into a large complex which today encompasses approximately five acres. The only event within the Virgin Islands region which could have merited the attention of such a large military presence on Tortola must have been the invasion of the Danish Virgin Islands in December of 1807. Deceased local historian Mr. J.R. O'Neal asserts that:

> *There was only one garrison and it was located at Fort Purcell. There is a fort there with a few gun emplacements and a large number of buildings for quartering troops. Where did the troops come from that had been sent to retake St. John? They came over from St. Kitts and Tortola. Now the only place large enough to hold them was down there at Pockwood Pond. So those troops that were sent to St. John came from Pockwood Pond. Not more than 1,500 or so, but a lot. I invested in that fort thirty years ago. It was known as The Dungeons* (Kent, 2006).

Fort Purcell lies close to the modern shoreline with the main coastal road dividing the two and providing easy access to the site (**Photo 99**). The fort is a perfectly symmetrical stone structure facing south towards the sea. The east and west walls are splayed back at an angle of 60 degrees to the main sea-facing battery wall, creating a blunted V-shaped emplacement which once had two levels.

At the lower level to the rear of the main battery are two rooms, each at the base of two musketry towers. The room on the west side lower level is a subterranean powder magazine, which has a red-bricked vaulted roof similar to others recorded in the modern territory. Access to this magazine is through a narrow doorway (**Photo 100**), then into a confined area which immediately turns 45 degrees to the east, leading to a head-height corridor (**Photo 101**).

Photo 99.
The sea-facing battery of Fort Purcell, after site clearance in 2011.

Photo 101.
The corridor leading to the powder magazine at Fort Purcell.

Photo 100.
Entrance to powder magazine at Fort Purcell.

At the end of this corridor down two steps is a low doorway just one metre (3.28 ft) in height which leads into the powder storage area (**Photo 102**). This low corridor and subsequent awkward entrance were designed to repel an assault on the magazine; just inside the doorway puncturing the wall is a loop-hole covering the approach to the entrance.

The room beneath the east musketry tower has a vaulted roof and three irregularly shaped windows in the east and west walls. Similar angled windows may be found at the ordnance storehouse at the Brimstone Hill Fortification in St. Kitts and were designed to prevent an enemy from throwing a grenade into the magazine. This suggests that the room at Fort Purcell may have served as a free-standing powder magazine similar to that found at Fort Burt in Road Town, prior to being absorbed into the later structure.

It is inside this room that some of the most unique military graffiti anywhere in the British Leeward Islands may be found scratched into the plaster rendered walls. On the west wall, the figure of a dancing girl may be seen holding up her skirt exposing her legs and possibly represents a soldier's reminiscences of a cabaret show in England before being stationed in the West Indies (**Photo 103**). On the opposite east wall a male figure wearing a late eighteenth-century tunic may be observed; it appears to be the caricature of an officer or enlisted man in uniform. Although smaller than its opposite female counterpart, the carver has included distinctive fashion details that make the costume datable. The final carving, which has deteriorated more than its neighbours, illustrates a sailing ship whose extended bowsprit identifies it as a late eighteenth- or early nineteenth-century West Indiaman. The vessel's yards are crossed suggesting a ship at anchor, and the artist may have been sketching the troop carrier which had carried him to Tortola.

To the front of the fort on the first level is the main sea-facing battery which rests upon a thick wall. Even using small four-pounder ordnance, the recoil distance would throw a cannon off the edge of this wall, which was compensated for by a wooden platform extending back to the original citadel wall. Nine beam sockets are reciprocated on both walls and confirm the presence of a platform which was reached by a stone staircase with seven dressed steps (**Photo 104**). It is the presence of these steps—which cover two loopholes on the original citadel wall—that confirms the main fortification was constructed during at least two phases.

Photo 102.
The powder magazine at Fort Purcell.

Photo 103.
Dancing girl graffiti at Fort Purcell.

Photo 104.
Steps leading up to the gun battery at Fort Purcell.

Towards the south, the second storey of the main fortification contained the battery. Unlike the main battery wall, which has been fabricated with the typical andesite field stone found throughout the former colony's fortifications, each individual embrasure has been constructed with English red brick in order to carefully define the working distances between gun crews. To the rear of the platform are plastered walls suggesting the inclusion of further rooms, which today cannot be determined due to extensive collapse.

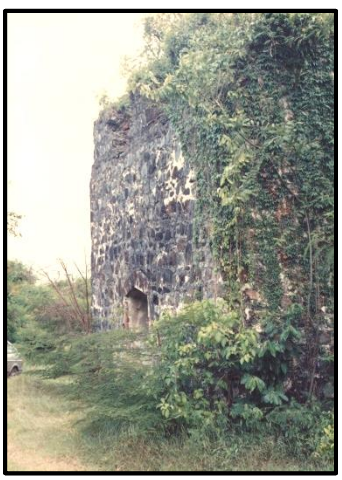


Photo 105.
East musketry tower, Fort Purcell.

At the very back of the main fortification are two musketry towers. Each has a small square platform surrounded with embrasures which would have allowed kneeling infantry to fire over the heads of the gun crews below, covering them against a potential enemy landing party (**Photo 105**).

A series of other buildings, whose full extent is still unknown, exist behind the main fortification covered in dense vegetation primarily consisting of sharp-leaved pineapple plants. Most of these structures are raised platforms upon which wooden barracks would have been constructed to protect them from water inundation.

To the northeast of the fort are found two separate but joined cisterns, attached to a large catchment platform (**Photo 106**). This platform gently slopes down towards the two holding cisterns below. It is clear from the surviving masonry that both cisterns would have once been completely covered with a vaulted roof. Directly in front of the cisterns is a working platform upon which—enclosed within wooden cradles—the limestone filtration buckets would have once been mounted, used to purify the dirty water.

Photo 106.
One of the two cisterns at Fort Purcell.

To the rear of the cistern a series of walls survive, which represent raised platforms for accommodation. Red-brick-dressed steps lead up to these platforms whose irregularity of shape provide an architectural conundrum that will only be resolved by a thorough clearance and survey of the site.

Fort Purcell is a unique site not replicated anywhere else in the British Leeward Islands. Its location on a main road makes it an ideal candidate as a heritage park.

6.2.3 Cooten's Bay Plantation Complex

The plantation complex surviving close to the shoreline within Cooten's Bay on the north side of Tortola is the most intact eighteenth-century example of its type remaining in the modern territory. A variety of buildings are present, each representing the various processes involved in converting cane juice to a solid.

Little is known about the site, but there are clues in a variety of maps and documents. The name Cooten is not typically associated with the United Kingdom but may have been a derivation of the Dutch surname Van Cooten, potentially indicating that the bay was being cultivated during the United Netherlands occupation of Tortola between 1649 and 1672. The 1798 map draughted by George King on behalf of Isaac Pickering shows that the plantation at that time was owned by prominent Virgin Islands planter, Richard Hetherington (King, 1798). Hetherington was the President of the Virgin Islands in the early nineteenth century but died in 1820 soon after the hurricane of 1819, which had killed his wife. The Cooten's Bay plantation was abandoned by 1829 and left fallow until 1864 when it was purchased by members of the local peasantry.

A variety of buildings remain in the bay today, dominated by one large structure which is the ruins of the boiling and curing house. This large, double-storied building is in good condition but is slowly being corrupted by a variety of trees and vegetation which have grown into and around the stonework and masonry (**Photo 107**).

It is likely that the top storey of this building was the plantation office. On the west wall of the structure can be found a large cistern (**Photo 108**) and the remains of a rum still foundation (**Photo 109**), both of which would have been used during the rum-making process.

Photo 107.
Curing house interior, Cooten's Bay complex.

Photo 108.
Rum still cistern at Cooten's Bay.

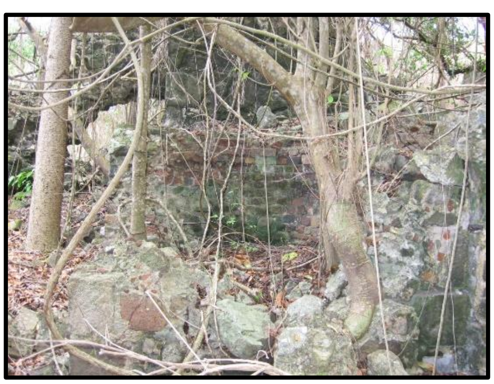


Photo 109.
Rum still foundation at Cooten's Bay Plantation.

To the northeast of the main structure is the animal round platform, which is in relatively good condition. The sea-facing dry stone wall is still intact (**Photo 110**) as is the foundation for the roller cradle (**Photo 111**) and drainage gully, where cane juice would run via a lead conduit to the boiling house below (**Photo 112**).

Photo 110.
Sea-facing dry stone wall of the animal round.

Photo 111.
Animal round foundation for the roller cradle (scale: 1 m/3.28 ft).

Photo 112.
Cane juice conduit foundation (scale: 1 m/3.28 ft).

Inland from the animal round platform are the remains of a large cistern which would have either held water or cane juice, depending on requirements. On the sea-facing side of the animal round are a series of pillars which would have once supported a roof, underneath which the crushed cane would be stored to dry (**Photo 113**).

Photo 113.
Bagasse shed pillars at Cooten's Bay.

The open sides of this bagasse shed (bagasse being the fibrous matter remaining after sugarcane is crushed to extract juice) would have allowed wind to air the crushed stalks, while the roof would have protected them from rain. These stalks would have been used as fuel for the boiling house or fodder for the dray animals that operated the animal round. Directly to the east of the animal round is a rectangular dry stone wall which would have been the corral for the dray animals operating the adjacent animal round.

Although the previously outlined structures represent the majority of the buildings in the bay, there are more artefacts on the site but in different locations. Lying within the remains of the bagasse shed are two identical nine-pounder merchant guns cast in approximately 1780 (**Photo 114**). Neither have any distinguishable marks which, coupled with their advanced state of deterioration, make any further identification difficult. It is clear, however, that they were not originally mounted at their present resting place and were abandoned prior to an extraction attempt. The bay itself—apart from a small channel—is surrounded by coral reefs, making removal by boat impossible. It is for this reason that the guns probably remain undisturbed.

Dividing Cooten Bay is a ridge or spur where a flattened area may have been the gun platform. Further up this ridge are the foundation remains of a

Photo 114.
One of the two remaining merchant guns at Cooten's Bay.

large great house, known as "Hetherington's Retreat," which would have been the residence of Richard Hetherington. From this site in 1823, following the Josiah's Bay slave rebellion, bounty hunters—hired to recover escaped slaves with dogs—met before pursuing their quarry (Maxwell, 1825).

6.2.4 Brewer's Bay Sugar Works

The Brewer's Bay Sugar Works, located within the bay towards the west side, provides an example of a facility that was reused subsequent to the nineteenth century economic decline of sugar.

This latter-day use occurred when the United States purchased the Danish Virgin Islands in 1916, with the formal takeover being performed the following year. In 1920, the US Congress enacted a prohibition law banning the sale and consumption of alcohol in the US, which was extended to the US Virgin Islands in 1921. A major source of income for the islands of St. Thomas and St. Croix was rum production, which ceased with the introduction of the prohibition law and left a deficit in the region. Seeing an opportunity to economically benefit from this, owners of sugar works in the BVI, particularly on Tortola, began to rehabilitate buildings that had been dormant for over half a century and commenced to produce rum again. The Brewer's Bay Works is an example of this phenomenon.

A description exists of these works in operation during the twilight of the BVI's sugar era, sometime around the late 1820s. A visitor to the island, who was staying at the Mount Healthy plantation, made his way down to Brewer's Bay and emerged among the hustle and bustle of the works nestled close to the beach. He describes how:

> *In the boiling house, we were received by the Manager, we found a negro at each of the coppers attending to the boiling and skimming of the cane juice; and what with the steam, and the ladling and splashing, and the calling to the firemen outside to regulate the fire, there was no lack of items for the observation and instruction of a novice and we regaled ourselves in the meantime with some new sugar in water which is not only refreshing but reputed wholesome. The buildings were on a larger scale, and their details were more complex than we had imagined, requisite for the purposes for which they were designed; but there was a want of cleanliness and order, and the general aspect indicated dilapidation and poverty: they were partially destroyed in the late hurricane and imperfectly repaired* (Wentworth, 1834).

The works consists of two sections, each divided by the main road running through the bay (**Photo 115**). On the sea or northwest side are the boiling house and rum stills, while opposite across the road remains the original animal round and subsequent hut used to house the more modern crusher, which is still *in situ*.

What makes this particular site unique is the fact that most of the equipment still remains, including the cauldrons used to reduce the cane juice, the copper stills within which rum was distilled, the original three animal round rollers and the later horizontal crusher and engine used to drive it. Apart from the Callwood Rum Distillery, there is not a complete works, with all of the equipment present from both phases of operation, anywhere remaining in the BVI.

The boiling house (**Photo 116**) clearly illustrates the reconstruction of the eighteenth-century works where poured rubble concrete has been unified with red brick and andesite stone (**Photo 117**). The copper battery is still present (**Photo 118**) as well as a rare example of where the cauldrons are still contained within their stone surround.

Inside the ruin lies an engine which would have powered the twentieth-century grinder on the animal round opposite (**Photo 119**). The red-bricked chimney, one of two at the site, is still standing but precariously leans over the adjacent road and requires stabilisation to survive (**Photo 120**). The eighteenth-century furnace holes for the cauldrons have survived, with the "tatch"' or final fourth furnace showing some signs of collapse (**Photo 121**). The stills in which the rum was brewed remain within their stone foundations on either side of the second red-bricked chimney, which is much smaller than the first (**Photo 122**).

On the opposite side of the road to the boiling house is the animal round platform, which is heavily eroded but still discernible (**Photo 123**). Wentworth (1834) briefly mentions the round being in operation during the 1820s, observing, "The sound was more frequent as we came to the works, where we found the mules working the mill, urged onward by the frequent repetition of it."

The animal round remaining at Brewer's Bay is unique in that subsequent to the nineteenth-century use of the facility, it later had a shed constructed upon it (**Photo 124**) to house the twentieth-century crusher which remains *in situ* (**Photo 125**). Likewise, the three rollers, which would have originally crushed the cane, are still present; these are only found at one other site in the territory (**Photo 126**).

Photo 115.
Brewer's Bay Sugar Works divided by the main road.

Photo 116.
The boiling house at Brewer's Bay.

Photo 117.
18th and 20th century construction material unified.

Photo 118.
The copper battery inside the boiling house, Brewer's Bay Sugar Works.

Photo 119.
Early 20th-century engine at Brewer's Bay Sugar Works.

Photo 120.
Red-brick chimney at Brewer's Bay.

Photo 121.
The furnace's stoke holes with the "tatch" furnace to the left, Brewer's Bay Sugar Works.

Photo 122.
The copper rum stills either side of the second red-brick chimney at the Brewer's Bay Sugar Works.

Photo 123.
The heavily eroded animal round platform.

Photo 124.
The 20th-century engine shed, Brewer's Bay Sugar Works.

Photo 125.
The 20th-century cane crusher at Brewer's Bay.

Photo 126.
One of the three remaining 18th-century rollers at Brewer's Bay.

6.2.5 Her Majesty's Prison, Main Street

The prison building on Main Street is a locally iconic structure which officially closed in the mid-1990s after the construction of a new facility at Balsam's Ghut; but, until 2008, the building was still used to house both female prisoners and illegal immigrants. Nestled between the Anglican Episcopal Church and the Methodist Chapel, it has always presented a source of amusement regarding the rehabilitation of prisoners who on Sundays received the benefit of overhearing the services of two denominations.

Like a number of historic sites remaining in the modern territory, the encompassing security wall has been adorned with an erroneous plaque at the entrance that states construction took place in 1774 (**Photo 127**). There is no supporting evidence for this, and the date is used liberally elsewhere on the basis

Photo 127.
The plaque outside of the old prison.

that 1774 represents the year the Legislative Council was introduced into the territory and money became available for constructing public edifices.

This is contradicted by the documentary evidence such as a letter written in 1808 stating:

> *Although the Virgin Islands had been partially settled by British subjects for a considerable number of years, yet it was not until the year 1776 [incorrect, the year was 1774] that the privileges of the British constitution were conceded to the inhabitants.*
>
> *At the first meeting of their Legislative body in that year an act of Assembly passed granting to His Majesty a duty of 4.5% on all the produce exported from the colony. At this period they had no public buildings, no house for the meeting of the Council or the general Assembly of the colony, no courts of justice, no public jails for the safe keeping of criminal offenders or debtors and no churches for divine worship* (Colquhoun to Secretary of State, National Archives, Colonial Office 152/91 misc.).

The same letter also mentions that:

> *A secure public gaol, a courthouse for the administration of justice and a church at Tortola for the performance of divine worship,*

none of which edifices, however indispensably necessary they appear to be at present, can be erected from the exhausted state of the finances of the colony (*ibid*.).

An inhabitant quoted shortly afterwards states that:

My unfortunate country is reduced to the most deplorable state of disorganisation and discredit. No place for divine worship, a public gaol so insecure as not to be able to keep in safe custody persons guilty of crimes and misdemeanors nor even to shelter the heads of unfortunate persons confined for debt (*op. cit*.).

Later in 1811, Governor Elliot writing about the trial of Arthur Hodge reported to the home government that:

It has been represented to me, that not only the gaol at Tortola is in a very insecure state, but also that there are neither regular troops nor embodied militia in the Virgin Islands (Elliot to Thomason, National Archives, Colonial Office 152/97).

Consequently it must be assumed that towards the end of the eighteenth century (probably sometime during the 1790s) the embryonic construction of the contemporary remaining facility took place.

Later colonial reports of the prison are all derogatory and well documented by Isaac Dookhan in his *A History of the British Virgin Islands* in which he writes:

The jail, though kept clean by regular scouring and whitewashing by the prisoners themselves was more often than not in a state of disrepair. It was unhealthy on account of improper roofing which caused dampness especially in rainy weather, inadequate ventilation and a lack of sanitary facilities. Even when a new jail was constructed after the destructions of the hurricane of 1867, conditions remained unchanged. Rather, it was reported of the new jail that 'the architect must have been reading a description of the Black Hole of Calcutta, and derived his plan from his reading.' Reconstruction was postponed pending the establishment of a central federal prison, in one of the Leeward Islands. By the end of the century the jail was almost in a complete state of dilapidation, and attempts to secure imperial aid of about £300 by way of a grant or loan to effect necessary repairs failed (Dookhan 1973).

Today, the old prison stands empty and derelict in the historical district of Road Town. The original prison layout remains unknown as no plans have been recovered illustrating the design, but the later 1867 re-construction forms the basis for the building today, which was added onto over the years. A photograph form 1887 shows the cells built along the rear wall and a main central building, all of which remain but have been adjusted significantly.

Over the years as the demographics of the territory changed, the prison evolved becoming a warren of different rooms and cells. The cells which run along the back or southwest-facing wall formed the original holding rooms and numbered six, but some were later subdivided into smaller rooms such as the solitary confinement block (**Photo 128**).

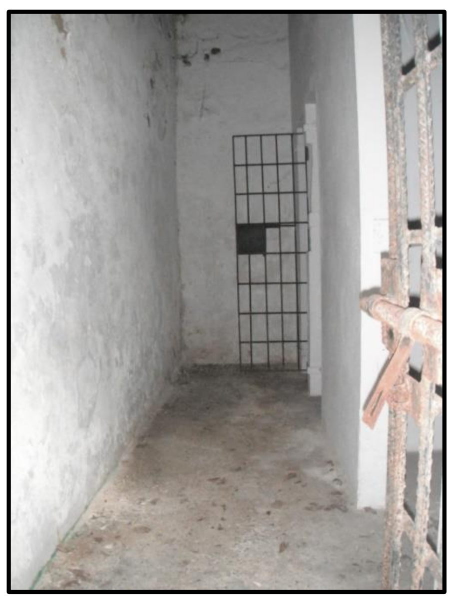


Photo 128.
The solitary confinement block at the old prison on Main Street in Road Town.

The interior open area within the surrounding walls is today heavily overgrown and looks somewhat ethereal compared to the modern street outside (**Photo 129**).

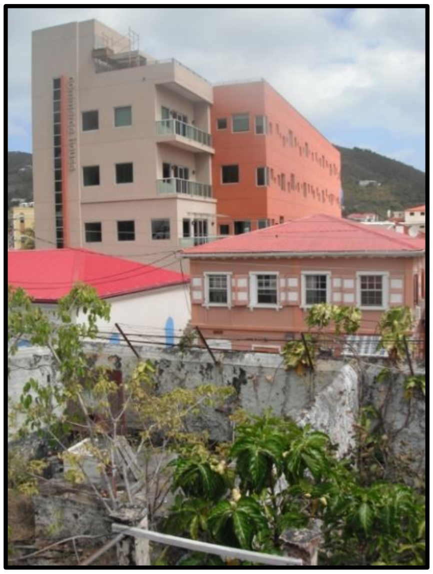


Photo 129.
The interior of the old prison
looking out on modern Road Town.

The two main gates are iron, one of which has a wicket gate for pedestrian use (**Photo 130**). Originally these were wooden and in the same location.

The original cells to the rear, which are constructed—like the main wall—of andesite and red brick cornering, still have wooden doors on them with iron outer doors and, in a number of cases, retain their original forged ironwork (**Photo 131**).

Photo 131.
An original iron bolt, probably dating from the 1860s.

Curiously, a Breadfruit Tree (*Artocarpus altilis*) which today still stands in the prison yard, was photographed in 1887 and appears then as a mature tree. Consequently, this tree was probably planted as a means of food for the prisoners after the 1867 reconstruction, making it nearly 150 years old.

At the beginning of the millennium, a committee was convened to create a national museum within the old prison, and some funding was made available. A clearance of the site took place in 2013 using volunteers and members of the British Royal Navy (**Photo 132**). Work is now underway to restore the old building and create a museum on the site to focus on BVI social history (GIS Press Release, 14 January 2015).

Photo 130.
The main gate and the pedestrian wicket gate
at the old prison on Main Street.

Photo 132.
Members of the British Royal Navy and other volunteers
clearing the prison in 2013.

6.2.6 The Old Administration Building

This particular building has served many different functions since its construction in 1866. Originally, the single-storey building—begun during the Presidency of Sir James Longdon in the early 1860s—served as a courthouse, but it later evolved as the site of the Government's main offices as well as the Governor's Office. The building has likewise served as a meeting place for the Legislature during the late nineteenth century, the Chief Minister's office, the Treasury, the Customs building and the Post Office, which was its last function before closing.

The original single-storey structure was composed of andesite field stone and red brick finishing, bound together with a lime mortar aggregate. Although a keystone above the central archway has the date 1866 (**Photo 133**), it would appear that a hurricane the following year delayed final completion, and a photograph taken in 1887 shows the unfinished building without a roof.

Photo 133.
The keystone with carved *1866* date.

Sometime prior to 1912, the structure was completed, and a photograph taken in that year shows the building in use (**Photo 134**).

Photo 134.
The Administration Building *circa* 1912 (*source*: Fishlock, 1912).

In 1924, the original structure was badly damaged by the hurricane of that year, which destroyed the front portico. The gratings in the 1912 photograph were blown away with only a few surviving which can now be found in the Old Government House Museum. Following this storm in the late 1920s—along with the hospital and Commissioner's (Governor's) residence—the building was rebuilt and given a second storey and decorated at the front with a cascade of arches and balustrades.

During the 1950s, the sale of postage stamps funded further construction with an annex added to the side that became the postal sorting office. A fire in 2001 destroyed the upper storey, and the building was finally vacated once a new Post Office was constructed. Today, for the most part, the building is derelict and in a state of disrepair.

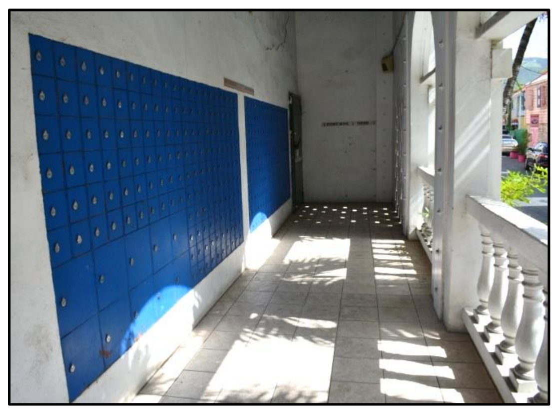


Photo 135.
The post office boxes at the old Administration Building are still in use,.

The original wooden shutters still hang from windows and doorways but are slowly rotting. The 1920s addition is collapsing, probably due to the fact that sea sand used in the concrete aggregate had not been properly rinsed and salt crystals have attacked the iron rebars. For the most part, the main original building is empty and shut up (**Photo 135**).

Issues, Conflicts, and Areas of Concern	Impacts of No Action/No Change	Short-term Options Long-term Recommendations
ISSUE ONE Tortola's tourism product has focused largely on yachting, cruise ships, and resorts. Too little is being done to develop or display the island's historic sites as a tourism niche for cruise ship passengers, land-based visitors, and residents. The success of heritage tourism sites in St. Kitts (Brimstone Hill Fortress National Park), St. Croix (Whim Estate), and Antigua (Nelson's Dockyard) demonstrates that there is an interest in Caribbean history by the region's tourists. It is time for Tortola to give appropriate attention to conserving its remaining historic sites and developing them as key attractions in a new heritage tourism marketing niche.	The future of the historic sites highlighted in this chapter is ambiguous at best. All of the sites are at risk; without proper maintenance and preservation, further degradation, perhaps even loss, will occur to all of these unique pieces of Tortola's historical past and potential tourism niche. If the full potential of these sites (and so many others) remains unrecognised, and if steps are not taken to enhance the importance of these ruins and buildings, the risk of damage and further degradation remains high.	**SHORT-TERM OPTIONS** **1.** A valuable tool is available to the island of Tortola in the form of the Sites and Monuments Registry, now maintained by the National Parks Trust. The Registry needs to be used not only to alert planning officials of the presence of historic sites and artefacts within the boundaries of proposed new developments, but the Registry needs to evolve as a tool for action that encourages Tortolans, whether in the public or private sector, to join forces in a concerted effort to conserve, protect and manage as many of these sites as quickly as possible. Priorities need to be established so that the most critical and the most at-risk sites are addressed first. **2.** An advocacy group for Tortola's historic heritage needs to be established that builds on the work of the older BVI Historical Society, no longer an active organisation. The recently formed Association for the Preservation of Virgin Islands Heritage, which has taken as its first project the restoration of the African burial ground at Kingstown, is providing an excellent model and should be encouraged to broaden its scope beyond the single site when it is in a position to do. **LONG-TERM RECOMMENDATIONS** The following is an overview of recommendations for the six historic sites highlighted in this chapter. **1. Fort Charlotte** Fort Charlotte should be officially protected and designated as a "heritage park." Once a protective legal status has been assured for the site, archaeological excavation can take place, followed by the rehabilitation of the existing fortification structures. The road leading to the site will have to be consolidated by paving the surface and retaining the cut into the hillside, thus providing safe vehicular access that is passable by the typical safari busses that transport tourists in the BVI. As funds are available, a visitors' centre could be constructed to tell the story of the fortification. **2. Fort Purcell** This particular site is in the hands of one family, and therefore options are more limited.

Issues, Conflicts, and Areas of Concern	Impacts of No Action/No Change	Short-term Options Long-term Recommendations
		The private-sector owners can be encouraged to avoid any further interference with the extant ruins and to safeguard them for the people of the BVI and their future generations. A clearing-out at Fort Charlotte in 2013 helped to clean up the site. At the time, a task force was formed for the site, including members from the Tourist Board, the NPT, the MCW and a representative of land owners. Nevertheless, this and other clean-up efforts at the site over the years have proven unsuccessful. Afterwards, the landscape has fallen back to the undergrowth and become a rubbish dump due to lack of professional management. The owners might be contacted for permission to carry out an archaeological excavation of the site. **3. Cooten's Bay Plantation Complex** Like Fort Purcell, the plantation complex at Cooten's Bay remains under private ownership. However, the site does not appear to be in immediate danger of destruction. Ideally, the site should receive protected status to guarantee that it does not fall prey to a larger development scheme. It should also be monitored regularly to make certain that the site remains secure and that any protected status it is given is being observed. **4. Brewer's Bay Sugar Works** The sugar works at Brewer's Bay also remains in private hands, and therefore the survival of the boiling house, rum distillery, and animal round is at the discretion of the individual land owner. Within the local community, there is interest in the site, which at Christmas time is transformed into a representation of the nativity with the requisite Biblical characters placed around the ruins and lit for the season. Unless emergency stabilisation of the structures, especially the chimney, takes place in the near future, the survival of the site remains precarious. **5. Her Majesty's Prison on Main Street** This site is on Crown Land, meaning that it is, to a certain extent, protected. It is possible in the near future, as part of the ongoing planning for Road Town's rehabilitation (see Section 2.2.2.8, Chapter 2), the site may be included in efforts to display the past within the urban environment.

Issues, Conflicts, and Areas of Concern	Impacts of No Action/No Change	Short-term Options Long-term Recommendations
		It certainly is a site worthy of protection and presenting as a heritage attraction, and in time this may become a reality as a museum on the site is scheduled to open in 2015. **6. The Old Administration Building** It is unusual that such a culturally iconic structure in the centre of Road Town remains derelict, which reflects negatively on the protection of historic sites in Road Town. As tourism grows in Tortola—particularly cruise tourism with passengers looking for interesting ways to spend a day in the BVI—this building could become a museum. For example, it could be converted to a museum dedicated to the postal history of the BVI, which, since 1866 (when the first stamps were produced), has had a long and distinguished record. The 1920s addition would need extensive repair work as would the areas gutted by fire, but this would be worthwhile on the basis that the building is still in relatively good condition. Care for the building could enhance the general area it is in, possibly providing shop space for business entrepreneurs. The site is owned by Government at the present time, and so it has some legal protection. Unfortunately, Government is not maintaining it as it should be.

7. POLLUTION RISKS[7]

7.1 Solid Waste

Dr. Edward Towle, founding president of Island Resources Foundation, wrote the following in 1972, as a rationalisation for why islands are different and need their own advocates:

> *Within a small island, no problem or area of study can stand by itself, no piece of life remains isolated; every living and non-living thing forms an integral part of a structured whole. Similarly, an island chain is a delicate and fragile network, representing a set of highly interdependent relationships—island to island, system to subsystem, island to sea* (Towle, 1972).

Perhaps in no sector are the constraints of insularity quite as demanding as they are with regard to waste management. Due to their relatively small size, the "environmental dimensions of social and economic actions taken by … [small island societies] are more immediately evident," and this is particularly the case for the management of waste (Georges, 2002).

The World Island Network Report (WIN, 2006), based on a survey of 51 islands worldwide, identified a broad spectrum of factors which influence the complexity of waste management on small islands (see Table **39**).

Table 39.
Contributing factors to the complexity of waste management on islands.

Contributing Factors	Issues
Organisational and Institutional Capacity	• Political priorities often lie with economic and community development • Lack of coordination in institutional systems, administrative bodies, management capabilities, and human resources can make it difficult to respond effectively to issues, assign responsibilities, and develop coherent plans and policies
Economic Strength and Stability	• Globalisation and trade affecting more and more of what is imported and exported • Poor economies of scale on islands, due to small population and local markets, leading to lack of financial management capacity, resulting in failed aid projects and high costs for low quantities of waste
Socio-political Status	Lifestyle changes (consumerism) and population growth resulting in: • An increase in non-biodegradable and hazardous waste, *e.g.*, nappies, plastics • A loss of traditional links with the local environment • A disintegration of traditional communities and family units • A change in land-use patterns • Cultural beliefs and values prohibit certain activities and affect litter and dumping • Communities sometimes have unrealistic expectations of authorities, and become demotivated, distrustful and unwilling to cooperate if these are not realised • Social problems are exacerbated by bad decisions in waste management that affect quality of life and loss of industry-linked livelihoods
Human and Technical Resources	• Limited ability to evaluate and implement technology or management methods • Lack of specific management and operational skills • Lack of research for future improvements to current practices • Lack of technical resources, *e.g.*, computers, information systems
Environmental Considerations	• Sensitivity of ecosystems, vulnerability to contamination • Lack of space and resources for waste facilities • Climatic factors affecting waste handling • Geographical remoteness and cost effectiveness of imports and exports, access to resources

Source: WIN, 2006.

[7] The author of Section 7.1 of Chapter Seven is Charlotte McDevitt. The author of Section 7.2 of Chapter Seven is Jean-Pierre Bacle.

Waste management is not usually considered a priority development area on islands, and there is generally a lack of institutional resources (human, technical and financial) to handle increasing, and more complex, waste streams. In addition, the small land area of many islands means there are limited disposal options.

Furthermore, islands are dependent on external markets and exhibit a high dependence on importations. Poor economies of scale on islands mean the costs for managing relatively small quantities of waste will be high. For example, some islands are isolated from mainland markets, thus rendering the cost of transporting recyclables impractical. Within these constraints however lie opportunities specific to island communities to develop innovative solutions to manage increasing waste volumes.

In recent decades, islands in the Caribbean have made more concerted efforts to address waste management issues. In the BVI, The National Environmental Action Plan (NEAP) and the draft Environmental Management and Conservation of Biodiversity Bill, 2008 (see Sections 2.2.3.6 and 2.2.4.4, Chapter 2) identify waste and pollution, among others, as issues which are:

> *serious and imminent threats to the Virgin Islands environment and natural resources, which if not immediately addressed could lead to the rapid deterioration of the Virgin Islands product and endanger the economy of the territory* (DCF, *et al.*, 2004).

7.1.1 Solid Waste on Tortola

7.1.1.1 Waste Categories

Volumes and types of waste categories vary significantly, depending on the economic development activities of the region in which the waste occurs. In a study by McDevitt (2008), data from four Caribbean islands were assimilated to provide an insight into the region's waste stream categories and quantities. The organic group is consistently the largest waste stream, representing 31 percent of all waste. This is followed by paper and cardboard, representing 26 percent. The third largest waste stream is plastic at 14 percent, followed closely by glass at 13 percent. Metals, textiles, construction and demolition waste, and special waste occur in smaller quantities. Although special waste quantities are not large, management of these wastes is important as they can be hazardous in nature.

Photo 136.
Pictured is the loading bay for incoming waste at the Pockwood Pond incinerator. Organic waste, cardboard, and plastic are among the most common items disposed of in Tortola.

These figures can be compared to a one-week waste audit conducted at Tortola's incinerator facility at Pockwood Pond in February 2013 (**Table 40**). The regional data are comparable to Tortola's with the exception of organics. The discrepancy might be accounted for by the fact that the recent Tortola audit was conducted during the dry season.

Findings of the waste audit indicate that of the waste received at Pockwood Pond (**Photo 136**) approximately 75 percent is combustible and 80 percent can potentially be recycled or composted. With this data, management strategies for the various waste streams can be developed, and the sizing of the equipment required for processing materials can be estimated with a fair degree of accuracy.

Table 40.
Results of a waste audit conducted in Tortola in February 2013.

Type of waste	Total Weight (lbs.)	% of total	Notes
PAPER AND PAPERBOARD	**689 lbs.**	**21%**	**Over 40% classified as compostable** (e.g., organics, paper and cardboard)
Newspaper	5 lbs.	<1%	
Cardboard	470 lbs.	15%	
Magazines and Catalogues	13 lbs.	<1%	
Boxboard (brown paper)	77 lbs.	2%	
Fine (office) Paper	57 lbs.	2%	
Telephone Directories	3 lbs.	<1%	
Other Miscellaneous Paper (*e.g.*, napkins)	64 lbs.	2%	
ORGANICS	**698 lbs.**	**22%**	
Food Waste	313 lbs.	10%	
Yard Waste	291 lbs.	9%	
Branches and Stumps	94 lbs.	3%	
GLASS	**501 lbs.**	**16%**	**40% is potentially recyclable** (e.g., metal, glass, construction and demolition debris, and some plastics)
Clear Beverage Containers	208 lbs.	7%	
Clear food Containers	6 lbs.	<1%	
Coloured Beverage Containers	287 lbs.	9%	
METAL	**249 lbs.**	**8%**	
Tin/Steel Beverage Containers	40 lbs.	1%	
Tin/Steel Food Containers	84 lbs.	3%	
Major Appliances	16 lbs.	<1%	
Other Ferrous Metals	36 lbs.	1%	
Aluminium Beverage Containers	33 lbs.	1%	
Aluminium Food Containers	4 lbs.	<1%	
Remainder/Composite	36 lbs.	1%	
CONSTRUCTION/DEMOLITION	**269 lbs.**	**8%**	
Concrete and Masonry	2 lbs.	<1%	
Lumber	267 lbs.	8%	
PLASTIC	**572 lbs.**	**18%**	
PET Containers	119 lbs.	4%	
HDPE Containers	110 lbs.	3%	
Miscellaneous Plastic Containers	3 lbs.	<1%	
Film Plastic	271 lbs.	8%	**Less than 20% to be alternately managed**
Remainder/Composite	69 lbs.	2%	
TEXTILES	**149 lbs.**	**5%**	
SPECIAL CARE WASTE	**41 lbs.**	**1%**	
Paint	8 lbs.	<1%	
Vehicle Oil and Filters	2 lb.	<1%	
Tyres	31 lbs.	<1%	
OTHER UNSPECIFIED	**40 lbs.**	**1%**	
Total	**3,208 lbs.**	**100%**	

Source: Adapted from Egarr & Associates, 2013.

7.1.1.2 Factors Influencing Waste Volumes

Local population size, the number of visitors, and the spending power and respective wealth of a country determine its waste volumes. The British Virgin Islands has experienced significant growth rates in population over recent decades. Tortola's population figures have followed a similar growth pattern with approximately 24,000 people now living on the island.

Additionally, the BVI has seen a steady growth in tourism and Gross Domestic Product over the last decade with correspondingly dramatic increases in the amount of waste generated (**Figure 38**). The average waste volume per capita in the BVI is higher than most developed countries due to the high importation rate and associated packaging.

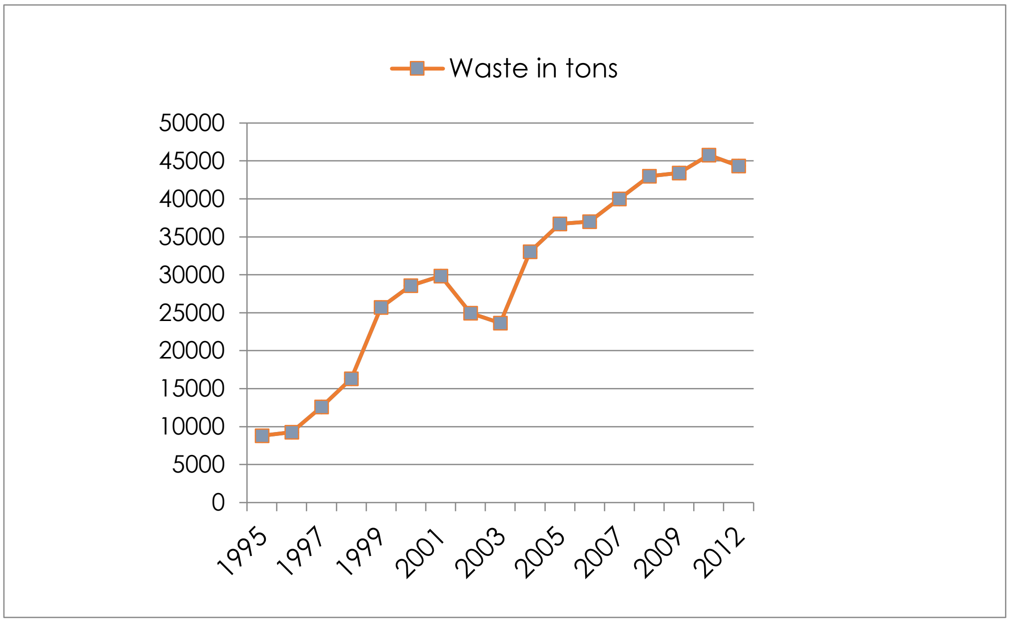


Figure 38.
Growth of waste in the BVI, 1995 – 2012
(*source*: McDevitt, 2008; Egarr & Associates, 2013).

In 2004, approximately 31,964 tons of wastes were generated in the BVI (DSW, 2004). In 2006, waste generation amounted to approximately 37,000 tons (DPU, 2007) and was up to 44,333 tons in 2012 (Egarr & Associates, 2013.) These figures are not conclusive as the weighbridge was not always functional, and some waste was delivered after hours. Egarr & Associates (2013) estimate that waste volumes will increase 48 percent between the year 2015 and the year 2030, to 171 tons, and will far exceed the capacity of the current incinerator.

7.1.2 Management of Solid Waste in Tortola

7.1.2.1 Historical

Historically, waste in Tortola did not pose much of a problem; primarily it was either composted or burned in backyards. Prior to the late 1940s, the island was self-sufficient and produced much of its own food through farming and fishing. Meat and fish were preserved through salting, using salt gathered in the local salt ponds. Wastes were predominantly biodegradable or used as a food source for farm and domesticated animals, and there were few imported, commercial goods on the island. Re-use of textiles, bottles and metals was a common practice. Post-World War II years saw the emergence of plastic and other commercial wastes imported from abroad.

By 1965 solid waste dumpsites were located on Tortola at Prospect Reef, Duff's Bottom, Coxheath, Carrot Bay and the East End—areas which span the island. To reduce waste volumes, open burning was common practice at these sites. Georges (2002) reported that during this time one government collection truck serviced the capital of Road Town and the densely populated area of the East End. On the northern side of the Island, some areas were serviced by outsourced contractors. Households in unserviced areas managed their own wastes through burning or burying. In 1972, the dumpsites located at Coxheath, Carrot Bay, and East End were closed. According to Georges (2002), Duff's Bottom was used until 1986/7 and Coxheath was reopened and used until the new incinerator was installed in February 1994.

Photo 137.
A litter-free road on Tortola due to regular clean-up teams working.

In 1971, the first regulations affecting solid waste were enacted in the BVI, requiring households to dispose of "house refuse" in bins with lids and that any excessive wastes, such as "white goods" (*e.g.*, appliances), had to be removed at the owner's expense. Solid waste management fell under the Division of Environmental Health until 1995 when the Department of Solid Waste was formed under the Ministry of Health and Social Development. More recently, this department was rebranded and renamed mid-2012 as the Department of Waste Management (DWM).

An Integrated Waste Management Plan (IWMP) was compiled in 1990 by the consultants who installed the Pockwood Pond incinerator. In addition to recommending incineration as the preferred method of disposal, recycling was advised. However, no recycling initiatives were implemented, and no comprehensive legislation regarding waste management was enacted.

7.1.2.2 Current Status

The DWM is responsible for the placement of dumpsters and bins, the collection of waste from dumpsters, maintenance of road verges, street cleaning, removal of derelict vehicles, management and maintenance of the incinerator and landfills, and waste education activities. Waste management in the BVI is financed solely through general government revenues, and no fee is charged for collection or disposal.

The DWM consists of a Department Manager who reports to the Permanent Secretary of the Ministry of Health and Social Development. DWM staff totals 88, with 9 assigned to the main office, 22 to Pockwood Pond, and the remainder to street cleaning throughout the territory.

The DWM faces many of the obstacles highlighted in **Table 39**, such as limited funding; inadequate physical, technical and human resources; and a lack of environmental monitoring and supporting legislation. This combination of factors has prevented full implementation of better waste management practices such as:

- waste reduction initiatives,
- better enforcement of litter control legislation (**Photo 137**),
- hazardous waste management planning, and
- provision of liners and leachate treatment plants for dumpsites.

Nevertheless, there is a general sentiment in the BVI that prioritisation of waste management by Government has improved and that there is currently political will to improve existing systems.

7.1.2.3 Storage and Collection

In general, the public is aware of how to manage their wastes correctly, although certain negligent behaviours still exist. In Tortola, although the public is encouraged to bring bulky items directly to the incinerator, some residents dump bulky goods, construction waste, and tree trimmings around dumpsters, which the DWM then collects at extra cost.

Ninety percent of waste collection in the BVI is outsourced but supervised by the DWM. Eight private waste companies are operational on Tortola, and, in addition to government contracts, they serve businesses and the eight districts of Tortola, with a contractor for each district. They are responsible for servicing 150 steel dumps (between 2-to-8 cu yds in size, **Photo 138**), which are strategically placed around Tortola. Residents place their household waste in these receptacles, but businesses are required to take waste directly to Pockwood Pond themselves or via a private contractor. Currently, cruise ship waste is not accepted on Tortola. It is uncertain whether the new cruise ship pier expansion project includes requirements to accommodate their waste.

In the last quarter of 2013, a "door to door" pilot collection system was initiated at Hawks Nest, Lambert Estate, Beef Island and Balsam Ghut, as these areas were not previously serviced with a steel dumpster. Collection is on Monday, Wednesday and Friday mornings and services approximately 70 houses. The collection system has not imposed any significant strain on the DWM, and the response from the public has been positive.

Sixty new fifty-gallon litter bins have been placed around Road Town (**Photo 139**) and are also serviced by the DWM. The DWM shares the responsibility of keeping Road Town clean and tidy with the City Manager's Office. Roles and responsibilities are currently under discussion.

Bins on selected beaches, such as Brandywine, Trellis, Josiah's, Cane Garden, Brewer's, Smuggler's Cove, and Long Bay, are serviced by the Department of Conservation and Fisheries with a crew of approximately ten personnel (**Photo 140**).

Photo 138.
An example of the steel dumpsters common on Tortola.

Photo 139.
Department of Waste Management bins in Road Town.

Photo 140.
An example of the bins placed on selected beaches by the DCF, this one found at Brandywine Beach.

The DWM shares responsibility for maintenance of road verges with the Department of Public Works. DWM is responsible for trimming grass and picking up litter, while the Department of Public Works cuts branches and trees and cleans gutters and drains.

Costs for managing waste are high relative to the volumes being managed. **Table 41** provides a breakdown of costs for 2012.

Table 41.
Waste collection indicators for 2012 in US dollars.

Island	Total Waste (Tons)	% Distribution	Contract Expenditure	Admin Cost	Total Cost	Cost/Ton
Tortola	35,746	80%	$1,295,487	$16,000	$1,311,487	$37/ton
Virgin Gorda	6,960	16%	$260,717	$3,220.	$263,937	$38/ton
Jost Van Dyke	1,250	3%	$48,581	$600	$49,181	$39
Anegada	377	1%%	$14,574	$180	$14,754	$39
Total	**44,333**	**100**	**1,619,359**	**$20,000.**	**$1,639,359**	

Source: Egarr & Associates, 2013.

7.1.2.4 Disposal and Treatment

The DWM operates the waste disposal and treatment facilities within the territory with waste in the BVI being either landfilled or incinerated. There are currently three dumpsites in the territory, situated on Tortola, Virgin Gorda, and Anegada. A fourth site in Jost Van Dyke has now been capped and closed. Open burning, spreading and compacting of waste are common practices. Landfills are unlined, with no leachate treatment plants.

Due to the limited land space and hilly terrain of the island of Tortola, landfill engineering is difficult and expensive. Macguire (2001) concluded that the construction of a landfill on Tortola would require special engineering and would cost approximately US$12 million, for an expected five-year life span. Therefore, incineration is considered the most viable option of disposal currently available to Tortola "despite the high cost of technology, and possible environmental and health effects of the emissions"

(Georges, 2002). Even with the Pockwood Pond incinerator, landfill space is still required for certain waste streams such as bulky white goods, metals, tyres and incinerator ash (**Photo 141**).

Photo 141.
A view from the landfill at Pockwood Pond, Tortola.

Sewage sludge is not accepted at the dumpsite. A chipper was procured in 2013 to chip wood into mulch. Mulch is given away at no fee. Chipping is done on a request basis and is not part of day-to-day operations.

Two incinerators are located at Pockwood Pond next to the landfill (**Photo 142**). The old incinerator, a Consumat CS-1600, was installed in 1994 with a capacity to burn 40 tons per day. It was decommissioned in late 2011, having operated well beyond its expected ten-year life span. Government anticipated that this incinerator could be repaired and used as a back-up, but repair costs proved prohibitive. The new incinerator, a Consumat CS-4000 costing $4.5 million, went on-line in November 2011 and has the capacity to burn 100 tons per day.

Initially, operational costs for the new incinerator spiked due to propane required for the incineration process. This has subsequently been adjusted and temperatures are now maintained by burning waste. The incinerator operates 24 hours a day. Incoming residential and commercial waste is dumped onto the concrete floor of the building and fed into the incinerator by a three-cubic-yard front-end loader every six minutes. The incinerator is shut down for approximately one week a month to stockpile waste and carry out maintenance.

Photo 142.
The incinerator at Pockwood Pond, Tortola.

In September 2014, new operating hours were put in place for public access to the incinerator plant, from 6 am to 4 pm. Contractors responsible for residential wastes tend to deliver waste between 9 pm and 1 am. The incinerator plant began accepting waste from Jost van Dyke in late 2014. Weekly delivery from Jost is anticipated as a 40-cubic yard compactor and possibly a 20-yard steel dumpster.

Certain waste streams have proven to be problematic for incinerators. A high organic fraction causes waste to burn less efficiently. Materials such as glass, metals, construction/demolition wastes, and bulky wastes cannot be incinerated. Glass melts and clogs up the equipment and has to be routinely chipped off by hand.

No separate collection or disposal methods exist for household hazardous wastes. The burning of household hazardous waste increases the likelihood of toxic emissions such as cadmium, lead and mercury. No scrubbers (air pollution control devices) exist on the new incinerator to trap toxic particles and gases being emitted as air pollution. However, scrubbers have been procured and, according to DWM personnel, will be in place by the end of 2015.

7.1.2.5 Policy and Legal Issues

When the BVI's National Environmental Action Plan (Section 2.2.4.4) was in preparation, a number of focus group sessions were conducted to determine perceptions of residents and visitors regarding the environment and to identify issues and mechanisms to protect and preserve the territory's natural resources. With reference to the disposal of solid and liquid wastes (including waste from vessels), 60 percent of respondents believed that current waste management practices (including sewerage systems) were inadequate (DCF, *et al*., 2004).

The NEAP report includes several proposals for improved management of solid waste:

- The monitoring and control of pollution from landfills and the incinerator.
- Early warning systems for potential waste disposal hazards such as oil spills.
- Development of a national strategy for waste management.
- Imposition of a tariff for waste disposal services.
- Installation of scrubbers on the incinerator.

Unfortunately, the NEAP was never approved by Government, and, as stated in Chapter 2, its objectives and recommendations exist now as a guide and planning tool without the force of policy.

A more current initiative for waste management was to be found in the Environmental Management and Conservation of Biodiversity Bill (Law Reform Commission, 2008). As discussed in Chapter 2 (Section 2.2.3.6), this legislative initiative, while dormant for several years, is currently being revised and updated by Government. If enacted, it will provide a broad and sweeping change for the way the environment is managed in the BVI going forward.

The 2008 bill included mechanisms to better understand the nature of the territory's wastes. Hazardous wastes were to be classified, with licensing and permitting standards implemented to manage these wastes safely. The bill also called for establishment of mechanisms to measure all forms of pollution, including those derived from waste management practices. Hopefully, a new environmental management law will address these same issues.

In the meantime, there is currently no comprehensive legislation to broadly guide waste management in the BVI. There are two relatively narrowly focused laws in effect at the present time.

1. The **Litter Abatement Act** was enacted in 1987 and amended in 2004 and 2009. The 2009 Amendment makes provision for the appointment of trained litter wardens, in addition to police officers, to be drawn from DWM staff, public health inspectors, and volunteers from community groups. The intention is to issue warnings to perpetrators in an attempt to change behaviour without clogging the legal system. To date, the legislation has largely remained unenforced, although there have been efforts to use surveillance cameras in problem areas, and in October 2014 Government announced its intention to reinstate litter wardens and provided training for proposed wardens. The Tortola community continues to rely heavily on periodic "clean-up" programmes initiated by Government and/or civic groups to help rid the island of unsightly litter. The maximum penalty for illegal dumping is $500 or three months in prison.

2. The 2006 **Derelict Vehicle Act** requires derelict vehicles to be identified and disposed of. Written notice is provided to the owner of the vehicle and if the vehicle is not removed within the designated timeframe, it is removed by Government and taken to a metal recycler site at Sea Cow's Bay (see below, Section 7.1.2.6). The Act provides for implementation of a "disposal fee," to be accessed when a vehicle is licensed and for the establishment of a fund to cover the costs of the derelict vehicle programme. It is not clear whether this provision has been or will be implemented.

In 2013, the BVI Government contracted with the Trinidadian firm of Egarr & Associates to draft a comprehensive Solid Waste Management Strategy for the territory (see also Section 2.2.4.12). The firm's scope of work included recommending a strategy to divert 80 percent of the territory's waste within six years, with an underlying tenet that waste was to be redefined as a resource and treated accordingly, *i.e.*, waste used to make alternative products.

The final report was completed in August of 2013, approved by Cabinet and subsequently tabled in the House of Assembly (*pers. comm.*, Petrona Davies, Permanent Secretary, Ministry of Health and Social Development). The report calls for a zero-waste management strategy (eliminating waste through recycling and reuse) and stipulates a budget of almost twenty million dollars to achieve the goals established. The report predicts these costs could be offset by about 21 percent because of reduced use of the incinerator.

The report also recommends the creation of a new Solid Waste Management Authority to oversee the development of waste facilities and to improve collection, storage and disposal of waste through cost-recovery methods.

A working group consisting of government and civil society members has been formed. The group meets monthly and is currently drafting a business plan to carry the strategy forward. It is presently comprised of four sub-groups: research and design, legal, operations, and education.

7.1.2.6 Education

The **Department of Waste Management** had a full time Waste Education Officer on staff who developed public education initiatives using the mediums of television, radio and print to teach residents how to dispose of waste correctly. School education programmes were complemented by competitions and a mascot. The temporary transfer of the Waste Education Officer in 2011 has resulted in a less active outreach programme.

The **Department of Conservation and Fisheries** assists in highlighting the importance of a clean environment with an annual volunteer beach clean-up as part of the International Coastal Clean-up(ICC) initiative. In 2013, 3,365 pounds of waste was collected by 188 volunteers over six miles on Tortola. The largest categories collected were plastic bottles, cans and glass bottles, utensils, and caps and lids (ICC, 2014).

The **BVI Tourist Board** facilitates an annual "Trash to Treasure" contest to encourage youth to see and understand the value of the materials they find in their every-day environment.

Green VI, a BVI not-for-profit organisation, has initiated projects focusing on waste, energy, water and education in order to build a greener, cleaner, and healthier BVI (*www.greenvi.org*). Green VI has initiated the following educational projects around the waste theme:

- Development of Green VI's Glass Studio at Cane Garden Bay which has welcomed thousands of visitors, including students from all BVI schools, to watch "trash to treasure" in action. Local apprentices are being trained in the art of glass blowing.
- A trash to treasure programme for schools, in which Green VI facilitates artists' interaction with students as treasures are created from trash. Participants are encouraged to enter the BVI Tourist Board's annual Trash to Treasure contest.
- An annual CHAIR-ity competition, facilitated by Nutmeg Designs, is a fundraiser for Green VI designed to encourage artists to make chairs from discarded materials. The contest is in its fourth year.
- Numerous outreach programmes to raise awareness on how participants can reduce, re-use and recycle.

7.1.2.7 Waste Reduction, Re-use and Recycling

The BVI, like many small islands, lacks the financial and technical resources, as well as the associated industries, to easily recycle materials. The high cost of transportation means that recycling is not practical in many instances and is therefore not pursued as enthusiastically as it is in non-insular areas. Furthermore, economies of scale render the quantity of recyclables insufficient. However, new markets and technologies are beginning to open up new possibilities.

A waste management hierarchy of reduce, reuse and recycle is presented in Egarr & Associates' Solid

Waste Management Strategy for the BVI (see **Figure 39**). It emphasises the following:

- *Reduce* as much waste as possible so that waste is not produced in the first place.
- *Reuse* all possible materials remaining.
- *Recycle* what cannot be reduced or reused.
- *Treat* what cannot be recycled, reused or reduced.
- *Landfill* only those wastes that cannot be filtered through the above tiers.

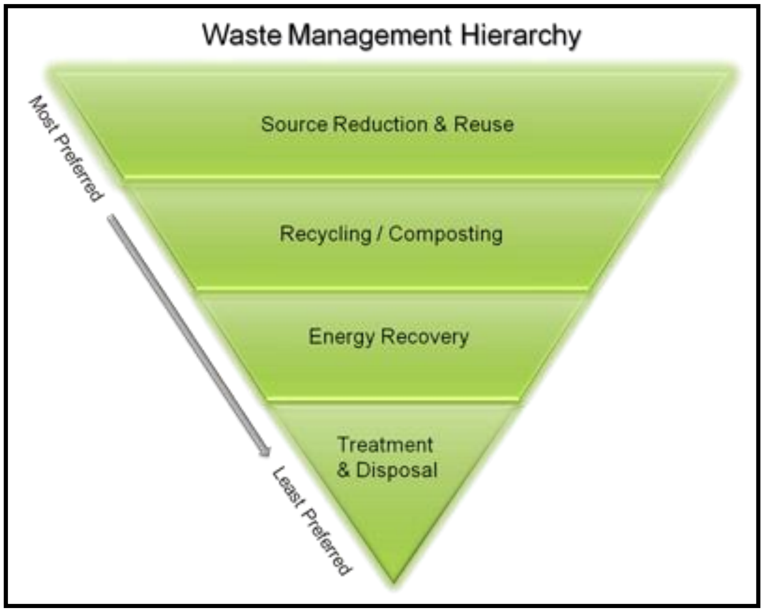


Figure 39.
Waste management hierarchy (*source*: Egarr & Associates, 2013).

The BVI's voluntary plastic bag ban, initiated in 2013, was an important first effort to reduce waste and encourage reuse in the territory. Two local NGOs—WorldHouse Caribbean and Green VI—in partnership with eight BVI retailers initiated a *voluntary* plastic bag ban. Participating retailers charged customers 15 cents for plastic bags for a period of one year in an effort to encourage shoppers to carry recyclable bags. For the most part, the response was impressive with large numbers switching to reusable bags. However, a year-and-a-half later, plastic bags are re-appearing at checkout stations, again indicating that the ban needs to be legislated, rather than voluntary.

During the 1990s, a private-sector aluminum can recycling project was implemented in Tortola and a recycling committee established. The initiative ran for approximately ten years, but ended for a variety of reasons, including pest problems in storage areas, mixed waste being added into the recycling bins, and transportation costs rendering the initiative unviable without government support.

In 2006, there was a glass recycling effort at Sea Cow's Bay. Many tons of bottles were collected with the aim of crushing glass and shipping it to Puerto Rico for recycling. When the time came to ship the crushed glass, there was no market demand, and the operation stalled. The glass is still on the site.

Current recycling activities on Tortola include:

1. **ENS Excavation Ltd**., which focuses on scrap metal recycling. Ferrous and non-ferrous metals are collected, sorted, compacted and exported to the United States. This private enterprise, based in Sea Cow's Bay on Crown Land,

has been in operation for almost a decade. The firm's baler was recently repaired (May 2014) after being down for almost a year. Derelict vehicles confiscated by the DWM are transported to the site where they are compacted and shipped to a scrap yard in Florida for processing. In partnership with the DWM, 675 derelict vehicles were recycled in 2011 and 673 in 2012 (Egarr & Associates, 2013).

2. **Green VI's Glass Studio** serves as a small-scale recycling project that demonstrates waste as a resource. Old bottles are recycled into decorative products; used vegetable oil is used as a fuel source for the reheat chamber; and textile, paper and cardboard waste become packaging. Relocation of the glass studio to Virgin Gorda is planned as is a methane digester that will utilise sewage and organic waste to create fuel to run the furnace.

3. A new recycling company, **Earth Culture Waste Management**, is currently in the process of procuring metal recycling equipment that can handle scrap metal of all sizes from cars to cans. The firm aims to establish itself at Pockwood Pond and collect metal from the dump site and prepare it for export. Once the scrap metal recycling is established, the company anticipates recycling plastics, cardboard and tyres.

4. DWM plans to collect and barge glass waste to the private recycler **Green and Clean VI, Ltd.** on Virgin Gorda. Green and Clean has an industrial glass imploder that can manage 2.5 tons of glass per hour. The output from the process is a clean-glass aggregate that can be used for numerous construction purposes.

7.1.3 Environmental Impacts from Current Waste Management Practices

Although no specific empirical data exist on the environmental impacts of current waste disposal practices in Tortola, it is generally known that waste management practices contribute to soil, water and air pollution, environmental degradation, and associated health problems. Below are some areas of possible concern for Tortola.

7.1.3.1. Emissions

Emissions from open burning as well as the incinerator have sparked cause for major concern. No scrubbers currently exist to trap toxins being emitted as air pollution on the new incinerator. No specific data have yet been gathered to assess these emissions on Tortola although there is a large body of information on health implications linked to incinerator and open burning emissions in other parts of the world.

Open burning at Tortola's dumpsite has been a common practice. Emissions from the old incinerator and the dumpsite sparked concern for residents downwind of the incinerator and also affected the neighbouring US Virgin Islands. The US Environmental Protection Agency formally requested that the BVI stop polluting the air of St. John in 2011. Complaints from the same US agency were also lodged against the BVI with the Foreign and Commonwealth Office in the United Kingdom.

The H. Lavity Stoutt Community College hosted a panel discussion to highlight the right to a clean environment in April 2010 with a focus on clean air. A team of lawyers highlighted steps that the public could take to file suits against the BVI Government due to negative health impacts from incinerator emissions.

Currently, open burning emissions have been significantly reduced due to the new incinerator being online. Government has procured a scrubber system for the new incinerator and aims to have it in place in 2015. The management of ash from the incineration process requires urgent attention. As there is no Hazardous Waste Management Plan in the BVI, it is likely that the incinerator's bottom ash is hazardous and should be treated accordingly. The ash may contain heavy metals such as lead, cadmium and mercury. Ash is currently disposed of behind the incinerator at the dumpsite where it can lead to air, water and soil pollution.

Methane is emitted as part of the decomposition process at landfills and is highly flammable. The risk of landfills catching fire is a common concern as the fire is difficult to extinguish and control. In addition, methane is known to contribute to global warming, and, as it filters up through layers of buried garbage, methane can also pick up carcinogens.

7.1.3.2 Leachate and Runoff

Leachate is the liquid (usually black in colour) that is formed in landfills as rain water (and other liquids), seeps through waste and "picks up" molecules from discarded items. The toxicity of leachate, and run-off, is thus dependent on the waste stream of the landfill.

In Tortola, there is no separation of hazardous waste, and therefore it is likely that leachate will contain heavy metals (such as mercury, lead and cadmium), major ions and volatile organic compounds, all of which have the potential to contaminate groundwater supplies and the terrestrial and marine environment of the watershed. There are many gaps in available knowledge regarding the long-term implications of leachate and runoff, such as:

- unknown chemical reactions in a landfill over time,
- the difficulty of detecting these compounds, and
- the need to understand how these compounds react with the existing environment.

Although new sanitary landfills trap methane and leachate, they are expensive to build and manage. Additionally, "*not in my backyard*" is a popular concept used to garner public opposition to the siting of new landfills and incinerators near to communities.

Even if the Tortola dumpsite was to be redesigned and lined according to sanitary landfill standards, long-term risks would remain, as even the most sophisticated liners will eventually leak. According to one expert, "State-of-the-art landfills merely delay, rather than eliminate massive pollution to groundwater" (Royte, 2005).

7.1.3.3 Litter and Illegal Dumping

There are no litter fences around the incinerator and dumpsite at Pockwood Pond, and there is evidence of wind-blown litter in surrounding areas. In general, litter and illegal dumping are on the increase in Tortola. Some residents consider littering permissible because it creates jobs for those who clean it up. Roadside litter is widespread throughout the island, but regular clean-ups by the DWM attempt to ensure that such litter is managed. Significant amounts of litter are evident in ghuts and bushes not serviced by the DWM.

Problems associated with litter and illegal dumping include:

- It is visually unappealing and sends a message that an area is not cared for.
- It decreases the positive perceptions visitors have about the island and may decrease the likelihood of return visits.
- It can block drains and contribute to flooding.
- It kills marine and bird life through strangulation and ingestion.
- It adds additional expense to the public coffers for clean-up.
- It is a potential breeding ground for insects and vermin.

7.1.3.4 Vector and Pest Problems

The presence of vectors and pests—such as flies, rats, mosquitoes, cockroaches and other animals—are common at the Pockwood Pond facility and at individual steel dumpsters. Fly bait is used at Pockwood Pond and dumpsters to control flies.

Litter and derelict vehicles can provide breeding areas for mosquitos and are of particular concern as there have been many cases of dengue fever reported on Tortola. There is also more recent concern about the spread of the mosquito-borne Chikungunya virus. Stagnant water in discarded tyres is a particularly convenient breeding ground for mosquitos.

7.1.4 Future Planning for Solid Waste Management

McDevitt (2008) recommends various short and long term strategies for waste reduction and resource management in the British Virgin Islands based on a concept of *utilising waste as a resource*. A few tools, methods, and practices to help achieve sustainable waste management are suggested below.

1. **Composting**. Composting is a simple and effective strategy to apply to waste management systems since organic waste constitutes as much as 30 percent of the waste stream in Tortola. Commercial fertilisers are imported, while valuable organic waste is rendered useless through burning and burying. Reducing the organic fraction in the waste stream is likely to reduce dioxin emissions.

   Further research into the most appropriate composting system for the BVI will need to be conducted. Composting systems that can handle food waste, organic waste and sewage sludge would be best suited. An educational campaign demonstrating home composting and the benefits of compost over artificial fertilisers could be implemented. Economic incentives might include the subsidising of home composting bins and locally produced compost. Imported fertilisers could be subjected to increasing taxes.

2. **Extended Producer Responsibility** is potentially a powerful leverage tool that can be used to minimise waste and manage resources at the source of origin. The responsibility for waste is transferred onto producers, suppliers and consumers through economic instruments and legislation. The concept can be used to reduce and even eliminate such problematic wastes as electronic waste (e-waste) and hazardous wastes, thereby reducing the accumulation of toxic materials in the BVI.

3. **Partnerships** are required to facilitate skill building, promote information and technology exchanges, and increase synergy between institutions and islands.

   Waste management affects the economic, social and environmental sectors of BVI society and is not simply the responsibility of the DWM. Inter-departmental co-operation within government will be necessary to successfully execute the new BVI Waste Management Strategy, for example, collaboration with the Department of Public Works to ensure recycled glass aggregate is used for sidewalk and road construction.

   Additionally, the BVI Government could partner with organisations outside of the local public sector, such as such as the Virgin Islands Recycling Partnership or the UK Foreign and Commonwealth Office, to increase collaboration and shared resources. Public-private partnerships could be supported so that local businesses begin to develop best management waste disposal practices. Small enterprises, such as Green VI's Glass Studio, need to be encouraged as they utilise waste as a resource.

   The BVI could also partner with Jamaica, Trinidad and Tobago, and the US Virgin Islands, all of which are currently pursuing electronic or e-waste initiatives and legislation.

4. **Green Procurement.** Due to the high rate of importation in the BVI, green procurement could effectively be used to encourage importation of environmentally friendly products. One example is biodegradable utensils and plates to replace the plastic counterparts that constitute the largest litter component on beaches.

5. **Construction Guidelines**. As part of the development planning process within the Department of Town and Country Planning, guidelines could be made available to encourage the reuse of certain materials in construction and the deconstruction of buildings to enable reuse.

6. **Plastic Bag Legislation.** Plastic bag legislation should be implemented to reduce the use of double-bagging flimsy plastic bags and encourage reuse of durable bags. Durable bags can be made locally using available materials.

7. **Current educational and public awareness initiatives** should continue to be supported and incorporated into a wider environmental education strategy for the BVI.

Many factors are already in place that point to a promising future for waste management in Tortola and in the wider BVI territory. These include:

- The presence of a political will to improve waste management.
- The development of the comprehensive Solid Waste Management Strategy for the British Virgin Islands.
- The formation by Government of a working group to implement a zero-waste strategy.
- The opening up of new recycling markets in Puerto Rico.
- The potential of private recyclers establishing systems in the BVI to manage various waste streams.

Egarr & Associates (2013) have outlined the following recommendations to achieve an 80 percent diversion rate (*i.e.*, waste used to make alternative products) within six years with a budget of $20 million. The action steps are outlined as follows:

1. **Public Education and Awareness**
   - Re-establish and strengthen the outreach capacity of the DWM.
   - Strengthen integrated communication programmes.
2. **Waste Minimisation, Segregation and Diversion**
   - Enhance existing minimisation and diversion Initiatives.
   - Develop additional waste minimisation and diversion strategies for the territory.
   - Promote community activities.
   - Establish incentives to facilitate minimisation and diversion strategies.
   - Establish minimisation and diversion strategies for selected materials.
3. **Institutional Arrangements and Legislative Framework**
   - Determine appropriate institutional and organisational structures.
   - Enact Solid Waste Management legislation and put the Solid Waste Management Authority in place.
4. **Physical Systems and Administrative Functions**
   - Revisit waste collection practices and mechanisms.
   - Establish a bottom ash management programme for the incinerator facility.
   - Establish new waste delivery hours for the Pockwood Pond Incinerator.
   - Re-define the incinerator facility's function relative to waste minimisation and diversion.
   - Commission a comprehensive study on a waste-to-energy strategy.
   - Establish segregated waste delivery requirements.
   - Review and determine location for a central material recovery facility.
   - Increase site supervision at existing disposal sites and develop a closure and post-closure plan for targeted sites.
   - Strengthen management information systems and performance indicators.
   - Schedule a training programme.

Improving current waste management practices and implementing a progressive waste management strategy will significantly contribute to a safe and sustainable environment for the BVI. Utilising resources optimally will improve human health, create jobs and harness the BVI's creative potential to transform current waste challenges into opportunities for the betterment of the territory.

7.2 Pollution and Associated Environmental Risks

As the largest and most populated island in the territory, with an increasing population and expanding infrastructure situated on a finite land surface, the island of Tortola is experiencing significant challenges in keeping pollution to a minimum while preserving the attributes that ensure a good quality of life for its people and attractive amenities for its visitors.

Tortola remains the territory's main gateway for visitors and residents alike, a role more recently enlarged with the Road Town cruise ship pier upgrade, a significant rise in inter-island ferry traffic, and the anticipated expansion of the Beef Island airport. Maintaining the integrity of the island's marine and terrestrial environments in the midst of so much expansion has reached levels that at times seem unsustainable. Signs of a deteriorating environmental landscape, with requisite impacts on daily life, are evident in such quality-of-life indicators as almost constant traffic congestion and high tourist density (especially cruise ship passengers) at limited and increasingly stressed visitor attractions. Concerns related to solid waste (Section 7.1), domestic wastewater, and other point-source and non-point-source pollutants have been intensified by increased coastal development, tourism infrastructure, and even residential development.

7.2.1 Wastewater Systems

Traditionally, sewage disposal in Tortola has been either by direct dumping in the sea or by the use of septic tanks and soak-aways or field beds. The direct discharge of raw sewage into coastal waters is usually practiced by shorefront residents and businesses. Sewage is also disposed by yachts navigating the island's nearshore environment or anchoring in the many harbours of Tortola and Beef Island (see also Section 5.2.1.2 in Chapter 5).

A centralised system to collect, treat and dispose of sewage is unavailable for most residents in the British Virgin Islands. According to the 2010 BVI Census Report, just under 29 percent of Tortola households have flushed toilets linked to a sewer system. The majority of households (almost 71 percent) have flushed toilets that are connected to septic tanks/soak-aways, and less than one percent of households have waste disposal systems such as pit latrines (**Table 42**).

Table 42.
Type of household toilet facilities in Tortola.

Type of Toilet Facility	#	%
Flushed toilet linked to sewer	2,499	28.6%
Flushed toilet linked to septic tank/soak-away	6,187	70.8%
Pit latrines	36	0.4%
Other	10	0.1%
None	5	0.1%
TOTALS: Stated Toilet Facility	**8,737**	**100%**

Source: Central Statistics Office, 2014.

7.2.1.1 Existing Municipal Wastewater Systems

On Tortola there are two network-based municipal wastewater systems, one for Road Town and the second for Cane Garden Bay. **Table 43** provides the general characteristics of the Road Town and Cane Garden Bay sewerage systems.

The older of the two serves a section of Road Town and primarily functions as a combined wastewater and storm water collection system that conveys wastewater to a discharge point offshore (Francis, 2014). The Road Town central sewerage collection system is essentially comprised of a network of gravity lines, force mains and pump stations. No treatment facility exists; hence, the raw sewage is directly discharged into the ocean, approximately 183 m (600 ft) offshore, near Slaney Point (**Photo 143**).

Photo 143.
Sewerage outfall located 600 feet from the shoreline at Slaney Point, southwest of Road Town.

Built over 30 years ago, the gravity pipelines are significantly undersized for the island's increasing population and expanding commercial establishments. In addition, some of the pipelines are deteriorating and pumps are failing. This contributes to frequent overflow of untreated sewage that enters storm drainage systems and eventually flows into the sea. As a result, Road Town has for many years experienced the strong odor of sewage that regularly permeates the air.

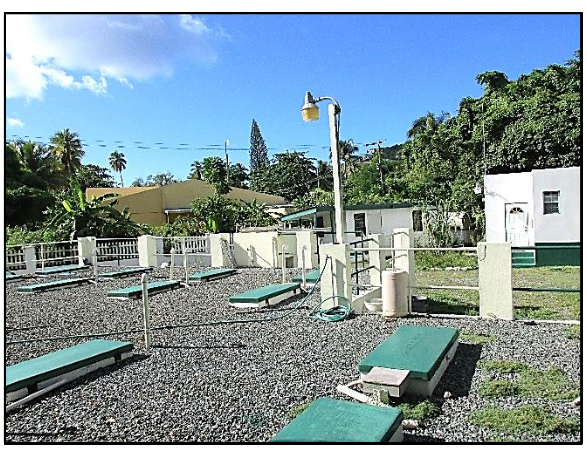


Photo 144.
Sewerage treatment plant at Cane Garden Bay.

The second and younger municipal wastewater system is located in Cane Garden Bay (CGB), a small community along the northwest coast of Tortola. This system was completed in 1999, following years of growing water quality issues culminating with significant flooding in 1997, which impacted CGB's residents, businesses and tourists alike. Up to that time, aside from private septic systems, waste and wastewater was frequently dumped into ghuts and tributaries. The storm of 1997 caused flooding along ghuts and low-lying areas producing major waste problems along the shoreline, beach and bay waters. The impact caused beach closures and marine pollution that seriously affected the local tourism industry and CGB residents. The construction of the first publicly run sewerage treatment plant began shortly after amidst growing public pressure (*BVI Beacon*, 23 October 2014).

The sewerage treatment facility serves part of the Cane Garden Bay community, although the total number of users is unknown (**Table 43**). It functions as a collection plant, and, secondarily, as an aerobic treatment and disposal system with a marine discharge point for treated effluent that extends some 220 m (720 ft) from the coastline (**Photo 144**).

Both systems are old, antiquated, and incapable of handling current loads that far exceed the original design capacities. As a consequence, the systems are in a constant state of disrepair, and operations are hindered by critical maintenance problems. These circumstances place a heavy burden on the Department of Water and Sewerage (DWS), the agency tasked with operating and maintaining the territory's municipal sewerage infrastructure (Francis, 2014).

Table 43.
Current municipal sewerage systems on Tortola.

	ROAD TOWN	CANE GARDEN BAY
General Data		
Age of System	>30 years	1999
Owner	BVI Government	BVI Government
Operation & Maintenance	Department of Water and Sewerage	Department of Water and Sewerage
Total No. of customers	1736	Unknown
Customer Category	Commercial: 303 Domestic: 1,413 Government: 20	Residential, Commercial, and Institutional
Sewer Network Coverage	= 60%	N/A
On Site Sewerage Disposal	Septic Tank with soak-way Septic tank without soak-way Direct disposal into environment	N/A
Cost of Service/Tariff Structure	Fixed charge based on rental value of property at the time of connection	Free
Wastewater Treatment Plant		
Treatment Type	None — disposal at marine outfall	Secondary aerobic with sludge processing and chlorination of effluent
Design Treatment Capacity	N/A	45,000 gal/day
Current Operating Treatment Capacity	N/A	30,000 gal/day
Collection System		
Type	Gravity/Pressurized	Low Pressure
Number of Pump Stations	18	35
Total length of piping	Unknown	15,000 feet
Outfall Discharge Pipe		
Type and Size	8 inch High Density Polyethylene/PVC	3 inch Polyethylene
Length	550 feet	720 feet
Anchor Type	Concrete block	Concrete block

Source: Francis, 2014.
Note: A tertiary wastewater treatment plant is located at the Beef Island airport to service the terminal building.

7.2.1.2 New Sewerage Systems

Guided by the 2002 Wastewater Master Plan prepared by Berger-CBE (BVI) Ltd., the BVI Government has initiated two major projects which are currently underway for East End/Long Look and Road Town. These efforts aim to resolve the serious deficiencies of the present system of collecting, treating and disposing of sewage in two heavily populated areas of the island. The primary objectives of the project are:

(1) to provide a centralised collection system in the East End, and

(2) to correct the deteriorating and inadequate system in Road Town.

The 2002 Wastewater Master Plan for the British Virgin Islands is a comprehensive 30–year strategy to develop a sewerage system and wastewater treatment for the entire territory. More specifically, the

Master Plan recommended specific initiatives to improve on existing systems and to provide proper sewerage collection and treatment systems in communities that have no centralised systems. The Master Plan envisioned 44 projects to be completed by 2019. Unfortunately, lack of funds, administrative issues, and shifting priorities have reduced the current effort to only two areas, detailed as follows.

(1) East End/Long Look Sewerage System

A new collection system is underway to service a population of the East End/Long Look area that is estimated to grow at an average rate of two percent per annum from 2011 to 2041 (CBE Engineering Associates Ltd., 2013) (see **Table 44**). The collection system, consisting of PVC pipes along narrow side streets, will be installed in the communities of Parham Town, Red Bay, James Young, Long Swamp and Major Bay. Two pump stations will be installed: one at Parham Town and one in James Young. These collector pipes will connect to a proposed transmission pipeline to be installed along the Blackburn Highway between Chapel Hill and eventually the proposed sewerage treatment plant at Paraquita Bay. A proposed pipeline will run the treated effluent from the plant to a sea outfall at Brandywine Bay.

Table 44.
Population and design flows
for East End/Long Look (EE/LL) and Road Town (RT).

	2011	2021	2031	2041
EE/LL Population	1,325	1,601	1,857	2,263
EE/LL Average Flow (gpd*)	127,737	212,955	248,505	300,565
RT Population	9,668	11,822	14,044	16,763
RT Average Flow (gpd*)	1,100,453	1,414,204	1,734,462	2,098,571

Source: CBE Engineering Associates, Ltd., 2013. * gallons per day

(2) Road Town Sewerage System

The current Road Town collection system is plagued by a number of problems, including: deteriorating and partially blocked pipes, a pump station that needs to be upgraded or replaced, and sewage overflows throughout the community (with unpleasant stenches) due to sewage entering the network of storm water drains.

In addition to the antiquated collection system, there is no treatment facility servicing the Road Town community. Raw sewage is currently pumped to an ocean outfall near Slaney Point.

The proposed upgrades and improvement in Road Town will focus on the most critical areas within the business district where pipelines are aged and can no longer handle the increased flow resulting from the fast-growing town with high-rise office buildings, restaurants, hotels and retail establishments. Within the Road Town area, the old 15 cm to 25 cm (6 in to 10 in) diameter gravity pipes are currently being replaced with new 30 cm to 53 cm (12 in to 21 in) diameter pipelines. This will eliminate overflows and provide adequate hydraulic capacity for at least a 30-year design period. Other needed improvements in the works include upgrade or replacement of pump stations and new force mains from the main pump station in Road Town to the new sewerage treatment plant at Burt Point, which is currently under construction (**Photo 145**).

The new pipeline design is based on population data obtained from the DPU (now the CSO), which predicted an average annual growth rate of two percent for the population of Road Town from 2011 to 2041 (see **Table 44**).

Photo 145.
Location for the Road Town Sewerage Treatment Plant at Burt Point. Pilings and backfilling works are in progress.

7.2.1.3 Domestic Sewerage System

According to the BVI Census Report for 2010, 70.8 percent of households use onsite septic tanks while only 28.6 percent are connected to the public sewerage system (**Table 42**). Pit latrines—although few—are still in use in Tortola with about three dozen households having such facilities. The Census Report further suggests that steps need to be taken to have the latrines totally eliminated, given the potential for negative health and environmental impacts.

Some onsite septic systems are old, overused (or undersized), and/or improperly installed and maintained. As a consequence, it is common to see untreated sewage overflowing from individual properties onto public streets and into storm water drains. Sewage seeping into ghuts is not uncommon as evidenced by an occasional stench or unpleasant odor. Eventually, during rainy periods, the effluent is flushed into the coastal environment, polluting the marine ecosystem and causing algal blooms.

A common reoccurring problem is associated with homebuilders who may initially construct a one-level dwelling with a small septic tank installed or built from cement block. As more financing becomes available to the owner, a second level is added to the structure. Too often, the septic system is not changed or upgraded to reflect the increased usage. The system quickly becomes over-capacity, and, to remedy the problem, sewage from the septic system is pumped somewhere out of sight but unfortunately not out of smell. A pump-out truck is sometimes called to perform the task.

A challenge is posed for the government agencies—usually under staffed—charged with monitoring pollution as too many homebuilders continue to construct homes or apartment buildings without having an adequate sewerage system in place. As the Chief Physical Planning Officer has noted, "One of the standard conditions for approval [of a building permit is] that, when persons are about to construct the septic tanks, they [are] supposed to inform both T&CP and Environmental Health Division so that they could monitor that aspect" (*www.bvi-platinum.com*, 18 March 2014). However, more often than not, homeowners building or expanding private residences simply fail to notify the appropriate authorities when commencing work on their sewerage disposal system.

Improper installation of septic systems is common throughout the territory and became a significant concern during the last decade in the Greenland area of Tortola, causing Government to intervene and install a temporary treatment plant to address the overflow of sewage in the streets of the community. The treatment plant is a temporary solution as work on the national sewerage project continues for the entire East End/Long Look areas (Section 7.2.1.2).

All septic tank users at some point have to request the services of a pump-out truck to de-sludge septic tanks. For the most part, pump-out trucks dump the sludge at the main pump station in Road Town near the roundabout (**Photos 146** and **147**). On a few occasions, depending on the composition of the sludge, the material is dumped at the Fort Burt and Waterfront Pump stations (*pers. comm*., Alva Francis, DWS, 13 March 2015).

Although septic tank waste is customarily dumped at the main Road Town pump station, at this time there are no regulations or policies in place for disposal of such waste in the territory and no official facility for waste sludge discharge, such as drying beds. Ultimately, the long term goal of the BVI

Government is to have an operational wastewater system for the territory. However, the lack of financial resources to implement the territory-wide system first envisioned in the 2002 Master Plan will require an incremental approach to setting priorities as funds become available.

Photo 146.
Tortola's main pump station at the Road Town roundabout.

Photo 147.
A typical sewage disposal truck used to de-sludge septic tanks and dispose of the sludge at the main pump station in Road Town.

7.2.1.4 Disposal of Waste Oil

Although there is no official policy or standards for waste oil disposal, the Department of Waste Management (DWM) encourages the community, businesses and individuals that generate significant amounts of oil to dispose of the waste oil safely at the incinerator in Pockwood Pond (GoVI Press Release, 19 December 2014). According to the DWM the oil disposal system at Pockwood Pond at capacity can hold between 1,500 and 2,000 gallons of oil. Once oil is received, it is held in the system until it is ready to be burned. The oil is then taken to the lower chambers of the incinerator where it is burned at a very high temperature while releasing minimal toxins.

Waste oil includes any petroleum-based or synthetic oil such as automotive oil, cooking oil, and other lubricants from household, mechanical and industrial sources. DWM states that persons should refrain from disposing of oil in kitchen sinks and the environment and instead leave waste oil in close proximity of solid waste dumpsters. There are reported cases of waste oil being dumped directly into the sea which has significant environmental implications.

While some establishments generating large amounts of waste oil, such as restaurants, have been utilising the recommended disposal site at Pockwood Pond, more businesses and individual households need to dispose of their waste oil at Pockwood Pond. The DWM is encouraging citizens to do their part to dispose of waste oil safely by storing the oil in tanks or containers that are in good condition and free of leaks and then transporting their waste oil products to the incinerator at Pockwood Pond for safe disposal.

Recycling is also an option for used waste oil. The NGO Green VI (Section 2.3.2 of Chapter 2) converts used vegetable oil as a fuel source to operate a glass furnace at its Cane Garden Bay Glass Studio.

7.2.2 Coastal/Marine Water Quality

While the largest and most populated of the major British Virgin Islands (see Sections 1.1.1 and 1.2.1 of Chapter 1), Tortola is also the most densely populated with 433 persons per sq km (167 per sq mi), more than double that of Virgin Gorda, the second most populated BVI island with 187 persons per sq km (72 per sq mi). Tortola's population is expected to increase from 23,419 to over 30,000 by 2020. This growth will inevitably contribute to additional stress to coastal and marine systems, particularly in areas with already elevated activity and development.

Of particular concern is Tortola's southern coast where most of the population resides. From Soper's Hole in the island's west end to EE/LL in the east end is a continuous zone of human-related activity where residential, commercial, industrial and tourist-related industry occurs—and continually grows. The northwest coast of the island is also experiencing a slow but expanding growth trend.

7.2.2.1 Marinas and Related Activities

The majority of marinas on Tortola are scattered along the south coast where there are numerous embayments that have favourable oceanographic and hydrographic conditions for marinas and other water-based activities (see **Table 45**). The high concentration of marinas, boatyards, repair shops, and related facilities increases the potential for pollution, including accidental spills of fuel and oil, pumping of contaminated bilge water, and improper disposal of solvents. Pollution caused by heavy metals is another concern associated with boatyards and marina operations.

Table 45.
Marina facilities on Tortola.

Name	Location	Full Service	Slips	Fuel	Garbage Disposal	Pump-out Facility
Fort Burt Marina	South Coast, Road Town	Yes		Yes	Yes	
H.R. Penn Marina	South Coast, East End	Yes				
JY Harbour View Marine Center	South Coast, East of Road Town	Yes	22	Yes	Yes	
Hodge's Creek Marina	South Coast, East of Road Town	Yes			Yes	
Inner Harbour Marina	South Coast, Road Town	Yes				
Manual Reef Marina	South Coast. Sea Cow's Bay	Yes	40		Yes	
Nanny Cay Resort and Marina	South Coast West of Road Town	Yes	180	Yes	Yes	Yes
Penn's Landing Marina	South Coast, East End Bay	Yes		Yes	Yes	
Soper's Hole Wharf and Marina	South Coast, West End	Yes	60	Yes	Yes	
The Moorings Marina	South Coast, Road Town	Yes	130	Yes	Yes	
Village Cay Resort and Marina	South Coast, Road Town	Yes	106	Yes	Yes	
Mega Surface Marina	South Coast, East of Road Town	Yes			Yes	
Wheatley's Harbour View Marina	South Coast, East End	Yes				
Joma Marina	South Coast, Road Town	Yes			Yes	
Light House Marina	South Coast, West of Road Town	Yes			Yes	
Prospect Reef Resort & Marina	South Coast, Road Town	Yes			Yes	
Road Reef Marina	South Coast, Road Town	Yes			Yes	

Note: Full Service indicates marina has water and power.

The growing number of yachts and other transportation vessels is a contributing cause to increased levels of pollution in the coastal waters surrounding Tortola. The result of sewage and wastewater discharge from boats, particularly "live-aboard" vessels, is an ongoing issue. Since vessels are not required by law to use holding tanks, most yachts dispose waste into the sea (see also Section 5.2.1.2 of Chapter 5). With a few exceptions, such as Nanny Cay, most Tortola marinas do not have pump-out stations (**Table 45**).

The lack of government controls and property owner oversight is a growing concern associated with marinas and boatyard facilities. Although wastes generated from the operation of marinas should be disposed of at the Pockwood Pond landfill facility, this is not always the case. Many marina operations cannot afford to implement inclusive environmental safeguards while trying to survive in an increasingly competitive economic climate. The unfortunate consequence is that hazardous elements, such as toxic tin-based anti-fowling paints (which are now illegal in the territory) and remains from fiberglassing and other boat maintenance—including oil and fuel—may leak into nearby coastal waters.

Additionally, most of Tortola's auto service stations are located within the island's coastal road corridor. These stations usually become *in-situ* storage areas for large quantities of stored used motor oils. This oil waste is stored in containers which eventually corrode and leak their contents on the ground, with much of this material finding its way to nearby ghuts and coastal waters.

7.2.2.2 Coastal Development

(see also Section 5.2.3, Chapter 5)

Development projects, particularly along Tortola's southern coastline, are numerous. All pose a threat to the coastal and marine environment if safeguards are not properly in place. Key among these has been expansion of the Road Town cruise ship pier, where the first cruise ship docked at the new structure in April of 2015. The scope of work involved the lengthening and widening of the cruise pier to more than 396 m (1,300 ft) and 18 m (60 ft), respectively. The pier is also being strengthened to accommodate ships up to 170,000 tons. The overall project includes a landside development called Tortola Pier Park, which is scheduled to be completed in 2015, featuring retail, commercial, entertainment and green space.

Dredging has been necessary in and around the pier facility and turning basin to allow for more space and safer maneuvering of ships. Existing rock rip-rap that formerly protected the landside will be replaced with a bulkhead for better protection. A 6 m (20 ft) wide boardwalk will be established from the pier along the waterfront for pedestrian traffic (*Island Sun*, 6 August 2014). **Photos 148** and **149** display the scope of work associated with the cruise pier expansion project.

Photo 148.
View of the cruise ship pier expansion project in Road Harbour, February 2015.

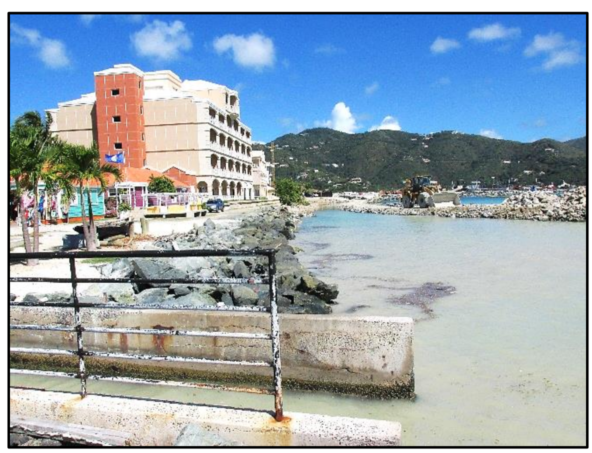


Photo 149.
Waterfront construction activity in front of Maria's by the Sea Hotel, with cruise ship pier project in the background.

The Environmental Impact Assessment prepared for the cruise ship pier expansion (Environmental Systems, 2012) identified a number of potential negative impacts that could arise from the project. The most significant were those from dredging and land reclamation activities, which have the potential to affect a wide area. Other impacts identified if proper best management practices are not put in place include: diminished water quality; increase in noise and air pollution; increase in liquid and solid waste; increase in traffic congestion; increase in pollution incidents due to increased boating activity; and a general degradation of the surrounding natural environment.

Other Road Town development projects under construction, such as the one in the east end of the capital city in **Photo 150**, illustrate poor management practices for control of sediment runoff. The improperly maintained silt fencing around the perimeter of this project is likely to pollute coastal waters after heavy rains.

In the East End, a re-development project at the Red Bay Fishermen's Dock (**Photo 151**) involves 1,115 m (12,000 sq ft) of land reclamation, a 44 m (144 ft) long concrete dock and an eight m (26 ft) wide public boat ramp. Land is reclaimed through the deposit of terrestrial sediment material and dredged marine sediments at the site. Unfortunately the exposed material remains unprotected from potential runoff (**Photo 152**).

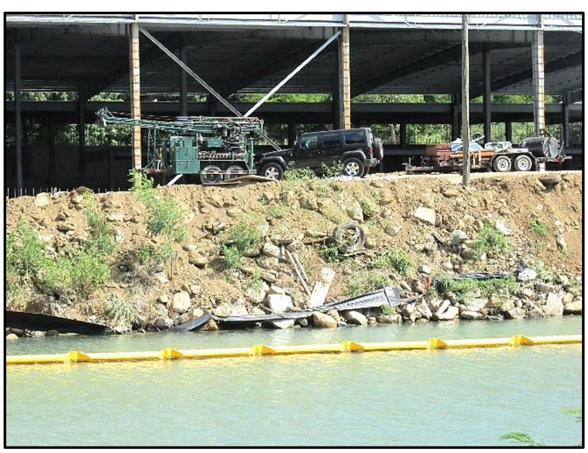


Photo 150.
Improperly maintained silt fences at the water's edge of this construction site—at the bottom of the dirt slope—contribute to sediment runoff. The additional silt curtains in yellow are mainly useful in containing oil spills and suspended sediments. Heavier sediments will settle to the bottom.

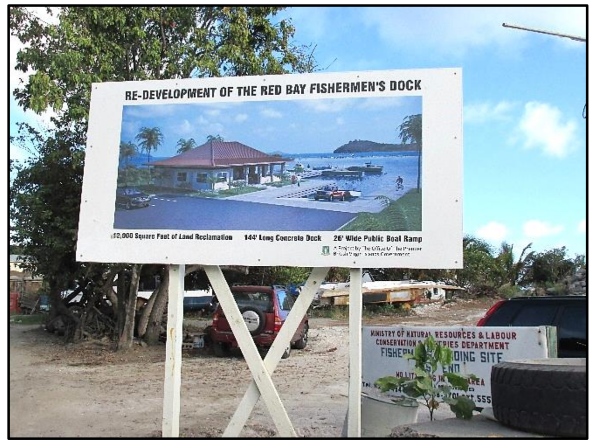


Photo 151.
Site of the Red Bay Fishermen's Dock re-development project.

Photo 152.
At the Red Bay site, exposed dredged marine sediments in the foreground and earth sediments in the background are both exposed to runoff.

7.2.2.3 Marine Traffic Hazards

The increase in marine traffic, especially in Road Harbour and the west end and east end of Tortola, presents an increasing risk of oil spills or other discharges of harmful materials. Incidents of oil spills and hazard material spills are documented in Section 3.1.10 of Chapter 3 and also discussed in Section 5.2.1.3 of Chapter 5. The impact of these incidents on the environment is attributed not only to the magnitude of the incident, but also its location, disaster response time and effectiveness of the salvage operation. A minor incident—such as a small spill or leakage—can, over time and if not properly addressed, also have a severe impact on the marine ecology of the affected area.

7.2.3 Erosion and Sedimentation

Tortola is an island of high peaks. The distance from ridge to shoreline is short, which makes for very steep slopes, which in turn generates high rainwater velocity flowing downslope. Flow velocity increases along exposed pervious, impervious surfaces and wherever vegetation is cleared. This added energy contributes to an increase of erosion and sediment runoff that have a direct negative impact on the terrestrial landscape and coastal and marine environments (see also Section 5.2.1.1 in Chapter 5).

Photo 153.
Typical "cut-and-fill" road construction along a steep slope on Tortola. The road cut face is approximately 6 m (20 ft) high.

7.2.3.1 Land Clearing for Road and Residential Development

Due to the island's steep terrain, "cut-and-fill" construction is a common practice used to establish roads and develop private residences along hillsides. Road switchbacks are necessary to negotiate steep gradient, and this in turn requires more cut-and-fill road construction (**Photo 153**). If left unprotected, the exposed surfaces become vulnerable to erosion and sediment runoff. As road gradient increases, so does runoff intensity and the potential of significant debris accumulation downslope.

A standard practice for preparing land for small-scale residential development is to bulldoze vegetation and entirely clear a parcel of land of its vegetative cover (**Photo 154**). Such methods expose the underlying soil making it susceptible to erosion especially during heavy rains. When best management practices for land development are not adopted and land-clearing is extended to adjacent parcels, the negative impact to the environment will be cumulative over time.

Photo 154.
Right half of photo shows land recently cleared of vegetation by a bulldozer, along a steep slope on Tortola. Exposed soils are vulnerable to erosion.

7.2.4 Air Quality

Although air quality issues have long been absent from Tortola, the island's increasing population and modernisation has led to an inevitable decline in air quality. An expanding number of motor vehicles and the dust and fumes emanating from rock quarries, asphalt plants, and the Pockwood Pond landfill and incinerator are all relatively new causes of air pollution. On Tortola, most air quality issues originate at the Pockwood Pond industrial complex, which comprises Tortola's solid waste landfill and incinerator, an asphalt plant, a desalinisation plant, and the largest quarry site on the island. Air quality issues are reoccurring and tend to be associated with the incinerator and asphalt plant.

7.2.4.1 Asphalt Plant

Environmental health concerns related to the privately owned asphalt plant at Pockwood Pond have been on the increase (*www.bviplatinum.com*, 2 November 2014; *www.virginislandsnewsonline.com*, 2 December 2014). Workers stationed at the nearby BVI Electricity Corporation site have complained about noxious fumes from the asphalt plant, which have also impacted the West End residential community. Plant owners have attributed the problem to faulty operations and equipment and have mobilised to resolve the issue. Nevertheless, the noxious fumes from the plant have continued on and off for many years and are only becoming worse with the passage of time.

Asphalt plants mix gravel and sand with crude oil derivatives to make the material used to pave roads such as the ongoing Blackburn Highway project. The emitted chemicals usually include potentially cancer-causing toxic pollutants such as arsenic, benzene, formaldehyde, and cadmium. Asphalt fumes can cause coughing, wheezing or shortness of breath, severe irritation of the skin, headaches, dizziness and nausea. Anecdotal evidence from residents in Tortola's West End community indicates a higher incidence of respiratory illnesses such as asthma (*BVI News Online*, 16 February 2015).

The second of the two primary asphalt plants on Tortola is located at the Fish Bay Skelton Quarry and is owned by the BVI Government.

7.2.4.2 Quarry Dust

There are two main quarry operations in Tortola: one located within the Pockwood Pond industrial complex and the other at Fish Bay. At these quarries, the process of blasting the parent rock, excavation, and grinding rock fragments into small sizes creates airborne dust as a byproduct and can, depending on wind direction, produce detrimental health issues for persons working or living in adjacent commercial and residential communities. The blasting phase can also pose other serious hazards as evidenced by stray rocks from a quarry blast that ripped through the roof at Tola Mitsubishi Motors in Fish Bay. In that incident, employees narrowly escaped serious injuries (*www.virginislandsnews-online.com*, 16 August 2013).

7.2.4.3 Incinerator Fumes

The nuisance of fumes from the incinerator at Pockwood Pond has persisted for many years despite continuing efforts to control the problem. Recently, following many complaints from local residents and even the neighbouring US Virgin Islands, efforts have been undertaken by Government to upgrade the facility (see also Section 7.1.3.1 of this Chapter). A new scrubber system—an air pollution control device used to remove some particles and gases from industrial exhaust streams—is to be installed at Pockwood Pond in 2015.

Issues, Conflicts, and Areas of Concern	Impacts of No Action/No Change	Short-term Options Long-term Recommendations
ISSUE ONE **Solid Waste Management: Institutional Capacity** Although the BVI Government has developed a new Solid Waste Management Strategy (2013), concerns continue about the existing organisational capacity of Government to develop, enforce, maintain and monitor the new waste management systems.	Without sufficient institutional support to implement the Solid Waste Management Strategy: • Public dissatisfaction and complaints will continue, particularly regarding air emissions at the Pockwood Pond landfill; • The risks to human and environmental health will continue; and • The ability of DWM staff to effectively carry out departmental responsibilities will be hindered.	**SHORT TERM OPTIONS** **1.** Ensure that sufficient resources (human, technical and financial) are available to the Solid Waste Mangement Working Group assigned to implement the 2013 Solid Waste Management Strategy. **2.** Increase the capacity of the Solid Waste Management Working Group through additional personnel training and visits to the sister islands and off-island state-of-the-art waste facilities. **3.** As part of the business plan being created by the Solid Waste Management Working Group, develop a plan to re-institute the DWM as a Solid Waste Management Authority, as recommended by the Solid Waste Management Strategy. **LONG TERM RECOMMENDATIONS** **1.** Enact required legislation to promote waste reduction and recycling including, for example, environmental levies, a glass bottle/aluminum can deposit system, and recycled bag use. **2.** Establish the Solid Waste Management Authority with an appropriate legislative mandate.
ISSUE TWO **Solid Waste Management: Increasing Volumes of Solid Waste/Insufficient Landfill Space** Tortola is experiencing Increasing solid waste volumes, lack of sufficient landfill space, and increasing costs to manage solid waste.	Without sufficient waste diversion, and with anticipated increases in population and tourism rates, the Pockwood Pond incinerator facility is expected to be under capacity in the near future, perhaps within 5-10 years, and will not be able to handle increasing volumes of waste, leading to: • Increased emissions from open burning; • Increased litter and dumping; • Increased leachate. No alternative landfill space is available.	**SHORT TERM OPTIONS** **1.** The Solid Waste Management Working Group should draft a Waste Minimisation and Diversion Plan. **2.** Based on a partnership model comprising the DWM, local recyclers, and NGOs, an island-wide glass and aluminum recycling system should be designed and implemented. **3.** The Solid Waste Management Working Group should complete business plans for: - The management of Industrial organics (including sewage sludge) as a renewable energy source. - The establishment of a repair/reuse centre for white goods, e-waste and construction waste. - The management of plastics. - The establishment of a cottage industry for recycled paper products. - The management of hazardous waste. *(continued)*

Issues, Conflicts, and Areas of Concern	Impacts of No Action/No Change	Short-term Options Long-term Recommendations
		LONG TERM RECOMMENDATIONS **1.** Government should develop a "materials recovery facility" for Tortola, focusing on receiving, separating and preparing recyclable materials for marketing to end-user manufacturers. **2.** A strategy to rehabilitate the current landfill site at Pockwood Pond needs to be put in place.
ISSUE THREE **Solid Waste Management: Emissions from Incineration and Open Burning** Emissions from the Pockwood Pond incineration facility and landfill cause smoke and the release of toxins. Methane, produced by the decomposition process, is not trapped.	Emissions from incineration are visually unappealing and have potential health impacts. Toxins such as dioxins and furans are released through the burning process. These and other chemical compounds bio-accumulate and are linked to potential health disorders such as asthma and cancer.	**SHORT TERM OPTIONS** **1.** Procedures need to be put in place to measure the emissions from the Pockwood Pond facility. There is insufficient data currently available on emissions from the Pockwood Pond site. **2.** The volume of waste materials subjected to burning can be reduced through the design and introduction of a glass and metal/aluminum recycling programme. **3.** Government needs to ensure that the scrubbers procured for the Pockwood Pond incinerator are installed by the end of 2015. **4.** The volume of organic waste disposed of at Pockwood Pond could be reduced through composting. The feasibility of a commercial composting system that generates power should be explored by creative entrepreneurs. **LONG TERM RECOMMENDATIONS** **1.** As part of implementation of the Solid Waste Management Strategy, a Hazardous Waste Management Plan needs to be drafted, approved by Government and implemented territory-wide.
ISSUE FOUR **Solid Waste Management: Leachate and Associated Runoff** Since there is no separation of waste at Pockwood Pond, it is likely that leachate will contain heavy metals (such as mercury, lead and cadmium), major ions and volatile organic compounds. *(continued)*	Leachate and associated runoff have the potential to contaminate groundwater supplies as well as the environment within the landfill's watershed area.	**SHORT TERM OPTIONS** **1.** Groundwater and soil around the landfill should be periodically tested by a designated Virgin Islands Government agency. **2.** Government needs to ensure that the comprehensive environmental management legislation currently being drafted contains the necessary tools to create standards on groundwater contamination and hazardous wastes. *(continued)*

Issues, Conflicts, and Areas of Concern	Impacts of No Action/No Change	Short-term Options Long-term Recommendations
There are many gaps in available knowledge about the implications of leachate and runoff in the Virgin Islands. No data are currently available.		**LONG TERM RECOMMENDATIONS** **1.** The Virgin Islands needs to develop and implement a vigorous hazardous waste management programme, which begins with a Hazardous Waste Management Plan (see Issue Three). The Plan should include a strategy for disposal of all medical waste and incinerator ash from the Pockwood Pond facility. A hazardous waste collection system needs to be put in place. **2.** As indicated in Issue Two above, a strategy to rehabilitate the current landfill site at Pockwood Pond needs to be implemented, including installation of a leachate treatment plant.
ISSUE FIVE **Solid Waste Management: Vectors and Pests** Vectors and pests such as flies, mosquitos, cockroaches, rats and other animals are common at the Pockwood Pond waste disposal site and at the island's many bins and dumpsters.	The presence of vectors and pests carries health risks and has potential to spread disease.	**SHORT TERM OPTIONS** **1.** Covers should be used for all public dumpsters. **2.** Every effort should be made to manage incoming waste daily at the incinerator. **3.** As part of integrated waste management planning, a commercial composting system might be implemented, in conjunction with home composting education, to reduce food waste that attracts vectors.
ISSUE SIX **Solid Waste Management: Litter and Illegal Dumping** Both littering and illegal dumping are on the increase in Tortola.  **Photo 155.** Bulky solid waste discarded at a dumpster in Greenland instead of being taken to the Pockwood Pond facility (*www.bviplatinum.com*, 4 April 2014).	Littering and the random dumping of solid waste outside of designated areas is detrimental to the environment because: • It is visually unappealing and sends a message that an area is uncared for. • It decreases the possibility of returning tourists. • It can block storm drains and contribute to flooding. • It can kill marine and bird life through strangulation and ingestion.	**SHORT TERM OPTIONS** **1.** The community should support efforts by the DWM, the BVI Tourist Board, and the Department of Conservation and Fisheries to implement waste education strategies, including periodic clean-ups, beautification campaigns, and "adopt a spot" promotions to engage local businesses. **LONG TERM RECOMMENDATIONS** **1.** Both the Litter Abatement Act and the Derelict Vehicle Act need to be reviewed to provide for better implementation and enforcement. **2.** In order to further impede the spread of littering, other legislative initiatives should be considered, including: - A ban on plastic bags. - A ban on polystyrene. - A bottle bill, which requires a deposit on beverage containers to be refunded when the container is returned. *(continued)*

Issues, Conflicts, and Areas of Concern	Impacts of No Action/No Change	Short-term Options Long-term Recommendations
		- Levies and deposit systems for difficult-to-manage waste streams, such as cars, batteries, tyres, and Styrofoam. For example, a deposit is made when a battery is purchased, which is refunded when the product has served its useful life and is properly disposed of. Or a tax could be placed on Styrofoam containers to serve as a disincentive to use such products.
ISSUE SEVEN **Pollution Control: Domestic Sewage** The coastal waters surrounding Tortola need better protection from land-based sources of pollution. Despite an ongoing national sewerage upgrade programme, a large number of households and commercial establishments still have private septic systems. A number of these are aging, undersized and poorly maintained, which poses a threat to coastal water quality and public health. Proper disposal of sewage and liquid waste is critical to ensure public health and maintain an attractive marine environment for the tourism industry.	Septic tank seepage from households and commercial outlets is likely a contributing cause of deteriorating coastal water quality. The situation is further aggravated during rainy events when untreated sewage is washed into ghuts and storm drains to ultimately discharge in the coastal environment.	**SHORT TERM OPTIONS** 1. As part of development control planning, the BVI Government needs to identify critical areas within the coastal zone with aging septic systems or overused septic systems that are prone to seepage and accidental discharge into coastal waters. 2. Efforts by the Ministry of Health and Social Development to engage in public consultations—with residents and commercial outlets alike—about the negative impacts of improperly maintained septic systems need to be encouraged and expanded. Programmes of community education on topics where individual action can make a difference will help increase public understanding of pollution issues, such as septic tank design and use, sludge removal and disposal, and water conservation. 3. Government needs to put in place a standardised policy for the disposal of septic tank waste. Furthermore, appropriate sludge disposal areas need to be identified and their use required. **LONG-TERM RECOMMENDATIONS** 1. Official guidelines for proper construction of septic systems based on local conditions and level of use need to be developed by Government. Equally important, a programme of certification and regular inspection of privately maintained septic systems should be put in place to ensure that such systems are properly designed and maintained for current levels of use by individual households and commercial outlets. 2. Public health legislation with standards for water quality, pollution control, and waste management needs to be developed for the Virgin Islands. *(continued)*

<table>
<tr><th>Issues, Conflicts, and Areas of Concern</th><th>Impacts of No Action/No Change</th><th>Short-term Options Long-term Recommendations</th></tr>
<tr><td></td><td></td><td>3. As part of development control planning, the Department of Town and Country Planning might provide guidelines for ecologically sensitive sewage disposal, designed for specific locations based on topography, slopes, soil types and thickness, and drainage conditions.

4. The Water and Sewerage Department should explore the feasibility of sludge recycling options.</td></tr>
<tr><td>ISSUE EIGHT

Pollution Control: Marine Activities

The utilisation of Road Harbour is significantly expanding to accommodate additional cruise ships and a steady increase of inter-island ferry traffic. Charter vessel activity in Road Harbour and the bays along the southern and northwestern coasts of Tortola is also increasing. These marine-based activities have the potential to contribute to deterioration of water quality in local waters.

Nearly all marinas on Tortola lack liquid waste or sewerage pump-out systems to service vessels using their facilities. This issue is exacerbated by the fact that charter vessels entering BVI waters are not required to be equipped with holding tanks for wastes.</td><td>The increase in cruise ship traffic, inter-island ferries and charter vessels in transit through the already busy harbours and coastal waters of Tortola will not only raise turbidity levels but also present a risk of oil pollution from collisions and potential groundings in environmentally sensitive areas.

Without modern pollution control policies and requisite resource user behaviour, expanding vessel use of Tortola's waterways will contribute to deteriorating water quality and mounting negative impacts on the island's coastal and marine ecosystems.

Without regulations targeting waste discharge by vessels in BVI waters, and without pump-out systems in most marinas in Tortola, many charter vessels navigating the BVI's nearshore waters will discharge their sewage at sea, thereby deteriorating water quality and consequently impacting the marine ecosystem.</td><td>SHORT TERM OPTIONS

1. With the increase in cruise ship and other vessel traffic in Tortola's harbours and coastal waters, Government should take steps to update its marine traffic safety guidelines, and marine disaster management planning.

2. Marine industry-funded efforts in collaboration with the BVI Government—such as the BVI Marine Awareness Guides (Gore, 2008 and 2011)—have been useful tools in educating visiting boaters and local operators about practices that minimise marine pollution. Such efforts need to be encouraged on a consistent basis by both the private and public sectors.

3. Collaboration between the marine industry and the BVI Tourist Board needs to be encouraged and strengthened, particularly as each sector would benefit from promoting environmentally friendly attitudes and practices by visiting and local yachters.

LONG-TERM RECOMMENDATIONS

1. The BVI Government needs to complete a major review of the legal framework regulating environmental pollution in the territory. Without this, it will be difficult to effectively move forward with implementation of the following recommendations all of which require action by the Government in the near term:
- A comprehensive water quality monitoring protocol for the coastal waters of Tortola needs to be developed and approved, including implementation of a uniform and ongoing water quality monitoring programme for Tortola's most heavily used bays.
- As part of a broader review and updating of pollution legislation, regulations need to be drafted and enacted that require major marinas to be

(continued)</td></tr>
</table>

Issues, Conflicts, and Areas of Concern	Impacts of No Action/No Change	Short-term Options Long-term Recommendations
		equipped with pump-out and waste treatment systems, or to have a means to dispose of such waste at a designated offsite facility. - Guidelines need to be established and put in place at major boatyards and haul-out facilities for proper storage and disposal of hydrocarbons and other toxic wastes. - A public policy is needed that aggressively discourages discharge of wastes in the nearshore environment and critical marine habitats. Areas of "no discharge" should be designated and enforced by the Government.
ISSUE NINE **Pollution Control: Erosion and Sedimentation** Land clearing for residential, commercial and road construction is one of the primary causes of erosion and sediment runoff, which has a direct impact on Tortola's coastal water quality. The problem is particularly acute when environmental guidelines and Best Management Practices (BMPs) have not been identified at the outset of development activities and /or not properly implemented during all phases of construction projects. BMPs need to be identified with submission of EIAs and Environmental Management Plans, and properly monitored by Government during project implementation.	Any earth-moving project that leaves soils exposed and unprotected can result in large quantities of sediment being transported offsite, into ghuts or downslope, ultimately reaching coastal waters. Especially on steep slopes, eroding dirt roads, and hastily cleared construction sites, such practices are major causes of debris flows, landslides, and significant sediment runoff, which will ultimately impact water quality and marine ecosystems.	**SHORT TERM OPTIONS** **1.** The BVI should adopt erosion and sedimentation control guidelines that best reflect the natural environment and terrain conditions of the territory. Guidance can be drawn from existing documentation already in use in the USVI (UVI/CES 2002, a/b) and from UNEP for the insular Caribbean (Anderson, 1994). **2.** A recent handbook on erosion control BMPs for the British Virgin Islands is also available (Gore and Leoniak, 2013). The handbook developed by the Department of Conservation and Fisheries in cooperation with The Nature Conservancy provides guidelines for reducing erosion with multiple useful illustrations. **LONG-TERM RECOMMENDATIONS** **1.** The Department of Town and Country Planning should require that sediment and erosion control BMPs are addressed in all EIAs that involve land clearing for building sites and road construction. Even small-scale construction activities near sensitive environmental habitats (such as wetlands) need to include sediment control practices in their construction activities. **2.** The DTCP should require and enforce the application of erosion and sediment control BMPs in the environmental monitoring and compliance phases of all mid-to-large development projects.

Issues, Conflicts, and Areas of Concern	Impacts of No Action/No Change	Short-term Options Long-term Recommendations
ISSUE TEN **Pollution Control: Air Quality** Air quality issues are increasing in Tortola due to an expansion of development and industrial activity on the island and a lack of safeguards, maintenance standards, and pollution control measures.	Fumes emanating from the asphalt plants and the island's incinerator, as well as dust from the two main quarries, can pose serious health issues to the surrounding community, especially those downstream from the source. Airborne toxic pollutants eventually settle onto the ground and in the long run will impact local flora, fauna, and soils.	**SHORT TERM OPTIONS** 1. Although not a significant environmental issue in the past, Government now needs to consider a comprehensive review of potential air pollution sources in the territory—especially in Tortola—and assess the impact on the population and the environment. 2. Government should ensure that the siting of new industrial plants and activities with potential air pollution impacts are located away from zoned residential areas and downwind corridors. **LONG-TERM RECOMMENDATIONS** 1. The need for air quality standards for various types of industrial and construction activities is becoming increasingly apparent in Tortola, and as Government considers new environmental management legislation (Section.2.3.6, Chapter 2), it should also consider development of new air pollution control standards, guidelines, and regulations. 2. As part of the process recommended in item 1 above, the BVI Government should put in place guidelines requiring that new industrial plants in the territory are properly and safely engineered with built-in, state-of-the-art emission controls and effective monitoring to ensure that operations are within permissible air quality safety standards.

8. PROTECTED AREAS AND RESOURCE CONSERVATION[8]

Island legend has it that, in the early 1960s, the entire BVI narrowly escaped designation as a *"Territory for the Birds"*:

> *At the time, the British Virgin Islands were considered the least valuable of Her Majesty's overseas possessions. At best, we were treated with benign neglect. At worst, our development prospects were considered so bleak it was once even recommended the islands should be abandoned and allowed to become bird sanctuaries* (Mathavious, 2014).

This rather expansive protected area proposal found favour neither with the BVI populace nor, strangely enough, with the colonial administration. The author of the O'Loughlin Report (1962), often credited as the source of this picturesque and amusing recommendation, actually states in her introduction, "I do not consider the British Virgin Islands are in the category either for total or partial evacuation, nor, at the moment, even near the margin." Since then, designations for more modestly sized protected areas within the territory have met with more success.

In addition to bird sanctuaries, the territory has seen a proliferation of national parks, forest, water and fisheries protected areas, laws, regulations, institutions, policies, and programmes to protect and conserve both living and non-living resources. Economic activity and development pressures have so escalated over the past 50 years that it is both sobering and mildly amusing to contemplate that the continued economic success of an archipelago of islands—once only "fit for the birds"—may well depend on the efficacy of measures to protect habitats and conserve the islands' capacity to support not only birds but other species too.

8.1 Overview

Protected areas have been called the "cornerstones" of bio-diversity conservation strategies (Secretariat of the Convention on Biological Diversity, 2008). The international definition of "protected area" is:

> *A clearly defined geographical space, recognized, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values* (Dudley, 2008).

Most of the BVI's protected areas are located in and around the area encompassed by this Environmental Profile.

- Designations began in 1955 with declaration of the Sage Mountain **Forestry Area** pursuant to the *Protection of Trees and Conservation of Soil and Water Ordinance.*
- Four years later, 20 **Bird Sanctuaries** were declared across the territory (under the *Wild Birds Protection Ordinance*), seven of which are located on Tortola's satellite islands or cays.
- In 1963, six **Water Areas** were declared in Tortola under the *Protection of Trees and Conservation of Soil and Water Ordinance*.
- Followed closely in 1964 with declaration of the Sage Mountain **National Park** under the *National Parks Ordinance* of 1961, which also established the National Parks Trust.

  Since then, a total of 19 terrestrial national parks have been declared under this law and a revised *National Parks Act* (NPA) in 2006. Nine of the territory's terrestrial parks are located in the area of the Tortola Profile: five in Tortola, and four on nearby cays. Three of the four national parks on Tortola's offshore cays are also designated bird sanctuaries.
- The only marine national park, Wreck of the Rhone **Marine National Park**, is also located

[8] The author of Chapter Eight is Noni M. Georges.

in the profile area and was established in 1980 under the *Marine Parks and Protected Areas Ordinance* (which was repealed and replaced by the *National Parks Act* in 2006).

- In 2003 14 **Fisheries Protected Areas** (FPAs) were declared under *Fisheries Regulations* (2003) to the *Fisheries Act* (1997). Ten of these are located in the area of the Tortola Profile. One of them, the Hans Creek Fisheries Protected Area adjacent to Beef Island, became the subject of a protracted legal dispute, the outcome of which cast some doubt on the validity of protection for all FPAs, but this has since been resolved (see Section 8.3.3). At the time of this writing, declaration of one new FPA is pending.

In 2004, the *Physical Planning Act* came into force, providing power to declare **Environmental Protection Areas**, although none have been declared to date. Most recently, the *National Parks Act*, 2006, which replaced the original 1961 Ordinance, provides power to declare nine different categories of protected areas, not just national parks, each category representing specific management objectives. Thus far, one **Habitat Management Area** has been declared and declaration of four new protected areas under the NPA is pending. One of the pending areas is located in the Tortola Profile area (Great Tobago Protected Seascape).

8.2 Legislative and Policy Framework for Protected Areas

Every person has the right to an environment that is generally not harmful to his or her health or well-being and to have the environment protected, for the benefit of present and future generations, through such laws as may be enacted by the Legislature including laws to —

(a) prevent pollution and ecological degradation;

(b) promote conservation; and

(c) secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.

Virgin Islands Constitution Order, 2007

8.2.1 Domestic Law

Five key pieces of BVI legislation, each under the responsibility of a different management authority, presently allow for the declaration of 18 different categories of protected areas with varying management objectives (see **Table 46** and Section 2.2.3 of Chapter 2):

1. National Parks Act (No. 4 of 2006) and National Parks Regulations 2008.
2. Physical Planning Act (No. 15 of 2004).
3. Fisheries Act (No. 4 of 1997) and Fisheries Regulations 2003.
4. Wild Birds Protection Ordinance (Bird Sanctuaries Order 1959), Cap 97 of the Laws of the Virgin Islands.
5. Protection of Trees and Conservation of Soil and Water Ordinance, Cap 86 of the Laws of the Virgin Islands.

Table 46.
Summary of the legislative framework for BVI protected areas.

Legal Instrument	Management or Enforcement Authority	Protected Areas Category and *IUCN* Equivalent	Management Objectives and Number of Sites Declared for Tortola and Its Sister Islands		Prohibitions
National Parks Act, 2006 National Parks Regulations, 2008	National Parks Trust	Strict Nature Reserve *IUCN Category Ia*	Preservation of habitats, ecosystems and wildlife species in as undisturbed a state as possible	0	<u>Restricted Activities</u>: Entry into closed areas Pollution of water Disposal of solid waste, sewerage or hazardous substances Development Fire Clearing land Landing aircraft Domestic animals Mining Removal of coral Removal of animals or plants Occupation or agriculture Possession of weapons <u>Licensed Activities</u>: Research, concessions, filming, weddings and other events
		Wilderness Area *IUCN Category Ib*	Protection and preservation in a natural wilderness condition	0	
		National Park *IUCN Category II*	To protect, in as natural a state as possible, representative samples of major physiographic regions, biotic communities, genetic resources and species for ecological stability and diversity	10	
		Natural Monument *IUCN Category III*	To protect or preserve in perpetuity a unique area of land or sea containing one or more natural, or natural and associated cultural, features of outstanding value because of their inherent rarity	0	
		Habitat or Species Management Area *IUCN Category IV*	Protection of wildlife habitat where specific human manipulation and active intervention are required	0	
		Protected Landscape or Seascape *IUCN Category V*	To maintain and support the harmonious interaction of people and nature	0	
		Managed Resource Area *IUCN Category VI*	To ensure long-term protection and maintenance of biological diversity while providing a sustainable flow of natural products and services to meet community needs	0	
		Urban Park	Managed primarily for aesthetic, educational, scientific or recreational purposes	0	
		Historic Site	Managed primarily for the conservation of the historic and cultural features of the site and any objects located therein	0	

Legal Instrument	Management or Enforcement Authority	Protected Areas Category and *IUCN* Equivalent	Management Objectives and Number of Sites Declared for Tortola and Its Sister Islands		Prohibitions
Physical Planning Act 2004 No regulations *(regulations are being drafted and are near completion)*	Planning Authority DTCP Enforcement Officers	Environmental Protection Area	The preservation, enhancement and management of the special features of the Environmental Protection Area	0	Permitted and prohibited uses may be specified in a management plan made in collaboration with the Chief Agricultural Officer and the Minister of Natural Resources and Labour
		Special Resource and Use Area	An area within an Environmental Protection Area where public use of certain lands and waters of the foreshore or seabed needs to be controlled or protected to ensure the safety and welfare of the public and the preservation of the coastal environment	0	Permitted and prohibited uses may be specified in a management plan made in collaboration with the Premier and the Minister of Natural Resources and Labour
		Plant Preservation Order	Protection of any plant or group or species of plants that need to be preserved		Cutting down, chopping, lopping, digging, or destroying a plant, group or species of plants
Fisheries Act, 1997 Fisheries Regulations 2003	Chief Conservation and Fisheries Officer	Fisheries Protected Area *IUCN Category IV*	No explicit PA management objectives in the enabling legislation	10	Prohibited Activities: fishing, anchoring, diving or recreation, and "any development activity," terrestrial or otherwise, likely to cause an adverse impact Licensed Activities: fishing, anchoring
		Marine Reserve *IUCN Category IV*	To protect natural breeding grounds and habitat of aquatic life, particularly those in danger of extinction To allow natural regeneration of aquatic life To promote marine scientific study To preserve natural beauty	0	Licensed activities: fishing by SCUBA
Wild Birds Protection Ordinance, Cap 98	Royal Virgin Islands Police Force	Bird Sanctuary *IUCN Category IV*	No explicit PA management objectives in the enabling legislation	8	Prohibits killing or exporting 31 listed birds, destroying nests, sale or possession of their eggs Prohibits traps, nets, live decoys and shot guns for killing wild birds Prohibits killing or destroying of nests or eggs of any bird in a bird sanctuary

Legal Instrument	Management or Enforcement Authority	Protected Areas Category and *IUCN* Equivalent	Management Objectives and Number of Sites Declared for Tortola and Its Sister Islands		Prohibitions
Protection of Trees and Conservation of Soil and Water Ordinance, Cap 86	Chief Agricultural Officer The Governor	Protected Area	To maintain and preserve protected trees growing therein	0	Prohibits cutting protected trees
		Forestry Area *IUCN Category IV*	To prevent de-afforestation and denudation of land on steep slopes To prevent soil erosion and the deposit of earth, mud, stones or sand upon agricultural land To protect roads and highways	1	Prohibits injuring any tree, fires, entry of livestock
		Water Reserve *IUCN Category IV*	To maintain water supplies within the reserve area or on land adjacent to it To maintain such supplies in ghuts, springs, streams, watercourses or reservoirs To prevent the silting of sources of water supply To prevent or reduce the pollution of any water supply	6	Prohibits Injuring any tree, fire, entry of livestock

8.2.2 International Conventions and Agreements

Descriptions of policies and agreements affecting the BVI's environment are found in Chapter 2, Section 2.2.4 (see also Table 15). In this and the following sub-section, specific commitments in relation to protected areas are highlighted.

International environmental agreements have not for the most part been transformed into domestic law in the BVI and are not directly enforceable in BVI courts. However, those international obligations, extended by the UK to BVI, form part of the broader policy background against which protected areas and resource conservation management occurs. Under international agreements, the BVI has agreed to do the following:

(1) Convention on Wetlands of International Importance Especially as Waterfowl Habitat (RAMSAR), 1971.

To promote the wise use of wetlands. One wetland of international importance has been designated in the territory (see *Anegada Environmental Profile*, IRF, 2013). Applications for designation of two wetlands on Tortola (Long Bay, Beef Island, and Belmont) have been prepared by the NPT but have not yet been forwarded to the Ramsar Secretariat (NPT 2012).

(2) World Heritage Convention, 1972.

To identify, conserve and protect cultural and natural heritage. No World Heritage nominations have been prepared for the Tortola Profile area.

(3) Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES), 1973.

To prevent exploitation of species through international trade. Enacted in BVI law as Endangered Animals and Plants Ordinance (1981), Cap 96. However, this Ordinance is outdated and does not fully comply as CITES legislation. The MNRL is currently developing new legislation on trade in endangered species to comply with CITES (see Table 15 in Chapter 2).

(4) Convention on the Conservation of Migratory Species of Wild Animals (BONN), 1979.

To take steps individually and in cooperation with other range states to conserve migratory species and their habitats. This convention is relevant to the BVI for endangered marine turtles which forage and nest in the territory, specifically the Green Turtle (*Chelonia mydas*), Hawksbill Turtle (*Eretmochelys imbricate*), Leatherback Turtle (*Dermochelys coriacea*), and Loggerhead Turtle (*Caretta caretta*). The BVI is obligated to "conserve and, where feasible and appropriate, restore those habitats of the species which are of importance in removing the species from danger of extinction" (BONN Convention, Art. III (4) (a)).

(5) Convention on Biological Diversity (CBD), 1992.

To conserve biological diversity and to:

- Establish a system of protected areas or areas where special measures need to be taken to conserve biological diversity.
- Develop, where necessary, guidelines for the selection, establishment and management of protected areas or areas where special measures need to be taken to conserve biological diversity.
- Regulate/manage biological resources important for the conservation of biological diversity whether within or outside protected areas, with a view to ensuring their conservation and sustainable use.
- Promote the protection of ecosystems, natural habitats and the maintenance of viable populations of species in natural surroundings.
- Promote environmentally sound and sustainable development in areas adjacent to protected areas with a view to furthering protection of these areas.
- Rehabilitate and restore degraded ecosystems and promote the recovery of threatened species, *inter alia*, through

development and implementation of plans or other management strategies;

- Prevent the introduction of, control or eradicate those alien species threatening ecosystems, habitats or species;
- Endeavour to provide the conditions needed for compatibility between present uses and the conservation of biological diversity and the sustainable use of its components.
- Develop or maintain necessary legislation and/or other regulatory provisions for the protection of threatened species and populations.

In addition, as party to the Jakarta Mandate on Marine and Coastal Biological Diversity, 1995, the BVI is also encouraged to (Vanderzwaag, 2001):

- Establish or consolidate representative systems of marine and coastal protected areas, based on consideration of biogeography, scale and CBD objectives.
- Promote research and monitoring of marine and coastal protected areas to assess their value for the conservation and sustainable management of biological diversity.

(6) Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region (known as the Cartagena Convention) and Protocols thereto (adopted in 1983 and entered into force in 1986).

To protect and manage the marine environment and coastal areas of the Wider Caribbean Region including, taking appropriate measures to protect and preserve rare or fragile ecosystems, as well as the habitat of depleted, threatened or endangered species, establish protected areas. and exchange information concerning the administration and management of such areas.

(7) United Nations Convention on the Law of the Sea (LOS), 1982.

To protect and preserve the marine environment. Pursuant to the Agreement for the Implementation of the Provisions of UNCLOS Relating To the Conservation And Management of Straddling Fish Stocks And Highly Migratory Fish Stocks (1995), the BVI should "develop data collection and research programmes to assess the impact of fishing on non-target and associated or dependent species and their environment, and adopt plans which are necessary to ensure the conservation of such species and to protect habitats of special concern."

In addition to the above treaties, the BVI has also agreed to work toward achieving the principles, goals and objectives of:

- Agenda 21 of the Rio Earth Summit (UN Conference on Environment and Development), 1992.
- The Barbados Programme of Action for Small Island Developing States, 1994.
- The UN Millennium Development Goals.

8.2.3 Regional and Bilateral Policies and Agreements

Under the St. Georges Declaration of Principles for Environmental Sustainability (OECS, 2007), the BVI has committed to:

- Protected areas management.
- Providing legal protection to nationally important natural sites.
- Providing a national baseline and monitoring progress in the ratio of terrestrial, coastal and marine areas protected compared to total national territory (see also Section 2.2.4.1, Chapter 2).

Finally, one of the guiding principles in the BVI-UK Environment Charter (see also Section 2.2.4.2, Chapter 2) is to safeguard and restore native species, habitats and landscape features, and control or eradicate invasive species. The UK Government agreed generally to build capacity and provide support, whereas the BVI Government has agreed to ensure the protection and restoration of key habitats, species and landscape features through legislation and appropriate management structures and mechanisms, including a protected areas policy, and to attempt the control and eradication of invasive species.

8.2.4 National Policy Statements

Policymakers in the BVI have long recognised structural weaknesses in the present environment and development framework and expressed a determination to adopt a more cohesive, coordinated and comprehensive approach to national planning, environmental management, compliance with international obligations and resource conservation on the whole.

In addition to the policies and plans detailed below, the *National Integrated Development Strategy 1999–2003* (Section 2.2.4.3 of Chapter 2) acknowledges the fragmentary nature of environmental responsibilities, and posits the establishment of a centralised environmental management authority, development of a national environmental policy and a *National Environmental Action Plan* (Section 2.2.4.4). A new environmental management framework had been proposed in the 2008 *Environmental Management and Conservation of Biodiversity Bill, but is now outdated and being revised* (Section 2.2.3.6), and efforts are underway to prepare a National Physical Development Plan (Section 2.2.4.5)

(1) Protected Areas System Plan 2007-2017
(see also Section 2.2.4.6 of Chapter 2)

The BVI has long focused on developing a systematic, ecosystem-based approach to protected areas planning and management. In 2008, Cabinet adopted the *British Virgin Islands Protected Areas System Plan 2007-2017* as a national policy, stating that the overall objective of the national park system is "to manage important natural and historical resources in ways that will contribute to an improvement of the quality of life of BVI residents" (Gardner, *et al*., 2008).

The Systems Plan is intended to function as a living document, regularly reviewed and updated to reflect current understanding of protected areas needs within a national framework. The Plan outlines the goals and objectives of the protected areas system; considers the intersection of protected areas with tourism, agriculture, environmental management and development planning; explores issues to be addressed; and identifies the following priority actions:

(a) Assessing the contribution of existing protected areas to national development.

(b) Completing the identification and characterisation of important marine and terrestrial habitats and resources that may be included in the system of protected areas.

(c) Evaluating existing and emerging threats to the long-term viability of sites and particular resources.

(2) Climate Change Adaptation Policy (CCAP)
(see also Section 2.2.4.9 of Chapter 2)

Climate change is recognised as one of the three main threats to biodiversity (UK/DEFRA 2009). Having examined the potential impacts climate change may have on all sectors of the territory, the BVI Government formulated and, in March 2012, adopted a national policy outlining measures necessary to adapt to climate change (DCF, 2012). The CCAP states that climate change adaptation must take an ecosystem-centred approach, that is, it must recognise the value of healthy natural ecosystems in buffering impacts of climate change and favour natural engineering solutions wherever practical.

Specific policy directives affecting protected areas include:

- Declare and transfer all of the areas in the approved *British Virgin Islands Protected Areas System Plan 2007-2017*.
- Enact the draft *Environmental Management and Conservation of Biodiversity Bill* (legislation that is currently being redrafted).
- Develop and approve a *National Physical Development Plan*.

(3) Caribbean Challenge Initiative
(see also Section 2.2.4.13 of Chapter 2)

Commitments to implement the System Plan and the Climate Change Adaptation Policy in their entirety were echoed at a national consultation on *Greening the Economy* (CANARI, 2012), and in a regional *Caribbean Challenge Initiative* (CCI) forum in 2013. At CCI, the BVI announced its commitments to implementing the System Plan in a phased approach and to protecting 33 percent of the territory's nearshore marine and coastal environment by 2020, implementing buffer zones for marine protected areas, and managing beaches and salt ponds through a new Wetlands Management Plan (CCI, 2013).

8.3 The Protected Areas System

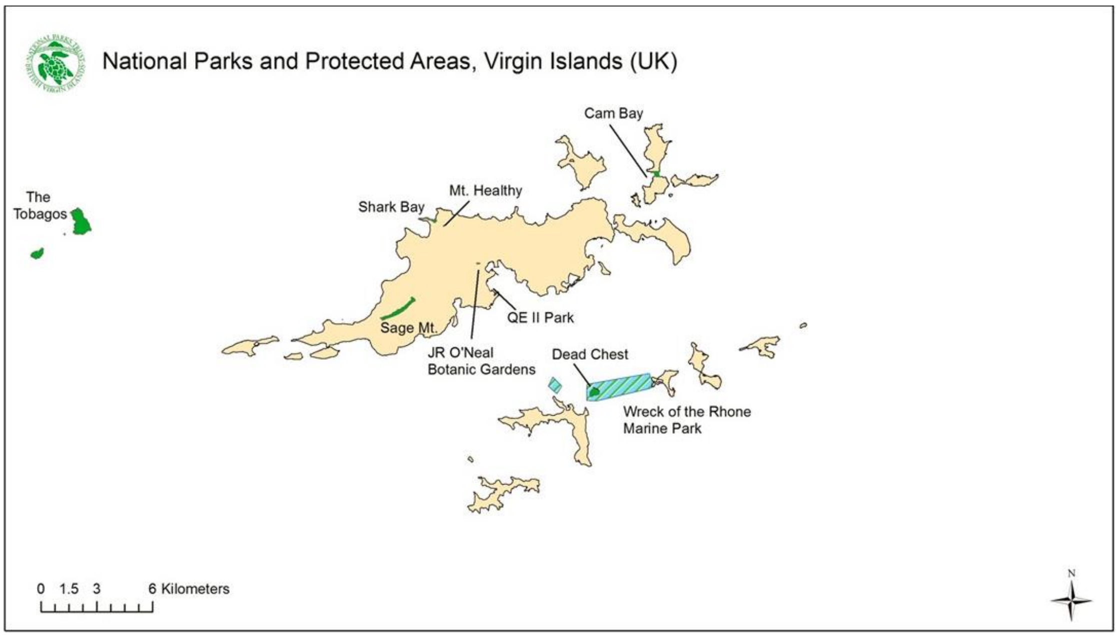


Figure 40.
Existing national parks in Tortola and surrounding islands and cays (*source*: National Parks Trust).

8.3.1 Existing Protected Areas

There are 33 designated protected areas on Tortola and the islands and cays surrounding the island (see **Tables 47-50** and **Figures 41-44**). They include:

- Nine terrestrial national parks (five on Tortola, four on adjacent islands and cays) and one marine national park (**Figure 40**), all under the jurisdiction of the National Parks Trust.
- Ten fisheries protected areas under the jurisdiction of the Department of Conservation and Fisheries.
- Seven bird sanctuaries (three are also national parks, four are not formally managed).
- Six water areas (under the jurisdiction of the Department of Agriculture).

Only those areas declared under the National Parks Act and the Fisheries Act experience active management and enforcement.

Table 47.
National Parks and Fisheries Protected Areas for Tortola.

Sage Mountain National Park

Established: 1964
Size: 92 Acres
Authority: NPT
Annual budget: unknown
Dedicated Staff: 0 (3 roaming staff shared with 4 other parks)
Biome: xerophytic rainforest
PA Category: II-National Park

Note: Sage Mountain Forestry Area was established in 1955.

Management Objectives: conservation, education
Critical PA Activities: plant inventory, trail maintenance, development control, endangered plant mapping, educational tours

Queen Elizabeth II National Park

Established: 1974
Size: 0.7 Acres
Authority: NPT
Annual budget: unknown
Dedicated Staff: 0 (3 roaming staff shared with 4 other parks)
Biome: n/a
PA Category: II-National Park (Urban Park)

Management Objectives: recreation
Critical PA Activities: maintenance

J.R. O'Neal Botanic Gardens National Park

Established: 1979
Size: 2.87 Acres
Authority: NPT
Annual budget: unknown
Dedicated Staff: 6 plus 3 roaming staff shared with 4 other parks
Biome: n/a
PA Category: II-National Park (Urban Park)

Management Objectives: recreation, conservation, education
Critical PA Activities: seed collection and inventory, herbarium, native species conservation, educational tours

Mount Healthy National Park

Established: 1983
Size: 1 Acre
Authority: NPT
Annual budget: unknown
Dedicated Staff: 0 (3 roaming staff shared with 4 other parks)
Biome: n/a
PA Category: II-National Park (Historic Monument)

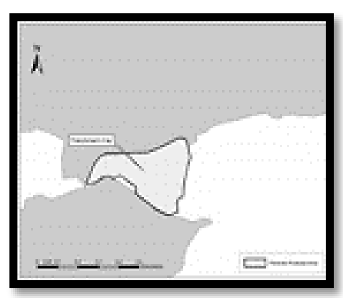
Management Objectives: recreation, education
Critical PA Activities: preservation of historical resource, educational tours

Shark Bay National Park

Established: 1999
Size: 18.4 Acres
Authority: NPT
Annual budget: unknown
Dedicated Staff: 0 (3 roaming staff shared with 4 other parks)
Biome: scrub forest
PA Category: II-National Park

Management Objectives: recreation, bird/bat habitat
Critical PA Activities: trail maintenance

Frenchman's Cay Fisheries Protected Area



(map source: Fisheries Order, 2011)

Established: 2003
Size: 23.5 Acres
Authority: DCF
Annual budget: unknown
Dedicated Staff: 0
Biome: mangrove/ seagrass
PA Category: IV–Habitat or Species Management Area

Management Objectives: protection of nursery habitat
Critical PA Activities: prevent mangrove loss

Table 47 *(continued)*.
National Parks and Fisheries Protected Areas for Tortola.

Beef Island Channel Fisheries Protected Area

(map source: Fisheries Order, 2011)

Established: 2003
Size: 93.9 Acres
Authority: DCF
Annual budget: unknown
Dedicated Staff: 0
Biome: mangrove/seagrass
PA Category: IV–Habitat or Species Management Area

Management Objectives: conservation of fish nursery habitat
Critical PA Activities: prevent mangrove loss, maintain water quality, development control, prevent fishing and anchoring

Hans Creek Fisheries Protected Area

(map source: Fisheries Order, 2011)

Established: 2003
Size: 119.4 Acres
Authority: DCF
Annual budget: unknown
Dedicated Staff: 0
Biome: mangrove/seagrass
PA Category: IV–Habitat or Species Management Area

Management Objectives: conservation of fish nursery habitat
Critical PA Activities: prevent mangrove loss, maintain water quality, development control, prevent fishing and anchoring

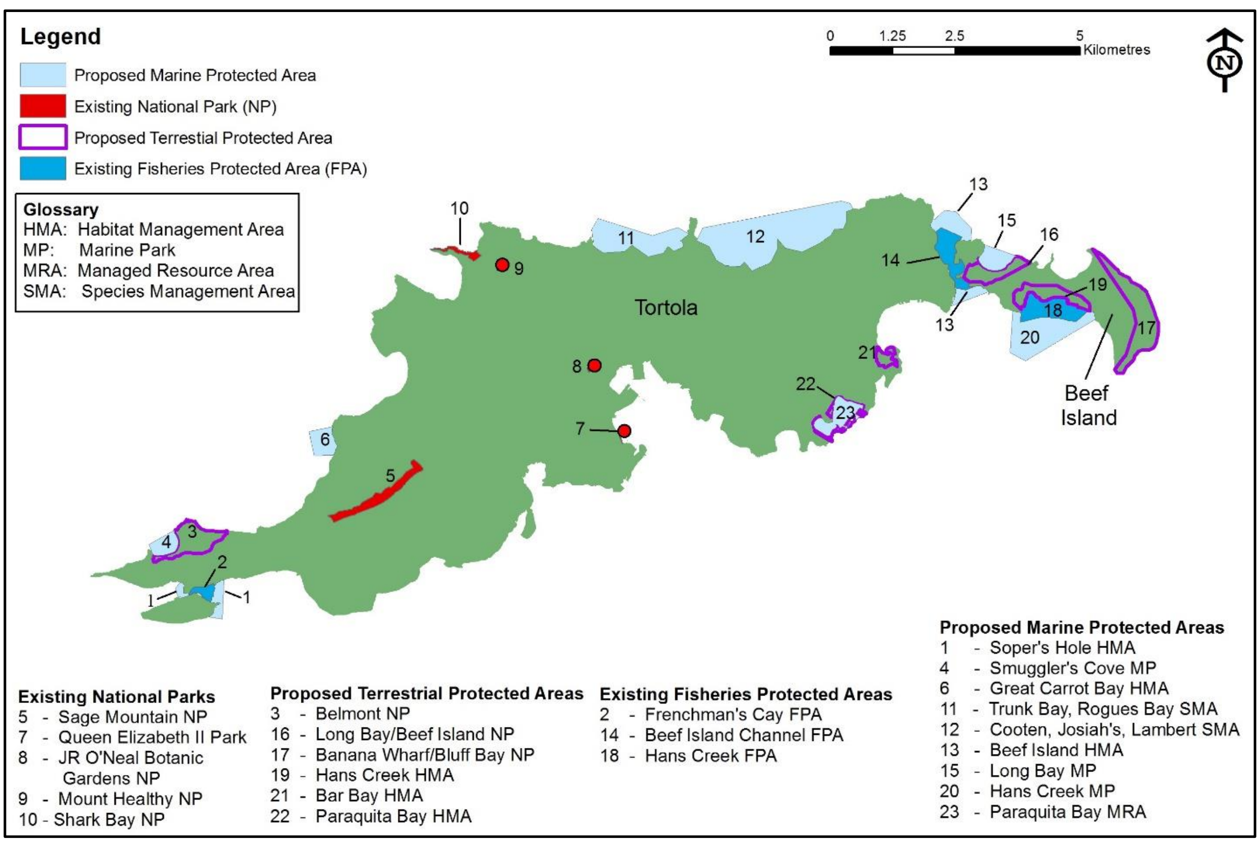


Figure 41.
Existing and proposed protected areas for Tortola (see also Tables 47 and 51).

Table 48.
National Parks and Fisheries Protected Areas for Tortola's Western Cays.

Great Tobago National Park

Established: 1995
Size: 210 Acres
Authority: NPT
Annual budget: unknown
Dedicated Staff: 0
Biome: scrub forest
PA Category: II–National Park

Management Objectives: bird sanctuary
Critical PA activities: artificial nests, feral goat eradication, fishing line removal, bird monitoring

Little Tobago National Park

(photo source: NPT)

Established: 1998
Size: 55 Acres
Authority: NPT
Annual budget: unknown
Dedicated Staff: 0
Biome: scrub forest
PA Category: II–National Park

Management Objectives: bird sanctuary
Critical PA activities: feral goat eradication, bird monitoring

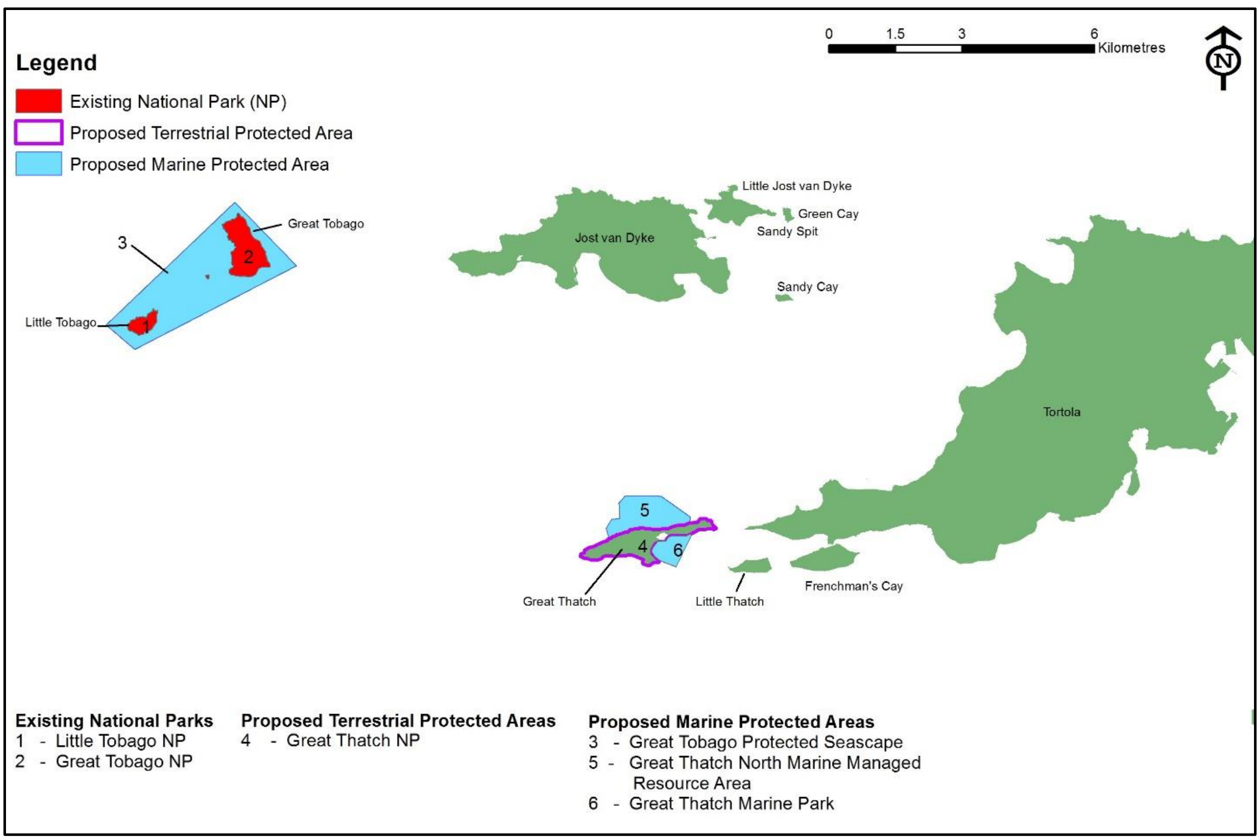
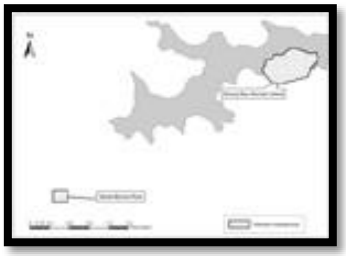


Figure 42.
Existing and proposed protected areas for Tortola's Western Cays (see also Tables 48 and 51).

Table 49.
National Parks and Fisheries Protected Areas for Tortola's Southern Cays.

Money Bay Norman Island Fisheries Protected Area [depicted upper right on map]

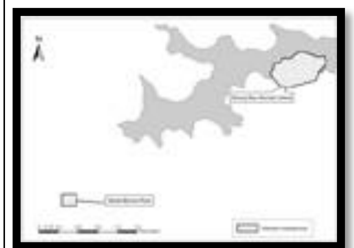


(map source: Fisheries Order, 2011)

Established: 2003
Size: 79.8 Acres
Responsible Authority: DCF
Annual budget: unknown
Dedicated Staff: 0
Biome: seagrass
PA Category: IV–Habitat or Species Management Area

Management Objectives: conservation fish breeding and nursery habitat
Critical PA activities: maintain water quality, prevent illegal fishing and anchoring

Santa Monica Rock Fisheries Protected Area [depicted lower left on map]



(map source: Fisheries Order, 2011)

Established: 2003
Size: 10.4 Acres
Responsible Authority: DCF
Annual budget: unknown
Dedicated Staff: 0
Biome: coral
PA Category: IV–Habitat or Species Management Area

Management Objectives: conservation fish breeding and nursery habitat
Critical PA Activities: maintain water quality, prevent illegal fishing and anchoring

Wreck of the RMS Rhone Marine Park

(photo source: Armando Jenik)

Established: 1980
Size: 766 Acres
Responsible Authority: NPT
Annual budget: unknown
Dedicated Staff: 0
Biome: coral
PA Category: II–National Park

Management Objectives: recreation, conservation, economic
Critical PA Activities: moorings maintenance, enforcement, fee collection, prevent illegal fishing, prevent removal of artefacts

Dead Chest National Park

(photo source: NPT)

Established: 1974
Size: 34 Acres
Responsible Authority: NPT
Annual budget: unknown
Dedicated Staff: 0
Biome: scrub forest/mangrove
PA Category: II–National Park

Management Objectives: bird sanctuary
Critical PA Activities: endangered plant mapping

Big Reef Peter Island Fisheries Protected Area [depicted in centre of map]

(map source: Fisheries Order, 2011)

Established: 2003
Size: 362.1 Acres
Responsible Authority: DCF
Annual budget: unknown
Dedicated Staff: 0
Biome: coral/seagrass
PA Category: IV–Habitat or Species Management Area

Management Objectives: conservation of fish breeding and nursery habitat
Critical PA Activities: maintain water quality, prevent illegal fishing and anchoring

Dead Chest Fisheries Protected Area [depicted upper right on map]

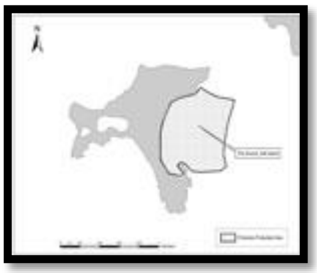
(map source: Fisheries Order, 2011)

Established: 2003
Size: 326.9 Acres
Responsible Authority: DCF
Annual budget: unknown
Dedicated Staff: 0
Biome: coral/seagrass
PA Category: IV–Habitat or Species Management Area

Management Objectives: conservation of fish breeding and nursery habitat
Critical PA Activities: maintain water quality, prevent illegal fishing and anchoring

Table 49 *(continued)*.
National Parks and Fisheries Protected Areas for Tortola's Southern Cays.

The Sound Salt Island Fisheries Protected Area

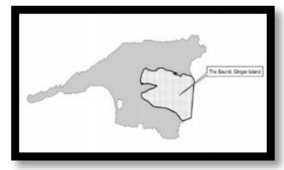


(map source: Fisheries Order, 2011)

Established: 2003
Size: 112.8 Acres
Responsible Authority: DCF
Annual budget: unknown
Dedicated Staff: 0
Biome: seagrass/coral/ mangrove
PA Category: IV–Habitat or Species Management Area

Management Objectives: conservation of fisheries habitat
Critical PA Activities: prevent illegal fishing and anchoring

The Sound Ginger Island Fisheries Protected Area



(map source: Fisheries Order, 2011)

Established: 2003
Size: 62.5 Acres
Responsible Authority: DCF
Annual budget: unknown
Dedicated Staff: 0
Biome: coral
PA Category: IV-Habitat or Species Management Area

Management Objectives: conservation of fisheries habitat
Critical PA Activities: prevent illegal fishing and anchoring

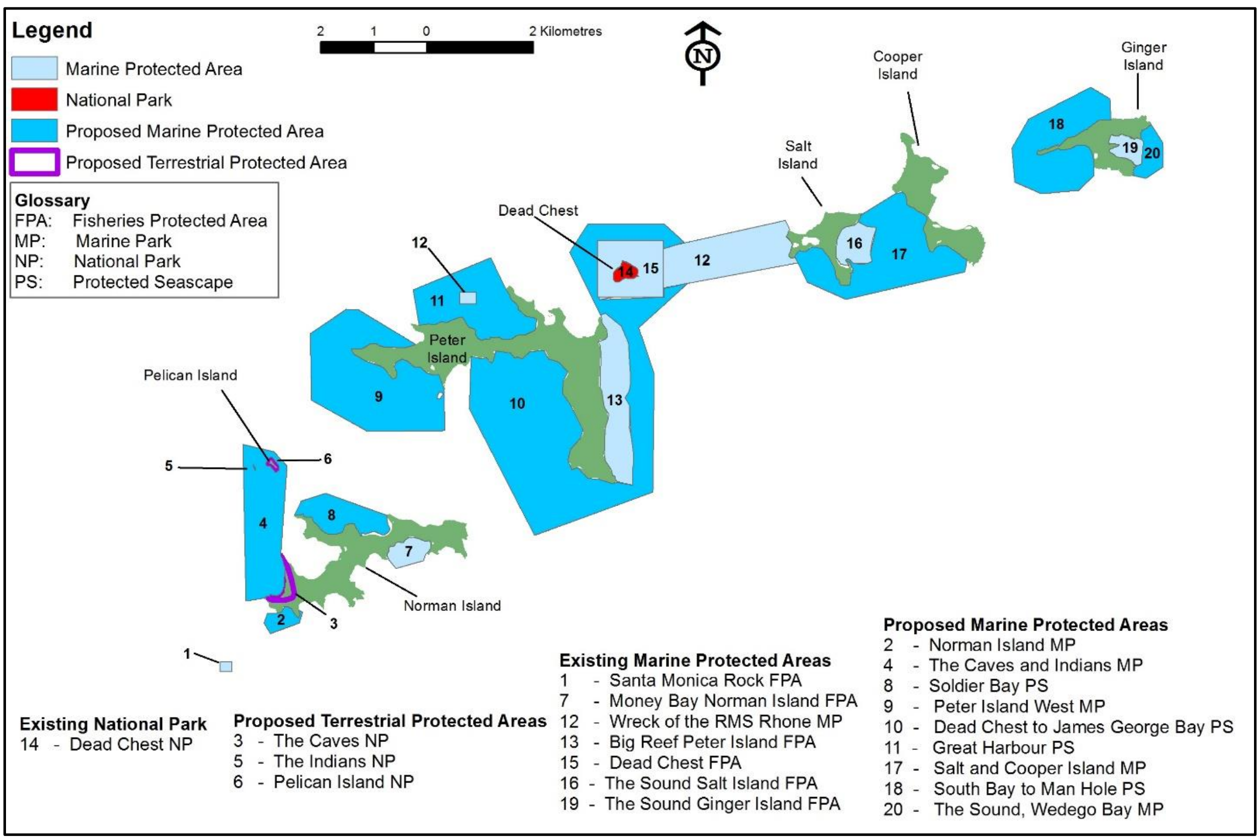


Figure 43.
Existing and proposed protected areas for Tortola's Southern Cays (see also Tables 49 and 51).

Table 50.
National Parks and Fisheries Protected Areas for Tortola's Eastern Cays.

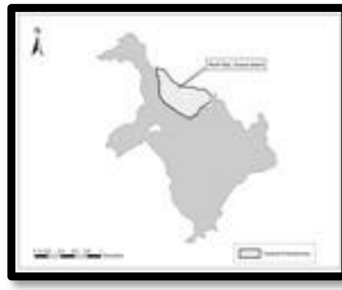
Cam Bay National Park

(photo source: NPT)

Established: 1999
Size: 19.6 Acres
Responsible Authority: NPT
Annual Budget: unknown
Dedicated Staff: 0
Biome: scrub forest, rocky beach, salt pond
PA Category: II-National Park

Management Objectives: bird sanctuary
Critical PA Activities: solid waste removal, endangered plant mapping, bird monitoring

North Bay Guana Island Fisheries Protected Area



(map source: Fisheries Order, 2011)

Established: 2003
Size: 70.7 Acres
Responsible Authority: DCF
Annual Budget: unknown
Dedicated Staff: 0
Biome: seagrass, coral
PA Category: IV-Habitat or Species Management Area

Management Objectives: protect fisheries habitat
Critical PA Activities: prevent illegal fishing and anchoring

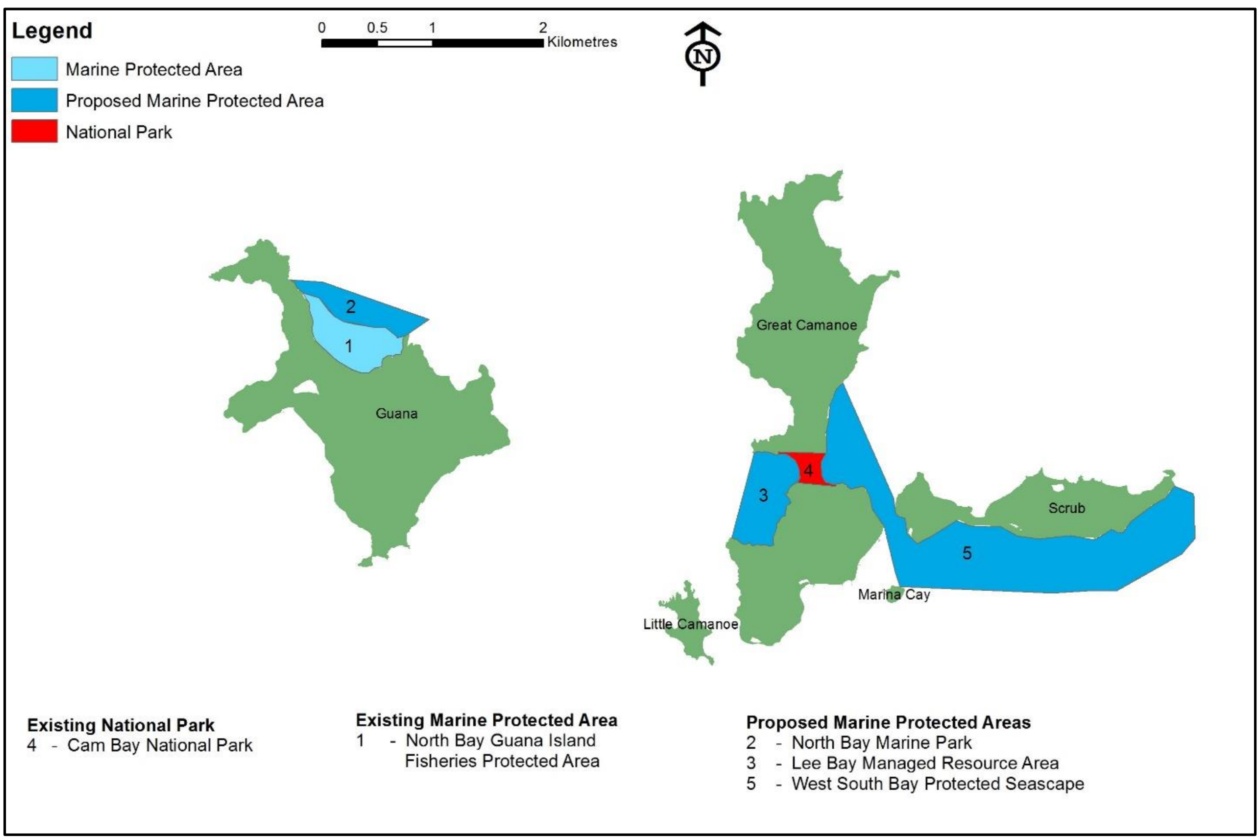


Figure 44.
Existing and proposed protected areas for Tortola's Eastern Cays (see also Tables 50 and 51).

8.3.2 Descriptive Overview, Pressures and Threats

The main threats to biodiversity in the Overseas Territories are invasive non-native species, climate change and habitat loss (e.g., through development for tourism).

UK/DEFRA, 2009

8.3.2.1 Terrestrial National Parks

Located at the highest point on Tortola, **Sage Mountain National Park** (**Photo 156**), donated by Laurance Rockefeller, is one of the crown jewels of the protected areas system and a conservation success story.

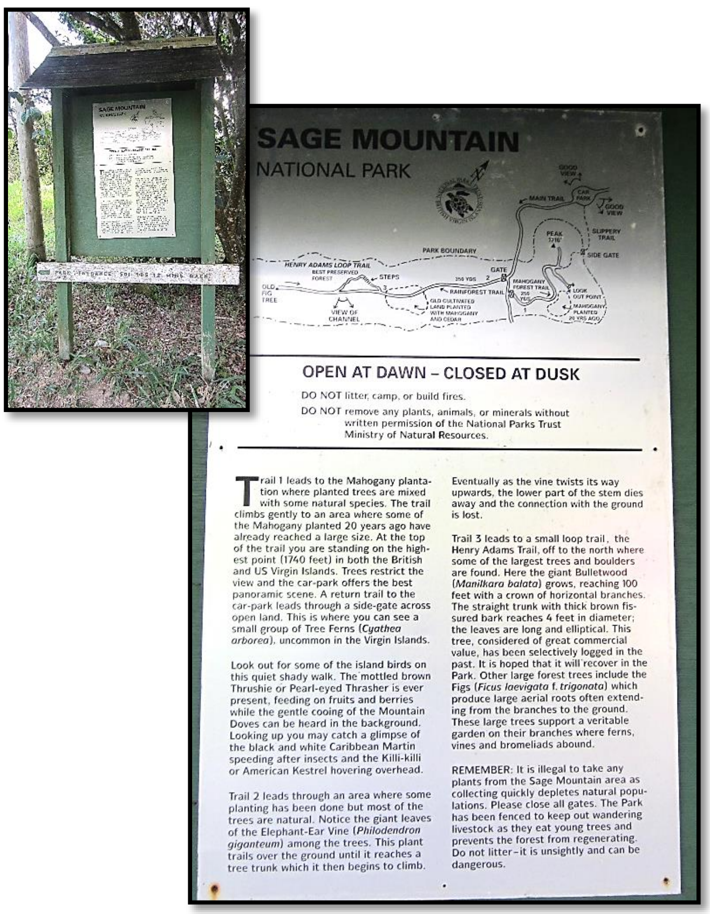


Photo156.
Entrance sign at Sage Mountain National Park.

Writing about the Sage Mountain National Park in 1976, Howell and Towle stated:

> *The poor soils now existing, however, once supported large xerophytic forests that covered most of the islands. Indiscriminate felling for charcoal, clearing for pastures and exploitation for timber have resulted in the almost complete removal of the original forests, with only a very small remnant at Sage Mountain, and isolated Bursera, Pisonia and Lonchocarpus trees remaining.*
>
> *Forest removal even in the recent past has been rapid. In 1954 less than 100 acres of the original xerophytic forest (only a small part of which was virgin) remained in the Mount Sage area, whereas less than a decade previously apparently 300 acres were reported to have existed …. In 1968, only about 13 acres of virgin forest remained, although there were also a number of patches of thicket regrowth …. Because of its protection, the forest area since then has stabilized, and thicket regrowths are possibly expanding"* (Howell and Towle, 1976).

Recommended for preservation since 1913 (Pascoe, 2014), Sage Mountain is a unique ecosystem whose historic range in the BVI has been greatly diminished. It contains what remains of the xerophytic rainforest originally found at this elevation in Tortola. An estimated 14,000 white cedar (*Tabebuia heterophylla*) and West Indian (*Swietenia mahagoni*) and Honduran (*Swietenia macrophylla*) mahogany trees were planted to reforest areas cleared for farming.

In its early years, the NPT obtained grants to assist with construction of fences to keep out livestock and for the development of trails and interpretative materials. A network of three main trails interspersed with several smaller looping trails crisscross the park, which is one of the most well-known and heavily visited attractions on Tortola.

Trail maintenance and upkeep in the Park's moist environment is very challenging. Residential development between the parking lot and the Park entrance has resulted in a number of driveways branching off from the former foot-path (now expanded into a dirt-road) leading to the Park's entrance. Increased vehicular access has degraded the road causing accumulation of excessive mud and water at the Park entrance. Visitors without guides sometimes have trouble finding their way to the Park's entrance (*pers. comm.,* Andie and Joy Hodge, visiting nationals, 30 July 2014), and, on occasion, finding their way out of the Park.

High rainfall causes rapid deterioration of materials used in the Park (NPT, 2012). Many signs are old, mouldy and faded; some have fallen on the ground, become overgrown or broken on the trail. The trails themselves suffer from erosion in certain areas. Hikers trying to avoid these difficult paths create side-trails and damaging trail widening. Detritus and debris have also accumulated within the Park. The NPT recognises that maintenance requirements are challenging, in part due to the Park's size, remote location and wet environment. The NPT is looking at replacement materials that are more water resistant for use within the Park, as well as recyclable wood. At this writing, it is also raising funds to replace deteriorating signage in the Park (*pers. comm*., Nancy Pascoe, NPT, 8 April 2015).

Sage Mountain is one of two terrestrial parks in the profile area for which entrance fees are imposed. Over 1,000 persons visit the Park each year (NPT 2010, 2011). Fulltime staff is no longer assigned to the Park, although three roaming NPT staffers maintain this and four other Tortola parks. Fee collection has been suspended, pending completion of new infrastructure at the Park (Standing Finance Committee, 2015). The Trust undertakes annual maintenance to clean, repair and replace signs, install boardwalks to alleviate muddy trails, and replace park benches; however, less than $100,000 per year is allocated in the budget for routine maintenance at ***all*** 21 parks (see also Section 8.5.1 below). The funding gap to effect all required maintenance and infrastructural development just at Sage Mountain was estimated at approximately $150,000 in a study by the Royal Society for the Protection of Birds (Rayment, 2007).

Sage Mountain is one of the BVI parks that had been scheduled to benefit from the Management of Protected Areas to Support Sustainable Economies (MPASSE) project. Launched in 2010, MPASSE was a joint venture between the Turk and Caicos Islands, the BVI, and the Cayman Islands, funded by the European Union, and chaired by the UK Overseas Territories Conservation Forum (UKOTCF, 2010). The project focused on improving management and infrastructure for protected areas.

Among BVI project activities under MPASSE was removal of an old structure and construction of a new facility at Sage Mountain for use as a shelter and office storing trail maps and other interpretive materials, a visitor centre, and a fee collection booth. In July 2014 a contract just under $53,000 was awarded to construct the facility (*BVI Beacon*, 24 July 2014). Unfortunately, MPASSE concluded in December 2014 before the Sage Mountain works were fully completed (about 80 percent finished at that time), and the Trust had to assume responsibility for financing the remainder of the work from non-MPASSE funds (*pers. comm*., Nancy Pascoe, NPT, 8 April 2015).

The **Joseph Reynold O'Neal Botanic Gardens** in Road Town was named in honour of a local entrepreneur and conservationist who also served as the first and longest-servicing chairman of the National Parks Trust. The Gardens' namesake described the site thusly in the mid-1980s:

> *Sixty-five years ago we were an agricultural community and the Botanic Station with its Curator was the hub of activity for all the Virgin Islands. During the intervening years, the Botanic Station became the Agricultural Department and its 60 acres, under relentless pressure for progress has been reduced to under 5 acres. Schools, recreation facilities, housing and commercial development have claimed the rest. It is the goal of the BVI Botanic Society to convert these acres into the beauty spot of the British Virgin Islands* (JR O'Neal, 1985).

Established in 1979, the Gardens presently occupy only 1.2 ha (2.9 ac) of the 2 ha (5 ac) initially envisaged, the rest having been lost to encroaching residential development on Crown Land (**Figure 45**). From 1985-2001, a very active Botanic Society was heavily involved in assisting with the Gardens.

The Botanic Society coordinated the layout for the Gardens, the establishment of its early collections, and the raising of funds to assist with expenses, including payment for a curator. In 2001, the Botanic Society disbanded, and the Gardens reverted to the sole management of the National Parks Trust.

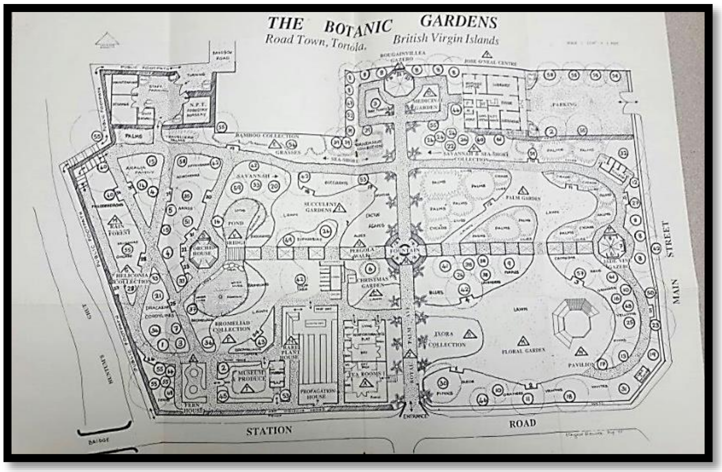


Figure 45.
The original proposed layout for the Botanic Gardens (source: Botanic Society, 1985).
Land north of the path above the fountains was lost to encroaching residential development.

The botanic collections represent different habitats of the BVI such as the rainforest, coastal environments, and dry forests, in addition to displays of exotic species and an extensive collection of palms (see Weddell, 1999, for a description of the various collections). The Trust has invested in curating the collection, developing a seed bank and cataloguing native seed species along with developing a propagation nursery.

The Gardens are a major tourist attraction, particularly for cruise passengers, with over 5,000 visitors reported by the Trust during a one-year period (NPT, 2011). Engaging a dedicated staff of six persons, it is also the main centre for horticultural environmental education in the territory. Native plants grown at the nursery are given to school children each year to plant on Arbour Day, and the NPT hosts a prestigious annual Flower Show in the Gardens.

Hurricanes, vandalism of infrastructure, and even feral animals are among the threats facing the Gardens. For example, Hurricane Earl in 2010 caused extensive damage to the plant collections, affecting 66 mature trees, damaging 40 percent of seedlings in the plant nursery, and destroying the fern house, which had to be rebuilt (NPT, 2010).

High staff turnover at the Trust has also been a problem for the Gardens, at all levels. A succession of curators on short-term contracts made it difficult to establish continuity in developing the collections (Darwin Initiative, 2003). At present, the role is not filled, and has not been for some time. There is some sentiment that the quality of the collections has suffered as result (Harris, 2013).

Currently, a stronger focus on the Gardens' *ex-situ* conservation role as the national repository for in-house collections of threatened and endangered species of plants is being promoted. Major on-going projects that support this focus are listed as follows:

(1) Integrating National Parks, Education and Community Development for the British Virgin Islands (1998 – 2002).

This Darwin Initiative project implemented by NPT included training workshops in botanical identification; inventory, monitoring and data analysis techniques; recovery planning; and botanic garden management. Attendees were drawn from all BVI departments involved with biodiversity (RBG Kew, 2015; Darwin Initiative, 2003). Outputs included the start of a redevelopment programme for the Botanic Gardens to shift its focus to conservation and education and production of a strategic development framework for the Gardens.

(2) Seed Conservation in the Caribbean UK Overseas Territories (2013-2015).

The project, funded by the UK's Darwin-Plus Fund, is implemented by the Royal Botanic Gardens, Kew and the NPT. It aims to build the capacity of partners in the five Caribbean UKOTs to conserve seeds of native species by establishing small-scale local seed banks and training staff, thus enabling seeds to be banked in-country (Darwin Initiative, 2013). The targeted seed collecting programme aims to increase the number of priority species held in collections. The aim in the BVI is to collect at least 50 new seeds for banking in the BVI, with duplication at the Millennium Seed Bank in the UK.

(3) Conserving Plant Diversity and Establishing Ecosystem Based Approaches to the Management of Forest Ecosystems in the British Virgin Islands in Collaboration with Royal Botanic Gardens Kew, July 2013-March 2015.

This vegetation-mapping project sought to identify the composition of terrestrial ecosystems and diversity of plants across the Virgin Islands. The project utilised GIS mapping to delineate the distribution of endangered and invasive species. All information will be shared with the NGIS to inform the development planning process.

While the Gardens may be small in size, they play a pivotal role in meeting the territory's biodiversity conservation goals and obligations.

Great Tobago National Park and **Little Tobago National Park** in the western cays, managed as a single unit, are examples of coastal dry scrub habitat and are also designated bird sanctuaries.

Great Tobago is an Important Bird Area (IBA) (Devenish, *et al*., 2009), home to one of the five main Magnificent Frigatebird (*Fregata magnificens*) colonies in the insular Caribbean (Petrovic, *et al*., 2008). Although categorised as national parks, these uninhabited cays are effectively managed as wildlife reserves and are not generally open to the public. Permanent wardens are not stationed there, but the NPT monitors the site and the bird colonies several times a year. Management interventions focus on eradication of invasive species and elimination of marine debris. Feral goats and fishing line entanglement are affecting the habitat and mortality of its avian residents.

Photo 157.
Magnificent Frigatebird entangled in fishing line
(photo courtesy of S. Zaluski).

In 2011, a scientific permit was issued to the Jost Van Dykes Preservation Society (JVDPS) for a project entitled End of the Line: A Community-based Project to Protect Caribbean Wildlife through Marine Debris Removal and Public Outreach. The project's goal is to remove synthetic fishing line from the nesting habitat at Great Tobago's Frigatebird colony (**Photo 157**), set up game cameras to observe the colony, and conduct a public outreach programme to reduce the number of Frigatebirds caught in fishing line. It is a collaborative project that supports the Royal Society for the Protection of Birds' BEST✦-funded project, in which the Trust and JVDPS are both partners (NPT, 2011).

Goat and rat eradication in Great and Little Tobago is a target of a project entitled Conserving Species and Sites of International Importance by the Eradication of Invasive Alien Species in the Caribbean UK Overseas Territories. This is a €266,432 cross-territory project, funded by the European Union BEST Fund. Partnering with the RSPB, Anguilla, the Cayman Islands, the Turks and Caicos Islands, and Montserrat, the NPT will coordinate and implement project activities in the Virgin Islands, which include: goat eradication at the Tobagos National Parks, planning for rat eradication at the Tobagos, and vegetation monitoring following goat eradication.

The **Shark Bay National Park** (Alexander H. and Gaby Nitkin Nature Reserve), on Tortola's northern shore, was donated by Mrs. Gaby Nitkin. Its cactus and scrub forest provides coastal cliffside habitat for bats, birds and other species. Primarily a recreation and hiking park, amenities include two trails and a lookout centre with a stunning view of the

✦ BEST is the acronym for **B**iodiversity and **E**cosystem **S**ervices in **T**erritories of European Overseas
http://ec.europa.eu/environment/nature/biodiversity/best/index_en.htm

Photo 158.
Shark Bay National Park:
Top: Tortola's north shore from the lookout platform;
Bottom: The one sign along the Shark Bay trail.

north coast (**Photo 158**). The new lookout was constructed by NPT wardens in 2012, with materials having to be brought in manually.

Park access remains an issue as private lands surround the park; also, there is no public parking area. Access to the Park is via wooden steps constructed over several boulders and abutting a private dirt road, with no indication that this is a park entrance. (see photo in Table 47). In 2010, construction of access stairs was delayed pending establishment of a right-of-way. The number of visitors is not monitored. Other management issues are trail maintenance and upkeep of the stairs and lookout.

Cam Bay National Park (Great Camanoe Island), donated by Herbert Lee in 1999, is the only park in the profile area protecting a near full range of habitats from terrestrial cactus scrub forest to coastal salt ponds, mangroves, and beach. The site also has historic value with evidence of a pre-Columbian settlement. Visitor use is unmonitored. Ocean-borne garbage is often deposited on the northeastern beach by prevailing currents. An annual coastal clean-up is conducted by the NPT with assistance from volunteers.

Dead Chest National Park (southern cays), another cactus scrub habitat, is a designated bird sanctuary and includes one of two protected ponds in the Tortola Profile area. It is also located within the Wreck of the Rhone National Park. The Trust has an agreement with the Royal Virgin Islands Police Force, whose forces use the island as a shooting range (NPT, 2012).

Mount Healthy National Park (**Photo 159**), the site of an eighteenth-century windmill once used for grinding sugarcane, is managed by the NPT for historic preservation.

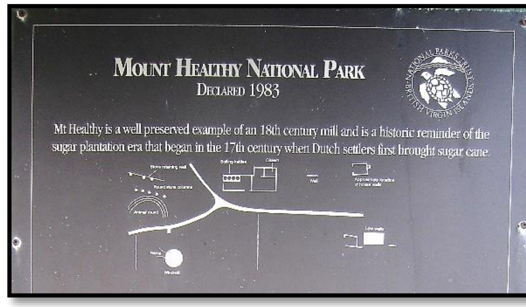


Photo 159.
Interpretive sign at Mount Healthy National Park.

The **Queen Elizabeth II National Park** is an urban park on reclaimed land in Road Town managed primarily for recreation. Amenities, including a swing set, picnic tables and jungle gym, make this park a popular spot for picnics and children's parties. The limited parking area is often used by nearby businesses, increasing the difficulty for park users to access the site (NPT, 2010, 2011, 2012). Other management issues include installing, maintaining and repairing fences, playground equipment, and picnic tables and discouraging free-roaming feral and domestic animals.

A master plan (**Figure 46**) proposes expansion of the Park to more than four times its present size. Although not complete, the expanded Park area is already in use as a public space, for example, hosting the annual Queen's Birthday Parade. Construction works on the Park have begun and are be-

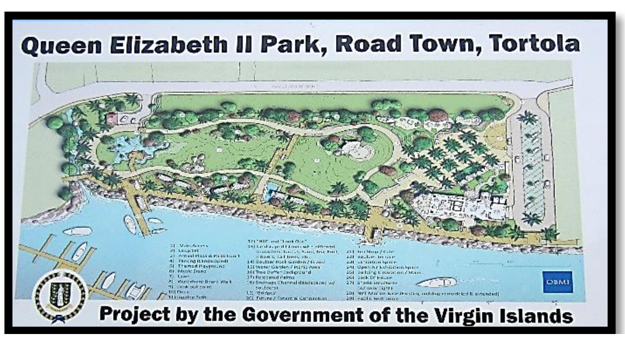


Figure 46.
Display of the Master Plan for an expanded Queen Elizabeth II Park.

ing directly managed by the Premier's Office, with horticultural assistance from the Botanic Gardens and a private landscaping firm.

8.3.2.2 Marine National Parks

The **Wreck of the Rhone Marine National Park** comprises a Royal Mail Steamer sunk by a hurricane in 1867. It lies in two main parts in depths of 9 m (30 ft) and 24 m (80 ft) between Peter and Salt Islands off Tortola's southern coast. The Rhone Anchor lies a short distance away, northwest of Great Harbour on Peter Island.

The Rhone is the largest park in the system, enclosing 310 ha (766 ac) of marine habitat consisting of fringing reef and seagrass beds that support endangered hawksbill and green turtles, while providing shelter for a large abundance of reef fish and marine organisms. It is the most visited and easily accessible dive site in the territory. Because marine permits give boaters access to all NPT moorings, it has not been possible to quantify how much NPT revenue is specifically generated by the Rhone.

Illegal fishing is sometimes a threat. Even larger management issues stem from anchor damage, boat waste, contact by divers, lionfish, and boat groundings (see also Section 5.1.2.1, Chapter 5).

8.3.2.3 Fisheries Protected Areas (FPAs)

Fisheries protected areas are selected to protect breeding grounds and nursery habitat. They are primarily located in areas adjacent to mangrove forests or areas of seagrass and coral. The main challenges for managers of FPAs are monitoring illegal fishing and anchoring, mangrove removal, soil erosion, and impacts from development on land.

See **Box 10** for a more detailed discussion of one FPA, the Hans Creek FPA (**Photo 160**).

Photo 160.
From the top of Mt. Alma, Beef Island, looking over Trellis Bay and the airport (right) and Hans Creek (left) (photo courtesy of Trish Baily).

8.3.2.4 Other Protected Areas

(1) Bird Sanctuaries

Cooper Island, Ginger Island, Peter Island, and Salt Island are the four bird sanctuaries that are not national parks (those declared as national parks are the Tobago Islands and Dead Chest). See **Figure 47**.

Salt Island is privately owned by local BVI families but is presently uninhabited. Ginger Island is for sale and may be subject to development in the foreseeable future. Peter Island is privately owned, and parts have been developed as an exclusive luxury

Figure 47.
Bird Sanctuaries in the Tortola Profile area (*source*: Department of Conservation and Fisheries).

BOX 10

Hans Creek Fisheries Protected Area

The Hans creek reef and lagoon system is ecologically linked to its seagrass, pond and mangrove habitats. Reducing the size of grass beds will reduce the number of fish that can survive in the area. Removing salt ponds and mangroves will alter the natural process of filtering sediment and nutrients in runoff water and will thus increase the risk of pollution effects in the Hans Creek ecosystem.

The Hans Creek Lagoon System on Beef Island—a shallow area of quiet water, coral rubble shoreline and fringing reef with 100 percent live coral cover on the forereef, supported terrestrially by a complex wetland system of seven networked salt ponds and a dense stand of red, black, and white mangroves—has been identified for protection since the earliest iterations of the BVI's Protected Areas System Plan (ECNAMP, 1981). Tourism development projects for Beef Island have been discussed equally as long.

Ecological Significance. Since the 1950s, at least 47 percent of the historical mangrove coverage on Tortola has been removed as a result of coastal development with 26 of the original 33 wetland sites on Tortola having been wholly or partially filled and replaced with building sites and/or marinas (Jarecki, 2006). Hans Creek retains ***the largest single contiguous mangrove forest system*** (approximately 80 acres) remaining in the BVI outside of Anegada.

A 1996 study that compared fish at three BVI sites found that 50–80 percent of the commercially important species caught were from traps set in Hans Creek:

> *The importance of Hans Creek may be due to water circulation concentrating settlement stage fish in this area, or it may perhaps be due to the proximity of all three juvenile nursery habitats (mangroves, seagrasses and backreefs) in one interconnected habitat. Whatever the ecological reason, it seems likely that Hans Creek is an important nursery ground for juveniles of commercially important species, and the planned development of Beef Island which currently threatens the area should be a cause for concern to the fishing industry* (Munro and Watson, 1999).

The Legal Challenge. Hans Creek Lagoon was one of 14 FPAs declared by the Fisheries Regulations in 2003. In January 2007 a developer received planning approval to construct a 5-star hotel, mega-yacht marina and golf course on Beef Island. The proposed golf course and marina would have been located next to, and one golf-hole on the islet within, the Hans Creek Fisheries Protected Area.

The Virgin Islands Environmental Council (VIEC), a group of concerned fisher-folk, residents and scientists, filed a court action arguing that the planning permission granted for the Beef Island Development Project was illegal because the development would adversely affect Hans Creek. The High Court agreed, saying that any breach of Fisheries Regulation 51(1) was a criminal offence. The proposed project would in part involve development within the Hans Creek area and therefore the approval granted by the Minister [for Planning] was illegal since "it is clear that the prohibition in that regulation was intended to apply to Hans Creek" and evidence showed the development would have an adverse effect. ✦

The Court of Appeal, however, decided that planning permission was valid because the Fisheries Act 1997 gave the Minister of Natural Resources and Labour power to declare Fisheries Protected Areas "by ***Order*** published in the Gazette" but not by way of Regulation♦. Therefore, Hans Creek was not a protected area. By implication neither were the other thirteen FPAs.

(continued)

> **Fisheries Regulations 2003, s. 51(1):**
>
> ***No person** shall carry out **any development activity**, whether terrestrial or otherwise which may or is likely to adversely impact **on a** … **protected area** declared by the Minister by Order in the Gazette.*

Re-Declaration of FPAs. Given the Court's position, an Order was published in the Gazette on 17 November 2011, once again declaring Hans Creek and the other sites as "Protected Areas." The Order was retroactive, and stated that it took effect on 19 June 2003, the date the Fisheries Regulations were originally brought into force.

Current Position. Despite re-declaration, the legal status of areas protected under the Fisheries Act remains highly insecure. On the one hand, the Protected Areas System Plan proposes to augment the existing FPA by creating a Hans Creek terrestrial **Habitat Management Area** and **Marine Park** resulting in a larger ecological unit for management. Statements by Government officials have indicated an intention to implement the System Plan fully (for example, see commitments under CCI, Section 8.2.4 above). On the other hand, development of a hotel, marina and golf course for Beef Island remains very high on the political agenda, along with expansion of the airport runway, another project which could significantly impact the Beef Island ecosystem (BVI *Platinum News*, 6 November 2013; 4 June 2014; 3 October 2014).

Clearly, there is every likelihood for continuing tension between conflicting policies and objectives. And, in the meantime, the Hans Creek Fisheries Protected Area and the otherwise unprotected mangrove forest and wetland ecosystems of Beef Island remain under high risk from potential development.

✦ BVIHCV 2007/0185 (Hariprashad Charles J), Judgment 22 September 2009.
♦ BVIHCVAP 2009/0021 (Rawlins JA, Edwards JA, Baptiste JA), Judgment 12 August 2011.

resort, although much remains in a natural state. Residential and commercial development on Cooper Island has been increasing, largely centred in the beach area. Feral goats are a problem on Peter, Cooper and especially Salt Islands, while the excellent state of vegetation on Ginger is largely due to the island being goat-free.

The Royal Virgin Islands Police Force, which falls under the Governor, is the only enforcement authority identified by the Wild Birds Act. Perhaps in keeping with the Environment Charter (see Sections 2.2.4.2, Chapter 2 and 8.2.3 of this chapter), the Governor could be invited to act as a patron and sponsor of an annual bird count for the four non-NPT-managed bird sanctuaries.

(2) Water Areas

Under the Protection of Trees and Conservation of Soil and Water Ordinance 1954, there are six declared water areas in Tortola:

- Belle Vue Ghut
- Morning Rose Spring, Belle Vue
- Purcell
- Harrigan and Long Bush
- Great Mountain and Gordon
- Joes Hill, Albion and Nibb's Estate, Sea Cow's Bay.

There is no Forestry Officer on staff at the DOA, and no current information available on the status of forests in the protected Water Areas. Until broader environmental management legislation is enacted and implemented in the territory, perhaps the Minister for Natural Resources should request from the Department of Agriculture an annual report to ascertain the status of these protected forests.

(3) Shark Sanctuary

On 22 May 2014, the Minister of Natural Resources and Labour, by Order in the Gazette (Fisheries [Protected Species] Order, 2014, SI 2004/28), declared the fisheries waters of the BVI a shark and ray sanctuary. The Order is applicable to the entirety of the BVI's Exclusive Fishery Zone, and prohibits fishing, selling, or mutilation of shark or ray species (*Island Sun*, 24 May 2014).

8.3.3 Proposed Parks and Protected Areas

The establishment of a national system of protected areas is supposed to rationalize the approach to protected area planning, as well as link conservation priorities and efforts to other development strategies and activities.

Lloyd Gardner (2002)

The Protected Areas System Plan states that protected area managers in the BVI have made progress toward "completing the identification and characterization of important marine and terrestrial habitats and resources that may be included in the system of protected areas" (Gardner, *et al*., 2008), most significantly in the marine system. Thirty-one parks are proposed in the System Plan for Tortola and its surrounding cays, and two additional sites have since been identified by Government: (1) a terrestrial national park *and* a marine park at Long Bay, Beef Island and (2) a marine park at Smuggler's Cove. Twenty-four of the proposed sites are marine. See **Table 51** and **Figures 41** to **44**.

Table 51.

Proposed parks and protected areas for Tortola and surrounding cays.

Location	Proposed Marine Protected Areas	Proposed Terrestrial Protected Areas
Tortola	1. Beef Island Habitat Management Area 2. Hans Creek Marine Park 3. Cooten, Josiah's, Lambert Species Management Area 4. Trunk Bay, Rogues Bay Species Management Area 5. Paraquita Bay Managed Resource Area 6. Soper's Hole Habitat Management Area 7. Great Carrot Bay Habitat Management Area 8. Smuggler's Cove Marine Park***** 9. Long Bay, Beef Island Marine Park*****	1. Banana Wharf/Bluff Bay National Park 2. Hans Creek Habitat Management Area 3. Bar Bay Habitat Management Area 4. Paraquita Bay Habitat Management Area 5. Belmont National Park 6. Long Bay, Beef Island National Park*****
Western Cays	10. Great Tobago Protected Seascape 11. Great Thatch Marine Park 12. Great Thatch North Marine Managed Resource Area	7. Great Thatch National Park
Southern Cays	13. Norman Island Southwest Marine Park 14. Soldier Bay Protected Seascape (Norman Island) 15. The Caves and Indians Marine Park 16. Great Harbour Protected Seascape 17. Peter Island West Marine Park 18. Dead Chest to James George Bay Protected Seascape 19. Salt and Cooper Island Marine Park 20. South Bay to Man Hole Protected Seascape 21. The Sound, Wedego Bay Marine Park	8. The Caves National Park 9. Pelican Island National Park 10. The Indians National Park
Eastern Cays	22. West South Bay Protected Seascape 23. Lee Bay Managed Resource Area 24. North Bay Marine Park	

***** Not included in the BVI Protected Areas System Plan.
Source: Gardner, *et al*., 2008; Smith, 2012; Pickering, 2012.

8.3.3.1 Proposed Marine Protected Areas Network

Building on the survey of marine resources carried out by ECNAMP in the 1980s, and the more recent BVI Coastal Resources Atlas, a proposed marine protected areas network was designed by the NPT in collaboration with the DCF and other partners as part of an OTEP- funded project entitled Assessment and Improved Management of New and Existing Marine Protected Areas in the British Virgin Islands (2004–2006); a parallel project was executed with TNC, funded by NOAA, entitled *Strategic Designation of the BVI MPA Network* (2005-2006). The overall goal was to create a network of marine PAs that met the following criteria (Woodfield-Pascoe, *et al*., 2013):

- Reflects the major marine and coastal habitats of the BVI;
- Protects 30 percent of the important biological habitats across the BVI (*e.g*., hard corals, soft corals, seagrasses, mangroves, turtle nesting beaches, fishery habitats);
- Clusters protected areas together so that they can be easily managed; and,
- Ensures that there are marine protected areas distributed across the BVI in order to promote "resilience" within the network.

System design involved fieldwork to verify and update a 1991 GIS coastal resources dataset. Then MARXAN, a computer decision-making programme created to assist with spatial analysis for protected areas planning, was used to identify proposed boundaries. Mapping took account of areas large enough to be resilient, areas important for biodiversity, fish breeding or nursery habitat, and feedback from primary resource users such as divers and fishers (*BVI Platinum News*, 1 October, 2012).

Further mapping of marine resources continues under a Darwin Plus-funded project entitled BVI MPA and Hydrographic Survey Capacity Building (2014–2016), led by the UK Centre for Environment, Fisheries and Aquaculture Science, in partnership with the UK Hydrographic Office and the NPT (Darwin Initiative Secretariat, 2014b). The project will update BVI hydrographic maps—currently based on nineteenth century lead-line observations—by using sonar systems to produce state-of-the-art 3D maps. By accurately characterising the seabed, these charts will provide not just navigational tools, but also useful habitat data for environmental managers.

8.3.4 Resource Protection

8.3.4.1 Landmass

Approximately 2 percent of landmass in the profile area is under protection (**Table 52**).

According to the System Plan, if fully implemented, 12–13 percent of BVI landmass would be protected.

8.3.4.2 Forests

The range, extent and characteristics of forest cover in the BVI are presently under investigation. A draft Forestry Management Plan is one of the anticipated outcomes of a Darwin-funded project, Conserving Plant Diversity and Establishing Ecosystem-based Approaches to the Management of Forest Ecosystems in the BVI Project, a collaboration between the NPT and Kew. Figures reported in 1980 (FAO, 2010) estimated a total of 1,853 ha (4,579 ac) of terrestrial forest cover on Tortola comprised of Cactus Scrub, Dry Forest, Moist Forest and Rainforest. Most of this forest cover is considered to be secondary forest or re-growth. The majority of original forest cover was removed for sugar cultivation and boat building, activities that took place earlier in the island's history.

A small area of about 12 ha (29.5 ac) of the 37 ha (92 ac) Sage Mountain National Park is believed to contain the best example of what remains of the original forest cover at this elevation in Tortola. Declaration of the proposed Beef Island Banana Wharf/Bluff Bay National Park would expand protected forest area to include the territory's only remaining example of primary dry coastal woodland.

Currently protected forest cover in the Tortola profile area is depicted in **Table 53**.

Table 52.
Ratio of landmass to protected landmass.

	National Park	Existing Park Acreage	Total Acreage	% of Land Protected
Tortola	Sage Mountain	92.0	14,849	1%
	QE II	0.7		
	JR O'Neal Botanic Gardens	2.9		
	Shark Bay	18.4		
	Mt. Healthy	1.0		
	Sub-Total	**115.0**		
Tortola's Sister Islands	Cam Bay	19.6	4,249	1%
	Dead Chest	34.0		
	Great Tobago	210.0		
	Little Tobago	55.0		
	Sub-Total	**318.6**		
Profile Area Totals		**434**	**19,098**	**2%**

Source: Gardner, *et al*., 2008; Department of Town and Country Planning.

Table 53.
Protected forest cover on the island of Tortola.

Vegetation Classes	Tortola Area (ha)	Existing Protected Areas (ha)	Additional Proposed Areas (ha)	Comments
Rain Forest	57	37	-	Sage Mountain National Park—Xerophytic Rainforest only 12–18 m high
Moist Forest	378	-	-	
Dry Woodland	851	7	80	Existing: Shark Bay National Park Proposed: Beef Island Banana Wharf/Bluff Bay National Park
Cactus Scrub	567	*	-	* 125 ha are protected on Great Tobago, Little Tobago, Dead Chest and Cam Bay
Total	**1,853**	**44**	**80**	**Note: Addition of Banana Wharf/Bluff Bay National Park would increase protected forest cover on Tortola from 2 to 7 percent**

Source: FAO, Food and Resources Assessment Programme, 2010.

The six designated Water Areas on Tortola (see Section 8.3.2.4 above), under the jurisdiction of the Department of Agriculture, could also be considered protected forests since the authorising legislation prohibits removing or injuring trees to prevent siltation and pollution of water sources. However, there is no current information on the status of these Water Areas since there is no active monitoring and/or management of water or forestry areas by the Department of Agriculture or any other agency of Government. In addition, the DOA is not represented on the Planning Authority and is not appraised of any development in areas where there are protected watersheds (Dennis, 2001).

8.3.4.3 Flora

Distribution of flora in the profile area is also under investigation. While the presence or absence of some species within the national parks is known, the overall range and distribution of flora across the entire BVI has not been extensively studied. Accordingly, it has been difficult to evaluate whether existing protected areas or management strategies are sufficient to ensure survival of rare, threatened, endangered and endemic species in the profile area.

However, the Vegetation Mapping Project (Section 8.3.2.1 (3)) will produce for the first time comprehensive plant lists for each of the islands surveyed, plant lists for the national parks, and a plant layer for use in territorial GIS mapping (Pascoe, 2014). Continued work with Kew, under a new Darwin-funded project (2015-2017), *Building Capacity to Monitor and Conserve the BVI's Flora*, will extend BVI links to Puerto Rico and the USVI to better understand the distribution and significance of Puerto Rican Bank species (*pers. comm*., Nancy Pascoe, NPT Planning Coordinator, 8 April 2015).

In addition to identifying new areas for inclusion in the System Plan, an increased understanding of critical flora could expand the use of other conservation tools for their protection, such as Plant Preservation Orders under the Physical Planning Act 2004, as well as increase the number of plants in the collections at the JR O'Neal Botanic Gardens. The successful completion of these projects will be a significant step forward for biodiversity planning in the BVI.

8.3.4.4 Coral Reefs

One acute threat facing BVI reefs is anchor damage (see also Section 5.1.2.1, Chapter 5). According to Rebecca Flynn, a PhD student assessing the impacts of anchor damage on coral reefs in the BVI:

> *At one long term monitoring site, a single anchoring event caused a 12 percent reduction in coral cover in one day, a decline equivalent to that experienced in 21 years at 7 other sites. At sites across the BVI that have historically been more frequently anchored, coral cover is 7-8 percent lower than at sites without that history of anchoring. In addition, these highly anchored sites have lower structural complexity, fewer and smaller corals, and lower coral species diversity than sites subject to lower anchoring* (*pers. comm*., Rebecca Flynn, 21 January 2015).

With the exception of reefs within the Wreck of the Rhone National Park, the majority of highly visited reefs fall outside the existing boundaries of declared protected areas. Nevertheless, coral reefs benefit from a well-known, highly publicised Marine Conservation Programme implemented by the NPT since 1991, whereby over 200 mooring buoys have been installed on the seabed using the Halas System method (**Figure 48**). The buoys are for day use only, colour coded according to the type of vessel they serve, require purchase of a marine conservation permit for their use, and have a 90-minute time limit. Successful programme implementation depends heavily on cooperation from dive industry operators and other resource users.

The moorings are maintained and patrolled by NPT marine wardens in teams of 2–3 persons patrolling about 20 hours a week (NPT, 2011). Fees from the programme totaling almost $950,000 were collected by or remitted to the NPT in 2013.

Challenges over the years have included: inability to fully maintain the moorings during periods when the NPT patrol boat was down for repairs (a dedicated maintenance vessel is now part of the NPT fleet and a second patrol vessel was recently acquired); continuous abuse of moorings by some commercial vessels, particularly those from outside the BVI; overnight use of moorings which are not designed for that level of use; and lack of public cooperation with NPT wardens on patrol when they seek to enforce proper use of moorings.

The National Parks Regulations 2008 make provision for NPT wardens to issue penalty notices, in essence tickets, on the spot. However, law enforcement training is required before the wardens may be appointed as "authorised officers" under the Act, while police presence on patrols is rare and no penalty notices have been issued.

Yet, despite the challenges and the need for additional moorings and improvements in enforcement, the NPT moorings system is invaluable in helping to protect the marine environment.

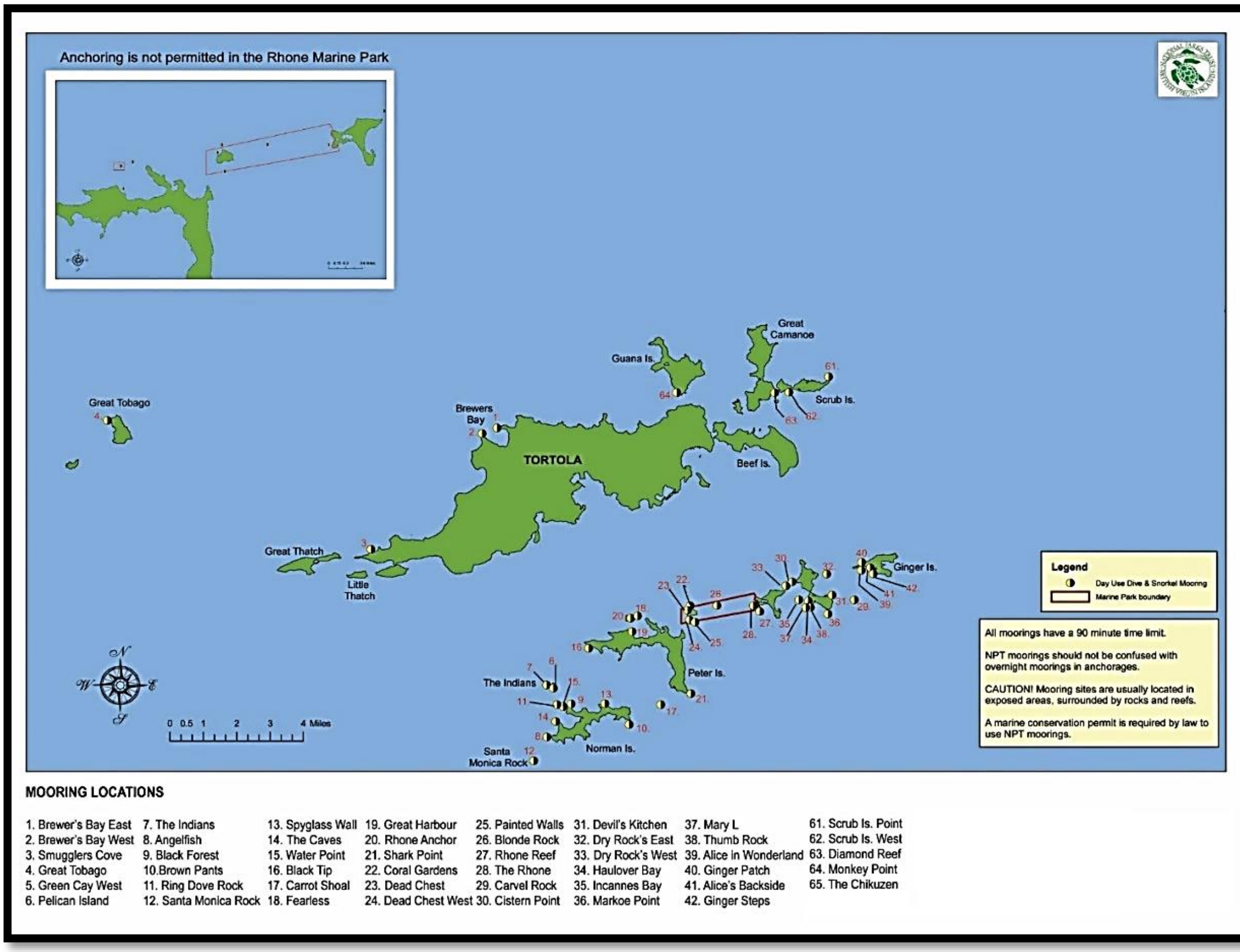


Figure 48.
NPT moorings in the Tortola Profile area.

With the exception of Wreck of the Rhone National Park, the majority of moorings presently fall outside the boundaries of protected areas under jurisdiction of the NPT. Hence, the importance of including many popular dive sites in the southern cays within the proposed MPA network and thereby enabling a formal management structure for better enforcement and protection of the underlying resource base, but with management categories that allow for fishing and tourism.

8.3.4.5 Beaches

Tortola has 25 km (6.2 mi) of beaches, and the southern cays have 7. 25 km (4.5 mi)—none of which are presently protected (DPU, 2006). Accordingly, there is no protection for the nesting habitat of endangered sea turtles. Declaration of the proposed Long Bay, Beef Island National Park and the Belmont National Park/Smuggler's Cove Marine Park would incorporate at least two recreational beaches within the PA System.

The Department of Conservation and Fisheries has prepared a draft Beach Management Framework, which is detailed in Section 2.2.4.10 of Chapter 2. The framework (Gore, 2013a and b) is intended to provide background and direction for a fresh look at beach management issues in the territory.

8.3.4.6 Mangroves, Salt Ponds and Wetlands

None of the mangrove or salt pond systems on Tortola are protected. A small acreage of wetland at Cam Bay National Park is protected as is a pond at

Dead Chest National Park (**Table 54, Figures 49** and **50**).

A draft Wetlands Management Plan (DTCP, 2005b) proposes: (**1**) designation of all salt ponds and mangrove systems as Environmental Protection Areas under the Physical Planning Act and (**2**) the preservation of outstanding examples of all wetland types by including them in the territorial System of Parks and Protected Areas. Fourteen critical mangrove areas have been identified by a DCF/OECS project for Tortola and Beef Island (DCF, 2013a).

Table 54
Mangrove swamps and salt ponds in the Tortola Profile area.

Island	Mangrove swamp area (ha)	# Mangrove Swamp Systems	# Protected Mangrove Systems	# Salt Ponds in Natural State	# Salt Ponds Filled, Partially Filled or Dredged	# Protected Salt Ponds
Tortola	148.4	34*	**0**	5	13	**0**
Beef Island	30.8	8*	**0**	6	1	**0**
Western Cays	2.9	1	**0**	1	0	**0**
Southern Cays	10.1	18	**0**	16	0	**1**
Eastern Cays	14.4	10*	**1**	5	3	**1**
TOTALS	**206.6**	**71**	**1**	**33**	**17**	**2**

Source: Jarecki, 2006.
* Includes known wetland locations that were not measured for the Jarecki study.
Note: Table 1 in Chapter 1 provides a listing of existing wetlands for Tortola and Beef Island, including those partially reclaimed. The above table includes all wetlands including those that have been totally reclaimed.

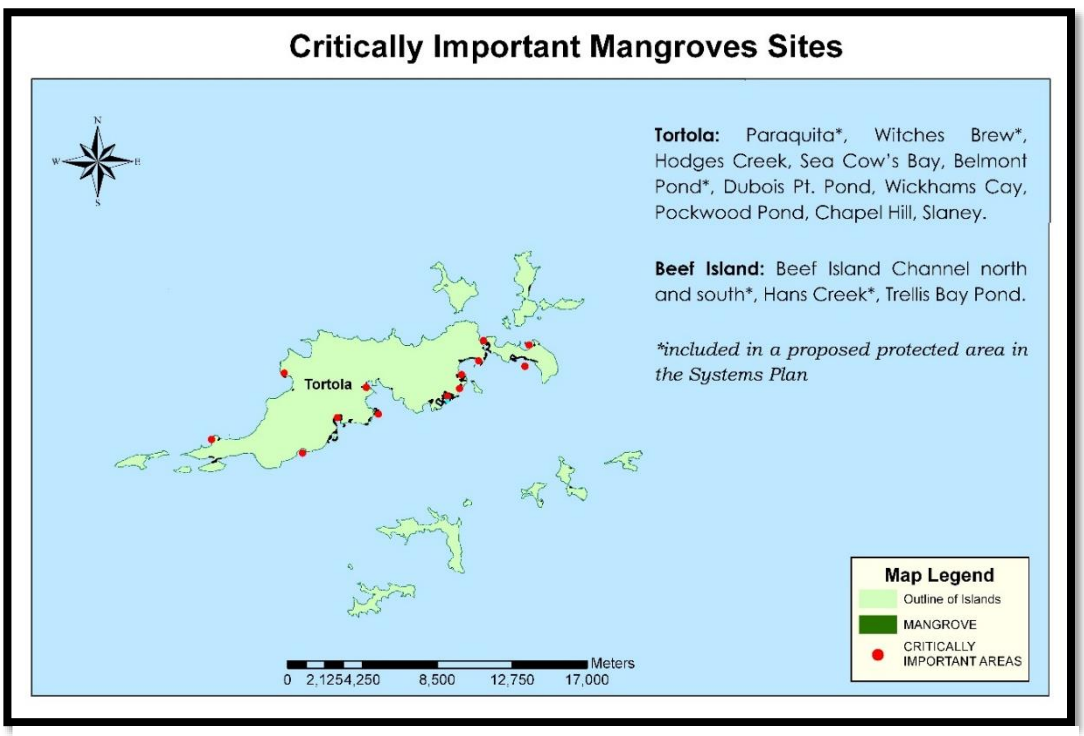


Figure 49.
Critically important mangrove sites identified by the DCF (source: DCF, 2013b).

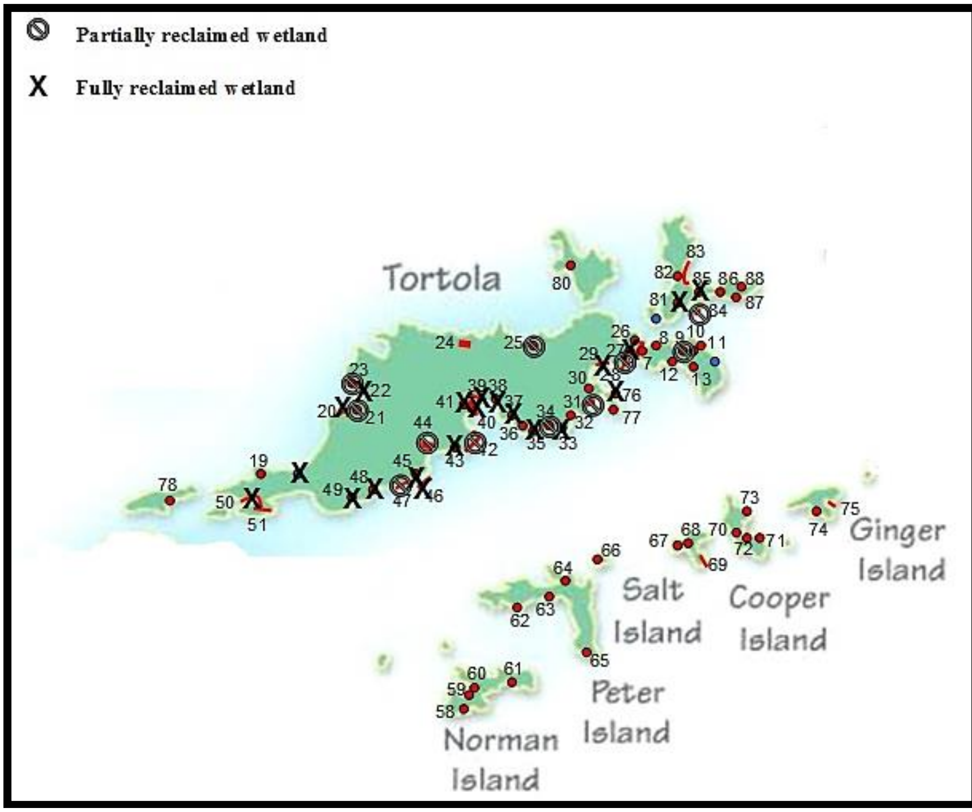


Figure 50.
Status of wetlands in the Tortola Profile Area (*source*: Jarecki, 2006).

Four of the 14 critical areas are included within proposed protected areas under the System Plan:

- Bar Bay (Witches Brew)
- Belmont
- Paraquita Bay
- Hans Creek.

Ramsar site applications (for wetlands of international importance) have been prepared for Long Bay, Beef Island and the Belmont/Smuggler's Cove Area (NPT, 2012).

Like coral reefs, in the absence of direct legislative protection, mangroves benefit from a management programme designed to promote resource sustainability. A joint project of the NPT and DCF, the Mangrove Reforestation Programme was initiated in 1999 to address the decline in mangrove forest cover (see also Section 1.1.1 (5) in Chapter 1). Over 2,500 seedlings have been replanted at 12 sites around Tortola with the participation of 12 volunteer organisations (NPT, undated).

8.3.4.7 Species

The species management and protection framework in the BVI is fairly weak (FIELD and RSPB, 2013), and those species—particularly terrestrial species—whose habitat fall outside the protected areas system are at a disadvantage. As part of current efforts to redraft the Environmental Management and Conservation of Biodiversity Bill (Section 2.2.3.6, Chapter 2), it is anticipated that there will be more focus on the protection of native and threatened species and protection of natural habitats.

Strict moratoriums are in effect against harvesting Leatherback and Loggerhead Turtles, as well as 31 species of birds. Commercial moratoriums are in effect against killing sharks and rays, but subsistence fishing by licensed fishermen is allowed. Closed seasons are in effect for conch, Green Turtles, Hawksbill Turtles, lobsters, whelks, red hind and Nassau Grouper (see also Section 5.1.3, Chapter 5).

The Department of Conservation and Fisheries collects fish catch data from the Fisheries Complex and directly from fishermen, but for the most part regular reports are not publicly available. The DCF also collects turtle monitoring data and in recent years has published or contributed to publications, presentations, papers and reports on the status of marine turtles. The consensus seems to be that turtle nesting populations in the Tortola Profile area are increasing, despite the absence of protected habitat, thanks to ongoing efforts spearheaded by the DCF to publicize harvesting bans, monitor nesting beaches and tag turtles (McGowan, *et al*., 2008).

Species lists for the territory exist (Procter and Fleming, 1999), Pollard and Clubbe (2003) and IUCN Red Lists (DCF, 2011), but are generally outdated and incomplete. The Royal Botanic Gardens, Kew and the National Parks Trust have long collaborated to gather data for updating the Virgin Islands' Plant Species Red List, including species distribution data needed to rank the level of threat.

Guana Island has been extensively studied as part of annual scientific retreats to Guana supported through the philanthropy of the family who own the island (Perry and Powell, 2009).

So far, three international priority sites for bird conservation—Important Bird Areas (IBAs)—have been identified covering about 11 percent of the territory's landmass (Allcorn, *et al.*, 2009). One—Great Tobago—is located in the Tortola Profile area and is fully protected. Petrovic, *et al.* (2008) note that it is possible that more IBAs may exist in the profile area, but in terms of determining breeding sites, population data, and necessary conservation actions, more systematic surveys and monitoring need to be undertaken.

Overall, the current status, distribution and population of wildlife species in the profile area—including rare, threatened and endangered species—is largely unknown. The elusive indigenous Virgin Islands tree boa (*Chilabothrus grantii* zenneck) is known to occur within Sage Mountain National Park (Procter and Fleming, 1999), but it is likely that much of the animal biodiversity resides outside of protected areas boundaries. The current knowledge gap makes it difficult to ascertain whether the existing protected areas contain "relatively" high numbers of rare, threatened, endangered or endemic species, or whether the protected areas system is adequate to ensure conservation of important species within the profile area. (See Section 4.3 of Chapter 4 for a detailed description of Tortola's fauna.)

8.4 Management and Administration

8.4.1 National Parks Trust

Established in 1961, the National Parks Trust is a statutory body charged with the management of parks and protected areas declared under the National Parks Ordinance (1961), the Marine Parks and Protected Areas Ordinance (1979), and the National Parks Act (2006). (See also Section 2.2.2.2 in Chapter 2.)

The National Parks Trust's statutory duties include:

- Management of parks and protected areas.
- Preparation of management plans for each protected area.
- Advising the Minister on the state of protected areas.
- Making proposals to designate new areas or modify existing ones.
- Declaring, conserving and restoring historic sites.
- Promoting education on natural and cultural heritage.
- Preparing annual budgets.
- Carrying out scientific studies and monitoring.
- Constructing and maintaining appropriate infrastructure within protected areas.

- Licensing/monitoring concessions and business operations within protected areas.
- Implementing relevant obligations under international and regional conventions.
- Training staff and officers.
- Preparing and updating the Protected Areas System Plan.

8.4.1.1 Organisational Structure

The NPT is governed by a Board appointed by the Minister of Natural Resources and Labour. It is administered by a director and currently employs 37 persons who discharge administrative, financial, and education duties, and manage terrestrial and marine protected areas.

8.4.1.2 Financial

The NPT's operational budget is funded by an annual subvention from Government along with revenues collected from the sale of permits for the use of NPT moorings at dive sites and entrance fees at designated park sites (the Botanic Gardens and Sage Mountain on Tortola). Project funding is obtained through grants and donations from private individuals, partner institutions and donor organisations. Estimated revenue in 2013 was $1.7 million dollars. In 2013, the MNRL reduced the Trust's annual subvention of approximately $400,000 (which accounts for about 20 percent of the NPT's operating budget), with a view to its eventual elimination. To compensate for the reduced subvention, the Ministry has formally allocated authority to the NPT to collect the seabed lease fees for *all* moorings in the territory. Collection of these fees began in April 2013 (NPT, 2013). It is anticipated that a proposed increase in moorings fees will provide sufficient funding to enable the NPT to eventually become self-financing (Standing Finance Committee, 2015).

8.4.1.3 Challenges

At the present time, expenditures for individual parks are not reported because all parks managed by the NPT are administered as a system. In 2013, an estimated $60,000 in recurrent expenditures was spent from the operations budget for routine maintenance at all 21 parks. This figure does not include capital expenditures such as heavy maintenance equipment for moorings, nor infrastructure projects in the parks that are funded through grants.

8.4.2 Department of Conservation and Fisheries

The Department of Conservation and Fisheries is a governmental department established under the Ministry of Natural Resources and Labour (see also Section 2.2.2.1 of Chapter 2). It is responsible for the management of Fisheries Protected Areas declared under the Fisheries Act 1997, which provides for fisheries management and the conservation of fisheries and fisheries resources.

The Department's statutory duties derive from the Fisheries Act and Fisheries Regulations 2003. The DCF work programme, however, broadly includes many of the Government's environmental management functions, including:

- Fisheries management;
- Coastal zone management;
- Environmental information and education;
- Environmental quality monitoring, surveillance and response, coastal maintenance, ocean safety.

8.4.2.1 Organisational Structure

The Department is staffed by a director and 25 persons, including a Fisheries Unit with 6 officers (2 stationed outside of Tortola) with primary responsibility for fisheries. Restructuring of the Department's organisational structure is being considered as part of the redrafting of environmental management legislation (see Section 2.2.3.6, Chapter 1).

8.4.2.2 Financial

The Department's annual budget is approximately $2 million. At present, there is no separate budgetary allocation for the management of Fisheries Protected Areas.

8.4.2.3 Challenges

Such surveillance as the Department carries out must cover all fisheries waters. The Department possesses a marine launch, but officers are not equipped to make arrests. The DCF undertakes joint surveillance and enforcement activities with the Royal VI Police Force, and occasionally arrests are publicized (*BVI Platinum*, 25 February 2014). No staff is specifically assigned to protected areas management, and no direct budgetary allocations are earmarked for inventorying, monitoring or patrolling the designated Fisheries Protected Areas.

8.4.3 Department of Town and Country Planning

The Department of Town and Country Planning within the Premier's Office is the administrative agency for the Physical Planning Act 2004 (see also Section 2.2.2.4 of Chapter 2). The Act seeks, among other things, "to make provision for the orderly and progressive development of land … and the protection of the environment…." The Planning Authority is a statutory board and the management authority for the Act.

The Planning Authority is empowered to declare "environmental protection areas" within: (1) a National Physical Development Plan that addresses land use in the territory as a whole, or (2) Development Plans for any particular part of the territory. No Environmental Protection Areas have been declared to date, and none of the Planning Authority's annual recurrent budget of approximately $950,000 is presently allocated to management or enforcement of Environmental Protection Areas. Current drafting of Regulations for the National Physical Planning Act (see Section 2.2.3.2, Chapter 2) will consider better definition and clarity regarding the use of EPAs.

The Department of Town and Country Planning increasingly plays the role of coordinator and lead agency when environmentally sensitive areas affected by multiple-stakeholders are in need of management. Hence, the DTCP is the agency that spearheaded preparation of a draft National Wetlands Plan (Section 8.3.4.6 above) and a draft Management Strategy for Smugglers Cove/Belmont Pond (TCP, 2005; see also Section 2.2.2.4, Chapter 2). These plans address areas that could potentially be designated protected areas but currently fall outside the official jurisdiction of the NPT.

8.5 Protected Areas and Development Planning

The Government of the Virgin Islands (GOVI) is committed to achieving its vision of "a prosperous Virgin Islands, ideal to live, work, visit and do business" through its development strategy while maintaining macroeconomic and fiscal sustainability and financial stability in the medium term …. Over the next three years, GOVI's focus is to ensure adequate and robust social, economic and environmental infrastructure which facilitates investment and economic growth in the Territory.

Ministry of Finance, 2014

8.5.1 Physical Planning

Major development concerns for the BVI's parks and protected areas include:

- Development in lands adjacent to existing parks which may infringe on park boundaries, cause negative environmental impacts, affect wildlife, or degrade ecosystem values.
- Approval of development in or adjacent to proposed protected areas where lands have not yet been acquired by the NPT or BVI Government.
- Loss of biodiversity to development in areas which have not been properly assessed.

- Granting of licenses and concessions for development and operation of businesses within parks themselves.

- Carrying capacity concerns arising from large numbers of visitors accessing parks that have limited human and financial resources for maintenance.

- Development practices that cause erosion resulting in negative impacts on the marine environment, fisheries and marine protected areas, and in particular coral reefs.

- Development practices that embolden the expansion of invasive species that may impact protected areas.

A number of mechanisms (items 1-4 following) currently exist to incorporate the above concerns into environmentally sensitive development planning decisions. These have met with varying degrees of success, with a much higher degree of acceptance and inclusion occurring in physical development planning than in financial and tourism development planning.

(1) Physical Planning Act 2004

Land development control is imposed through the Physical Planning Act, 2004, which prohibits any material change in land use unless permission has been granted by the Planning Authority or Minister responsible for Planning. The National Parks Act, 2006 addresses the issue of development planning by requiring an Environmental Impact Assessment for any proposed project that may have significant environmental impacts on a park or other protected area.

(2) Fisheries Regulations 2003

Consent from the Minister of Natural Resources and Labour is generally required for any development impacting fisheries waters (BVI territorial waters extend up to the three-mile limit). Any development activity negatively impacting a Fisheries Protected Area is prohibited (Fisheries Regulations 31 and 51).

(3) National Parks Act 2006

The National Parks Act (NPA) 2006 imposes a mandatory requirement to consider the impact of development on parks or protected areas established pursuant to the Act and to carry out a mandatory Environmental Impact Assessment wherever significant environmental impacts on a park or other protected area are identified. The NPA also makes public consultation a requirement prior to the declaration of new protected areas.

(4) The Planning Authority

The Planning Act 2004 provides that EIAs are required for any development in wetlands, marine parks, national parks, conservation areas, environmental protection areas, or other sensitive environmental areas, unless the Planning Authority otherwise determines. While there is a presumption in favour of EIAs, the only *mandatory* requirement for an EIA is provided in the National Parks Act for developments affecting national parks.

The Chief Conservation and Fisheries Officer is an *ex-officio* member of the Planning Authority, the body responsible for making development planning decisions. The National Parks Trust is not a member although it is routinely included in pre-planning consultation meetings, which allows the NPT to provide feedback on potential development activities that might impact parks and protected areas or rare, threatened or endangered species. Since 2012, the NPT has been involved in discussions with the DTCP regarding the need for buffer zones around national parks. There are indications that these representations are being taken into account by planners, *e.g.*, the Carrot Bay Development Plan (see Section 8.5.2 to follow).

8.5.2 Land Policy

The Virgin Islands' land mass of just over 37,000 acres is divided into over 17,000 plots, over 75% of which is less than 1 acre in size. The number of plots over 10 acres is less than 3%. This fragmentation of the land resulted from the fact that at the time of Emancipation the plantation system had virtually collapsed and the planters left the island. The estates were divided and sold to the peasants.

Louis Potter (2013)

Responsibility for land in the territory lies with the Ministry of Natural Resources and Labour. The current Minister has publicly embraced the Caribbean Challenge Initiative (Section 2.2.4.13, Chapter 2), declaring an intention to protect 33 percent of the nearshore marine environment. The Protected Areas System Plan proposes protection of 12-13 percent of BVI landmass; however, this policy position is not well-known.

Practical exposition of land use policy lies with the Department of Town and Country Planning through the preparation of physical development plans, whether for the territory as a whole or for specific areas within the territory. A physical development plan encapsulates the aims and objectives for development of land in a particular area. The plan is used as a guide by the Planning Authority when assessing planning applications.

The DTCP is currently preparing a new National Physical Development Plan to guide the territory's development until 2030. Completion date for the new plan was programmed for the end of 2014, but the process for plan development has fallen behind schedule (see Section 2.2.4.5, Chapter 2).

The Carrot Bay Development Plan, for the village of Carrot Bay on the northwestern coast of Tortola, is the only area development plan prepared thus far for the Tortola Profile area (see Box 4 in Chapter 2). The plan preparation process included a lengthy period of public consultation, as well as contributions from numerous stakeholders, including the DCF and NPT, to identify the principles and policies upon which the plan would be based.

The final plan clearly demonstrates that environmental concerns have been taken into consideration, including the presence of a nearby protected area, the Sage Mountain National Park. The land adjacent to the existing Park is designated a development-free buffer zone to: (1) protect sensitive areas (*e.g.*, moist and scrub forests) and (2) warn of potential risks of development in certain areas (*e.g.*, land in the vicinity of major ghuts) (DTCP, 2012). In addition, the marine environment and coral reefs below the slopes of the Park are protected by restricting development on very steep slopes above 35 degrees. The Plan also proposes development of ecotourism activities including the creation of additional trails to the National Park.

The plan was approved by the Planning Authority in 2014, despite continuing objections by some members of the community, but has yet to be adopted by the Minister responsible for Planning and forwarded to Cabinet for approval.

8.5.3 Financial and Tourism Planning

The rise of tourism over the past fifty years and latterly, the success of the financial services industry have brought a certain arrogance and strange attitude towards responsible caring for the land amongst certain residents, citizens and others alike.

Verna Penn-Moll (2014)

Expanding tourism infrastructure and increasing the number of visitors is a key priority for economic managers in the BVI. Any significant increase in visitor numbers will have implications for maintaining popular tourism amenities, many of which are managed by the National Parks Trust.

The BVI Tourist Board is a statutory body responsible for marketing and development in the tourism sector (see Section 2.2.2.7, Chapter 2). A new board of directors was appointed in December 2011, composed of members who are said to reflect "the range and diversity of the country's tourism sector, from hotel and resort experts to those with a focus on cultural and historical sites" (*Caribbean Journal*, 20 December 2011). However, while both the NPT and the DCF maintain good working relationships with the Tourist Board and cooperate on a number of initiatives, neither of these agencies are members of the Tourist Board. This despite the fact that a recent study commissioned by the UK's Joint Nature Conservation Committee (JNCC) estimated the *tourism value of nature in the BVI* at $194 million per annum, noting that this was attributable to both the marine (mainly coral reefs) and terrestrial (mainly beaches) ecosystems (Sipos, 2014):

> *Tourism in the BVI seems to be fundamentally [dependent] on ecosystems, especially the marine ones. Tourists are attracted by marine activities, such as snorkeling, diving, beach visits and chartering boats.*

Arguably, the Trust is the proprietor of some of the most heavily used tourist properties in the territory, including the Wreck of the Rhone National Park and the Sage Mountain National Park in the Tortola Profile area.

8.6 Issues and Challenges

8.6.1 Implementation Hesitation

The Parks and Protected Areas System Plan posits an ideal protection scenario of 12-13 percent of landmass and 33 percent of the nearshore marine environment. But, at the present time, less than two percent of BVI landmass is protected—within the Tortola Profile area, less than two percent of forest cover and less than one percent of mangrove, salt pond and beach ecosystems. Ironically, 100 percent of the Important Bird Areas in the profile area are protected (Great Tobago National Park), but the true status of birds and other faunal species across the territory is unknown. Even in the absence of comprehensive species and (completed) flora research, it can be assumed that the extent of biodiversity coverage in the existing protected areas is likely inadequate.

Full implementation of the Protected Areas System Plan will be a significant step towards accomplishing conservation goals. Ensuring its implementation, however, is a major challenge considering the number of environmental and conservation proposals which have not yet been implemented, beginning with the ECNAMP protected areas proposals in 1980, the Coastal Conservation Bill in 1987, the National Integrated Development Strategy in 1999, the draft National Environmental Action Plan in 2004, the Environment Management and Conservation of Biodiversity Bill in 2008, and approval of any of a series of National Physical Development Plans. This is not unique to BVI. A report assessing the environmental protection frameworks of UK Overseas Territories found that at least five major environment bills, and the same number of development plans, were stalled in UK OTs (FIELD and RSPB, 2013).

Any significant gaps in the conservation and protected areas framework of the BVI that could be identified in this chapter have probably already been identified and addressed in the National Parks Act and in the drafting of environmental management legislation, which is ongoing as of this writing but expected to be enacted before the end of 2015 (see Section 2.2.3.6, Chapter 2). For example:

- An overarching environmental management authority with statutory responsibility for all parts of the environment (not just the environment inside the boundaries of protected areas);
- Coordination and integration of all environmental functions across responsible agencies;
- Mandatory reporting on the "state of the environment;"
- A framework to identify, list and monitor endangered species both within and outside of protected areas;

- Requirement for the preparation of national policies, strategic plans, and management plans for all protected areas;
- Improved legislative frameworks for beach, coral reef and seagrass protection and for development and pollution control.

Furthermore, while it is being well thought out, even if the forthcoming legislation to enable comprehensive environment management is enacted, this type of comprehensive framework rarely functions as envisaged due to a lack of adequate human and financial resources. For example, the Physical Planning Act came into force in 2004; yet, 10 years later, the mandatory National Physical Development Plan required by the law has not been prepared nor have Regulations to the Act been approved. The National Parks Act came into force in 2006; yet, the management plans required for each protected site have not been prepared.

The current round of pending protected areas declarations is encouraging and suggests forward momentum on conservation issues. However, persistent lobbying and vigorous calls for full implementation of these various measures, when approved, must continue.

8.6.2 Management, Legislative and Judicial Concerns

8.6.2.1 Lack of Management Objectives for Fisheries Protected Areas

No explicit management objectives, beyond power to regulate fishing or entry by vessels, are stated in the Fisheries Act 1997 for FPAs, the only type of protected area that has been declared under the Fisheries Act to date. The law also makes provision for the establishment of marine reserves, being "any area of the fishery waters and, as appropriate, any adjacent or surrounding land" to:

(1) Protect the natural breeding grounds and habitat of aquatic life;

(2) Allow natural regeneration of aquatic life;

(3) Promote marine, scientific study; and/or

(4) Preserve natural beauty.

There is no significant difference in the procedure to designate a FPA and a marine reserve. Both are established by order of the Minister published in the Gazette. Marine reserves may extend to "surrounding land," whereas FPAs are limited to land "up to the high water mark," and marine reserves do not presently benefit from the prohibition against development causing "adverse impacts."

However, marine reserves are significantly easier to create than marine parks or protected areas under the National Parks Act, which requires recommendation from a Scientific Committee and public consultation prior to designation. Use of the marine reserve designation may be helpful in more quickly implementing the proposed marine aspects of the System Plan, or at least in securing protection pending an area's ultimate designation under the NPA.

8.6.2.2 Validity of FPA Status

For the moment, the legal status of the *existing* FPAs, and the Hans Creek FPA in particular, remains insecure. In the Beef Island court case (Box 10), the BVI Government sided with the developer and argued before the High Court that Hans Creek was not validly declared as a Fisheries Protected Area. The very act of this position before a Court does not inspire confidence in the Government's commitment to upholding its own environmental laws when a conflict with development arises.

8.6.2.3 Judicial Enforcement of FPA Status

FPA status potentially confers an absolute prohibition on any development, terrestrial or otherwise, that would cause adverse environmental impacts to the FPA. Fisheries Regulation 51 contemplates an integrated ecosystem-based approach to development. Yet, remarks made by the Court of Appeal in the Beef Island Case lead to a concern whether this provision would be strictly enforced by the

Courts. Chief Justice Hugh Rawlins in the Judgment remarked that:

> *The intention for the protection is not to prohibit development of all of the lands of an owner that borders protected fishery waters even where that land stretches, for example, for miles away from the fishery waters. . . I take it that the words "which may or is likely to adversely impact on" a declared protected area in Regulation 51(1) of the Fisheries Regulations refer to the "land up to the high watermark adjacent to the fishery waters."*

These comments are merely observation, since the issue of adverse impact was not before the Court of Appeal, but they highlight a possible lack of appreciation for the dynamics of very small island ecosystems, such as Tortola and Beef Island, where it is unlikely that any piece of land is more than 1.5 miles from the coast. Simply because a development occurs on a piece of land outside the boundaries of a protected area does not mean there will be no adverse impact caused within the protected area.

Fisheries Regulation 51 is *not* intended to prohibit development, merely to regulate development which may cause negative effects within a FPA. However, it *is* intended to affect developments taking place on land outside the boundaries of a FPA because land-based sources of pollution are among the greatest threats to the marine environment. Should the Courts in the BVI continue to adopt this line of reasoning in the future—*i.e.*, that the prohibition is not meant to apply to development outside the boundaries of protected areas—the prohibition will be difficult to enforce.

As part of ensuring effective enforcement of protected areas legislation, environmental managers should be aware of the need to educate and familiarise judicial officers with the ecological principles that underlie legislation. This may best be accomplished by building a relationship with the regional Judicial Education Institute, which organises annual seminars for judges, or by contributing *amicus* submissions if environmental or ecological points arise in future matters before the Court.

8.6.2.4 How "Legally Binding" Are Environmental Protection Areas?

Since the enactment of the Planning Act 2004, Environmental Protection Areas have routinely been included among the possible categories of protected areas in BVI. The draft Wetlands Management Plan, for example, proposes to declare all mangroves outside of the national parks as Environmental Protection Areas. Upon closer analysis however, the following concerns become clearer:

1. "Environmental protection area" is not a legally enforceable protected area status; it is merely a designation in a development plan.
2. A development plan does not create any legal rights or obligations. The Planning Authority is required to "consider" or "have regard to" the development plan when making a decision, but is not required to conform to the plan. It is permissible to depart from it. Designation of an Environmental Protection Area may create a presumption against a grant of development permission, but, particularly in a society with a weak enforcement culture, such a presumption is not a guarantee.
3. No Environmental Protection Areas have been declared in the BVI to date because no land use development plans have been approved to date. The pending Carrot Bay Development Plan recognises a buffer zone around Sage Mountain National Park but does not designate the area as an Environmental Protection Area.
4. None of the Planning Authority's budget is allocated for the management of Environmental Protection Areas.

A more effective tool for mangrove protection under the Physical Planning Act might be Plant Preservation Orders (Physical Planning Act, s. 54), the breach of which is an offence carrying a penalty of $25,000 in the first instance. Any mangrove area in need of active management ought properly to be declared as protected under the National Parks

Act, and other mangrove areas could be made the subject of Plant Preservation Orders, an approach that offers more real protection than designation as an Environmental Protection Area.

8.6.2.5 Consolidating National Reporting

The BVI is party to a significant number of regional and international treaty obligations. In partnership with overseas agencies and organisations, the DCF and the NPT have contributed to numerous reports assessing the BVI's environment, monitoring the implementation of the territory's obligations, or reporting on projects which contribute to meeting those obligations (JNCC, 2013). Most of these documents are available online, but via a plethora of different sites operated by various collaborating partners, *e.g.*, DFID, FCO, UKOTCF, JNCC, RSPB, RBG Kew, Darwin Initiative.

It would be helpful for the NPT and the DCF to keep a page on their respective websites focusing on their reporting under regional and global agreements, with a bibliography and links to the actual reports and specifically to the excerpts that deal with the BVI, the NPT or the DCF. Such presentations would serve to present a fuller picture of the global context of the work in which the two organisations are engaged.

The Environmental Management and Conservation of Biodiversity Bill 2008 (now undergoing revision and updating) contemplated an Environmental Agreements Committee to coordinate and report on implementation of various agreements in a rational manner. In the meantime, publication of a single annual, consolidated report on implementation of regional and international environmental agreements would do much to provide a bird's eye view of the BVI's performance across the board.

8.6.3 PA System Concerns

Conservation goals for the BVI Protected Areas System focus on conserving the natural and historical heritage of the British Virgin Islands, as represented by its biodiversity, scenic landscapes and seascapes, historic buildings, ship wrecks, and gardens, by (Gardner, *et al*., 2008):

- Preserving major representative stocks or areas of biological resources, including populations of indigenous and endangered flora and fauna, and natural communities.
- Protecting and enhancing unique ecosystems that are fragile or threatened by human activities.
- Protecting natural areas that are important for the production of important species of flora and fauna.

It is difficult to determine the contributions of the existing protected areas on Tortola and its surrounding cays in meeting these overall conservation goals for the larger Protected Areas System. Without baseline inventories, continual assessment, and standardised reporting, there is no quantitative means to determine at specified intervals whether individual protected areas are maintaining, gaining or losing populations of flora and fauna.

While the National Parks Trust's work load is substantial, it is under-resourced and struggles to maintain the individual parks in the Protected Areas System. One external study estimated the conservation funding gap in the BVI at $811,000 per year over five years (Rayment, 2007), although these figures have not been confirmed by the BVI Government.

The Protected Area System overall may be designed and managed on a macro-level to contribute to sustainability at a territorial level; yet, each protected area is a discrete property, deserving of individual focus, attention, and reporting. The Fisheries Act 1997 makes no mandatory requirements for FPAs, but the National Parks Act 2006 requires the Trust to produce management plans for each protected area, although none have been prepared to date for sites in the Tortola Profile area. More recently, the NPT has determined that it will not complete individual management plans for the 21-site park system, but will use an ecosystem-based approach to management planning (whether this will satisfy the provision of the Act (Section 25(1)) requiring plans for each park/protected area is not clear).

Thus far, the NPT has developed a draft Marine Management Plan and is also developing a Forestry Management Plan (*pers. comm*., Nancy Pascoe, Planning Coordinator, NPT, 8 April 2015).

Development of full management plans for the BVI's protected areas will require significant resources, which, for the time being, are often channeled towards executing equally critical, externally funded and targeted project activities. Assembly of necessary data, collation of biodiversity inventory lists, literature reviews, and integration of such information into the territory's GIS are ongoing tasks within the NPT's annual work plans. Yet, preparation and implementation of detailed management plans—even the ecosystem-based plans currently contemplated—will likely be delayed until further resources become available.

In the interim, an adjustment to the format of NPT's annual reports to include an appendix with a short section on each individual PA site would be very useful. This short summary, similar to those in Part II of the System Plan, could summarise the number of staff site visits or staff hours at the park site, project activities implemented, dates and type of maintenance performed, the amount of expenditure earmarked for the site—both directly and indirectly—significant events or challenges, and any observed changes in the resource base.

Some of this information is included in the NPT's annual reporting but is scattered throughout the document. If it were to be presented in this proposed format, then the reader could more easily observe the level of investment to and progress of individual sites from year to year.

8.6.4 The PA System Moving Forward

> *There is the possibility that the implementation of a parastatal protected area agency could be harmful for protected area conservation. The danger lies in the possibility that governments might abandon their responsibility for biodiversity conservation after creating a financially independent conservation agency*
>
> A. James, *et al*. (1986)

Adequately funded, effectively enforced, and well maintained protected areas play a vital role in the territory's economic success. Promulgation of this message must continue. More work on educating the public about the benefits of protected areas is needed, so that physical planning decisions like the Carrot Bay Development Plan, which takes the environment into account, can be implemented.

Government has recently allocated all seabed lease fees to the NPT, a decision predicated on Government's decision to eliminate its annual subvention to the NPT by replacing the subvention with this new recurring source of revenues. However, this allocation also eliminates one potential source of funding for the proposed Environmental Trust Fund, the funding mechanism that had been envisaged for the Environmental Management and Conservation of Biodiversity Bill in 2008. However, (**1**) since this proposed legislation is currently undergoing revision, with estimated approval sometime in 2015, and (**2**) since in March of 2015 Government established a Climate Change Trust Fund to access international funding to finance the BVI's Climate Change Adaptation Policy, future funding for the NPT, and indeed all BVI public sector environmental agencies, will undoubtedly undergo restructuring in the near term.

It is hoped that this process will benefit from the current momentum in the territory for climate change adaptation planning and the ongoing declaration of new protected areas, and that a viable and comprehensive framework to address resource conservation, biodiversity and climate change adaption will emerge.

Issues, Conflicts, and Areas of Concern	Impacts of No Action/No Change	Short-term Options Long-term Recommendations
ISSUE ONE **Limited resources and staff prevent comprehensive site-specific inventorying, monitoring, and reporting for sites included in the BVI's Protected Areas System** Specific to the national park sites and fisheries protected areas included within the Tortola profile area, limited resources have made it more difficult for the NPT and the DCF to fully monitor the status of species, the level of compliance, overall site integrity, and maintenance requirements for any individual protected area. In Tortola, NPT in-house staff reporting and monitoring at individual park sites is limited because only three roaming staff members have responsibilities for five park sites. In addition, bird sanctuaries that are not declared national parks lack overall management, although seabird monitoring is carried out. All protected water areas are completely unmonitored.	Site-specific biodiversity loss or habitat degradation may go unaddressed. Destruction of protected water areas may occur because of the unmonitored removal of protected trees; erosion and runoff may also increase.	**SHORT TERM OPTIONS** **1.** The NPT and the DCF should include an evaluation of each protected site they manage in an Appendix of their Annual Reports. **2.** Since the Royal VI Police Force is the enforcement authority for the Wild Birds Act, the Governor (who is responsible for security in the territory) could be invited to act as a patron and sponsor for an annual bird count at non-NPT-managed bird sanctuaries. **3.** The boundaries of existing protected forests should be identified and added to the National GIS, and the Minister of Natural Resources and Labour should request an annual status report on each protected water area. **LONG TERM RECOMMENDATIONS** **1.** Management plans should be prepared by the DCF for Fisheries Protected Areas and by the NPT for national park sites (the later required under the National Parks Act). The NPT is now fulfilling the requirement for management plans by focusing on ecosystem-based plans, some of which are now in draft form. **2.** Comprehensive environmental management legislation, currently in train, should be enacted as soon as possible as its Implementation will address the lack of environmental management authority for species and ecosystems not protected within the BVI's Protected Areas System. At this writing, a new environmental management bill is expected to be enacted in 2015.
ISSUE TWO **Inadequacy of existing protected areas coverage** Coverage is particularly inadequate with respect to protection of forests, mangroves, beaches, and coral. Much of this is addressed by proposed protected areas identified in the Protected Areas System Plan, although full implementation of the Plan has not yet been executed.	The Protected Areas System Plan calls for approximately 12 percent of the BVI's landmass to be under protected area status. However, this level of coverage may be insufficient to meet biodiversity goals.	**SHORT TERM OPTIONS** **1.** Protected areas managers should continue their efforts to improve the underlying ecological information base of the Protected Areas System Plan, and continue to promote the Plan locally and internationally. **LONG TERM RECOMMENDATIONS** **1.** Protected areas managers should continue to promote and call for full implementation of the Protected Areas System Plan.

Issues, Conflicts, and Areas of Concern	Impacts of No Action/No Change	Short-term Options Long-term Recommendations
ISSUE THREE **Unknown status of most species in the Tortola Profile area and throughout the BVI** The ongoing project *Conserving Plant Diversity and Establishing Ecosystem Based Approaches to the Management of Forest Ecosystems* will address many of the biodiversity information gaps for plant species. Similar work remains to be done for animal species.	Species that were once abundant in the Tortola Profile area may be lost without more aggressive mitigation efforts.	**SHORT TERM OPTIONS** **1.** As resources are available, the National Parks Trust should develop and implement formal monitoring regimes for the most heavily used protected areas under its management. **2.** The NPT and DCF should both identify additional ways to strengthen their data collection and data management capacity, including sharing of research priorities so that data requirements are less randomly linked to the priorities of external research institutions and donor organisations. **LONG TERM RECOMMENDATIONS** **1.** Comprehensive species surveys and assessments of the territory's protected areas need to be implemented. Partnership collaboration with external institutions—such as those already carried out with Kew and RSPB—need to be pursued as a means to identify funding for the required surveys/assessments. However, both the NPT and DCF need to review current and future research collaborations to ensure that research results can be applied to meeting the management requirements of local institutions as well as external partners.
ISSUE FOUR **Weakness of species protection outside of declared protected areas** The draft Wetlands Policy proposal to declare all mangrove systems as Environmental Protection Areas is an illusory protection status because it only depicts a designation in a development plan (see Section 8.6.2.4 of this chapter). Use of EPAs to protect other resources will display similar deficiencies, although these could be addressed in Regulations to the Planning Act, which are currently being drafted (Section 2.2.3.2, Chapter 2).	Without sufficient management and protection tools, BVI flora and fauna outside of declared protected areas will remain at risk.	**SHORT TERM OPTIONS** **1.** In preparing future local area development plans, the DTCP should consider use of Environmental Protection Areas as a useful means of demarcating areas which are proposed for inclusion in the Protected Areas System but have not yet been designated by law, recognising that EPAs in of themselves do not provide a legally protected status. **2.** A more effective tool for the protection of plant species would be Plant Preservation Orders under the Physical Planning Act, which, at present, offer more real protection than designation as EPAs. **LONG TERM RECOMMENDATIONS** **1.** Any resource in need of active management should be declared as part of an area protected under the National Parks Act, to ensure that protection can be enforced in the Courts.

Issues, Conflicts, and Areas of Concern	Impacts of No Action/No Change	Short-term Options Long-term Recommendations
ISSUE FIVE **Need to strengthen protection for coral reefs** Despite the NPT-administered moorings system, boats continue to anchor on the seabed destroying coral reefs and other marine habitat, and will continue to do so until there is legislation prohibiting this action. Much of the coral habitat surrounding the cays south of Tortola is now proposed for protection in the Protected Areas System Plan.	Continued anchoring by boats in sensitive environments will degrade marine resources, especially coral, and make them less productive in providing important ecosystem services and less attractive to tourists attracted to the BVI by its marine resources. Over the long term, as the quality of the marine environment deteriorates, the BVI will witness reductions in tourism revenues.	**SHORT TERM OPTIONS** **1.** Proposed marine protected areas in the Protected Areas System Plan could be declared as marine reserves by order of the Minister published in the Gazette. Marine reserves under the Fisheries Act are easier to create than marine parks or other protected areas under the National Parks Act, which—although viewed as providing an enhanced level of protection—requires recommendation from a Scientific Committee and public consultation prior to designation. **LONG TERM RECOMMENDATIONS** **1.** To best protect the BVI's coral reef ecosystems, the Protected Areas System Plan must be fully implemented.
ISSUE SIX **Deficiencies in the judicial system** BVI judges are generally uninformed about the ecological principles underlying the establishment of protected areas and therefore may interpret PA legislation in ways that limit its full effectiveness.	Loss of biodiversity and habitat may result because of poorly interpreted legal decisions.	**SHORT TERM OPTIONS** **1.** The NPT and the DCF should contribute *amicus* submissions where provisions in protected areas legislation (*e.g.*, the National Parks Act and Regulations and the Fisheries Act and Regulations) come before the Court. **LONG TERM RECOMMENDATIONS** **1.** Agencies of the BVI Government mandated with responsibilities for the protection of the environment should build a relationship with the regional Judicial Training Institute in Castries, St. Lucia (*www.eccourts.org/judicial-education-institute-history*) and participate in seminars and other fora that contribute to the environmental education of judges officiating in the BVI.

Issues, Conflicts, and Areas of Concern	Impacts of No Action/No Change	Short-term Options Long-term Recommendations
ISSUE SEVEN **Infrastructure at Tortola's national parks and protected areas is inadequate** At the present time—with the exception of the Botanic Gardens—parks and PAs in the Tortola Profile study area do not maintain infrastructure to support visitor use. The NPT is currently engaged in an upgrade of infrastructure at the Sage Mountain National Park.	Without appropriate types of infrastructure at existing and proposed national parks, oversight of ecological resources is at risk, while the NPT continues to lose opportunities to generate additional tourism-related revenues.	**SHORT TERM OPTIONS** **1.** The NPT should examine options for making park sites such as Mt. Healthy and Shark Bay more user friendly. **2.** The NPT might explore automated visitor counters as a means to track park visitation at sites without fee collection. **LONG TERM RECOMMENDATIONS** **1.** Government should include funding for park infrastructure in its public sector investment programming. **2.** The Tourist Board should actively promote visitation to under-used national parks, especially in view of the expected increase in visitors as a result of the opening of a new cruise ship pier in 2015.
ISSUE EIGHT **Parallel legislative initiatives undertaken by the BVI** Events have overtaken the drafting of comprehensive environmental management legislation, as first exemplified by the 2008 *Environmental Management and Conservation of Biodiversity Bill*. Since 2008, climate change has emerged as a high priority, exemplified by approval in 2012 of the BVI's *Climate Change Adaptation Policy* and 2015 legislation that establishes a *Climate Change Trust Fund*. At this writing, Government is revising the 2008 legislative initiative to provide for a new comprehensive environmental management law. It will be important that these two new laws complement each other and do not result in a duplication of structure and competition for funding.	Without careful consideration of potential overlapping areas within two new environmental initiatives—the Climate Change Trust Act 2015 and forthcoming holistic environmental management legislation—the ability of Government to execute coordinated environmental policy might be jeopardised.	**SHORT TERM OPTIONS** **1.** Consideration could be given to consolidating climate change initiatives and the forthcoming environmental management legislation to create a single environmental framework and a single funding entity. **LONG TERM RECOMMENDATIONS** **1.** With the recent (March 2015) enactment of the Climate Change Trust Fund Act and the imminent final drafting of new comprehensive environmental management law, it will be important that the capacity of the units of government responsible for their implementation is fully assessed with adequate funding, personnel and resources available for the execution of these important laws. Together, they have the potential to change how environmental management, biodiversity protection, and climate change are addressed forever in the British Virgin Islands.

9. DIRECTIONS FOR THE FUTURE[9]

9.1 Tortola: A Paradox and A Microcosm

In the context of the British Virgin Islands, Tortola is immense — strapping and over-sized — the heavyweight of this UK Overseas Territory. Among other things, Tortola has —

- big landscapes
- big mountains
- a big population
- big government
- a big economy
- big dreams.

It is the centre of the territory's public administration, commerce, health care, tertiary education. It is the BVI's transportation hub; it is where the vast majority of the territory's population resides and where major communities continue to grow. To understand the British Virgin Islands, one must first understand Tortola.

In the first place, Tortola is more of a **paradox** than its sister islands, *to wit*,

- **TORTOLA IS** heavily developed, densely populated, the most modernised and most urbanite of the islands comprising the territory.

  Yet, Tortola is also the birthplace of the territory's national parks system, the island where its first protected area at Sage Mountain was declared in 1964.

- **TORTOLA IS** where, in the 1960s, the territory determined to develop yachting tourism as a prominent sub-sector of its overall tourism product. Tortola is also where, in the 1980s, the BVI's lead economic sector, financial services, was established and came to dominate the forward growth of the island—and the territory.

  Both of these sectors were envisioned as engines of the economy that would "lay easy on the land" since they did not require a great deal of infrastructure for their support.

  Yet, along with cruise tourism and resort tourism, the modern development of Tortola has not been easy on the environment. Despite good intentions, mangrove and salt pond habitats have been reclaimed, land-based sources of pollution degrade coastal waters, and a multitude of development activities has transformed the island in ways not envisioned at the dawn of Tortola's modern age in the 1960s.

- **TORTOLA IS** a society with as many as 15 ethnic groups present and nationals from over 100 countries residing. There is a richness of cultures and diversity present on the island, all of which have potential to grow the available talent pool, enhance individual creativity, and sustain overall resourcefulness in all sectors, including the environment.

  Yet, indigenous Tortolans are now a minority within their own island, which has led to cultural clashes, social tensions, and even a xenophobic perspective that challenges the island as it moves forward in the twenty-first century. It is within this multicultural setting, with its attendant polarization, that the island's environmental agenda must be promoted and sustained.

- **TORTOLA IS** the centre of government where the territory's environmental laws and policies are drafted and in large part implemented. The current momentum for climate change adaptation, the establishment of new protected areas, and the drafting of new comprehensive environmental legislation all emanate from Tortola.

  Yet, it is also in Tortola where much of the "implementation hesitation" for past environmental initiatives (as discussed in Chapter 8) has resulted in disappointment and lost opportunities. Tortola is the leader for change, but too often has been the child of vacillation when it comes to the environment.

[9] The authors of Chapter Nine are Kevel Lindsay, Jean-Pierre Bacle, and Judith Towle.

In addition to these paradoxical inconsistencies, Tortola can also be seen as a **microcosm** of the environmental challenges confronting the territory as a whole. One could almost say that where goes Tortola, so goes the BVI. While it was with some ease that profile writers could discuss "*Jost Van Dyke and its environment*" or "*Virgin Gorda and its environment*" or "*Anegada and its environment*," it is not as simple to demarcate Tortola and its environment, for when we write of Tortola, we tend to easily slip into a discussion of the BVI as one entity—whether it is solid waste management, agricultural alternatives, preservation of biodiversity, experimentation with renewable energy, pollution control, exploitation of the marine environment, or land use planning. Indeed, almost all of the issues and opportunities identified in this *Environmental Profile* are also present throughout the British Virgin Islands, but are present in Tortola in greater volume or dimension or experimentation or challenge than elsewhere in the territory.

Photo 161.
Road Town, Tortola, capital of the BVI.

With publication of the *Tortola Environmental Profile*, Island Resources Foundation completes its four-volume series on the environment of the British Virgin Islands. As we look back at the preceding profiles for Jost Van Dyke, Virgin Gorda, and Anegada, and as we attempt to integrate earlier findings with those presented in this volume for Tortola, several compelling **realities** emerge as guideposts or harbingers marking the way forward for Tortola and its environment.

(1) *Modern-day Tortola is operating on the global stage, and therefore decision-making about the environment is likely to be framed by a future that will be more developed, more urbane, (**Photo 161**) more populated, less indigenous, more costly, and less and less like the Tortola many remember with fond nostalgia.*

As stated by the Premier in his 2015 Budget Address, the territory has a Gross Domestic Product of almost one billion dollars and a financial services industry that registers in excess of 400,000 companies, while foreign nationals residing in the BVI, primarily in Tortola, identify with over 110 countries worldwide as their place of birth.

As these social and economic changes—*e.g.*, new wealth, immigration, the financial services industry—move Tortola forward into a more global world, one environmental issue will also put the island and the territory on the world stage, along with oceanic islands everywhere, and that of course is global climate change. Small islands like Tortola will increasingly be vulnerable to sea level rise, as one critical effect of climate change.

(2) *Despite its world stage status, Tortola remains a very small island, with finite land space surrounded by infinite ocean waters.*

Conflicting user demands for limited land and natural resources will not diminish in the near future but will continue to dominate discussions and decisions about the island's ongoing consumption and utilisation of its land and resources. The mantra of the 1970s that "*small is beautiful*" may still be valid, but it is also challenging and comes with fewer options, particularly when it is a small island developing state. In confronting user demands, the BVI walks a thin line between consuming its finite resources (progress) and protecting them (conservation).

(3) *Contemporary change in Tortola will be overshadowed by two issues: the economy and the environment.*

The demand to grow the economy and the necessity to protect the resource base are emerging as the new twin pillars of Tortola, this time the twin pillars of public policy decision-making. The need to maintain *the right balance* between the two has never been easy and now could not be more important. The presumably dueling "**E**s" (the **E**conomy and the **E**nvironment) are more than ever inextricably linked.

(4) *All positive change regarding the environment—e.g., from protected area expansion to land use, from resource exploitation to biodiversity preservation—is a reflection of the prevailing public will.*

A constituency for the environment in Tortola has never been strong, although this may be changing as the tangible signs of environmental neglect or inaction are becoming more obvious. A public constituency—even a political constituency—on behalf of the environment in Tortola (and the entire BVI) needs to be mobilised, strengthened and actively engaged so that change is informed by public opinion and public needs. Environmental activists, whether in the public or private sector, must make a more compelling case for the wise management and protection of the environment.

(5) *The BVI's Government cannot, and should not, do it alone.*

The Government of the BVI, broadly speaking, is responsible for Tortola's and the territory's commonly shared resources. It stands as the presumptive guardian of the environment. Yet, in a more complex and faster-moving world, governments in general and the BVI Government in particular recognise the importance of partnerships—private sector, non-governmental, regional, and international—as key to building coherent resource management strategies and systems designed to improve efficiencies of environmental management, reduce risks of environmental degradation, and minimise adverse impacts on the environmental resource base. For the BVI, key among these relationships will be that of public/private partnerships, especially those which identify shared goals, shared benefits, and shared responsibilities.

The remainder of this chapter is devoted to a closer look at the specialness of Tortola's environment. While, as discussed in the preceding section, Tortola is known for its urbanness, its commerce, its built infrastructure, the island also boasts a richness of nature that is equally as splendid as the more tangible displays of its prosperity and success.

9.2 The Specialness of Tortola: Its Flora

As Tortolans go about their everyday lives, they often become insulated and isolated from the rich landscapes, unique species and wondrous natural drama at play under their very feet or just outside their windows. The demands of ordinary life are necessary distractions that ensure Tortolans live comfortably. But the environment also has its demands, and Tortolans need to answer that call, fighting to save the specialness of their home island.

Imagine yourself for a moment at the verdant summit of Sage Mountain on a rainy day, the skies a dingy wet veil from horizon to horizon, the soils earthy rich, moist and musky, the air cool and a bit too chilly at times. There alone, below the outstretched fronds of a giant tree fern (**Photo 162**), sheltering from the light rain that suddenly sweeps

Photo 162.
Tree Fern at Sage Mountain National Park.

up from Road Town below. From below the leaves the sun peaks out suddenly slicing through the veil of clouds to strike a glinting yellow blade of sparkling light against the raindrops that have collected on the greenery.

In the quiet aftermath of the passing shower, the peace is broken by the low chirping of something. Perhaps a cricket? No, a colony of Red-eye Tree Frogs (*E. antillensis*) in a small pool. Their chorus grows louder as other distant members respond, and so the songs grow in intensity.

Around a bend in the trail, a burst of flowers attracts a flurry of activity as bees and numerous butterflies vie for the rich nectar. A hummingbird, too fleeting to recognise the species, quickly takes a drink of the rich food before darting downslope and out of sight.

In a small gulley, giant leaves dance ever so slightly and rhythmically in the light breeze. These are indeed like the large ears of elephants. This oversized member of the popular Philodendrons so common in garden stores seems out of place in this small space, but it manages to fit right in and prosper.

Photo 163.
Heliconias at Sage Mountain National Park.

Approaching sunset, your mind wanders, wishing to hear the haunting call of the Virgin Islands Screech Owl. Experts say it may be long gone, but it hangs on in the USVI, so maybe a BVIslander will be lucky enough to see this diminutive denizen of the night.

As a visitor to Sage Mountain, you are alone among the Heliconias (**Photo 163**), splendid ferns, and giant trees that can be observed on the Virgin Islands' highest mountain. Off in the distance stretches a panoramic view of Tortola's sister isles like siblings, barely inches apart in the mind's eye. The specialness of this place is unquestioned and singular. Such is the uniqueness of Tortola, with its high rainforests, many species and intriguing landscapes, like no other member of the Virgins' chain of islands.

9.2.1 Belonger Plants of Tortola

In this final chapter of the *Tortola Environmental Profile*, we want to highlight many of the indigenous "born-here" species of Tortola and Beef Island, beginning with native plants. They are among the few living things that can claim to be true belongers to these shores, some having been here for many millennia.

Why are these "belonger species" so important? The simple answer is that they are collectively unique to Tortola. As such, they are a distinct part of the island's natural history narrative, which is only Tortola's to tell. It is a millennia-old tale that speaks of the eons of nature's chronicle on the island, of how species came here and made it their home, and how they possess a uniqueness and stature all their own—as "*belongers.*"

The word "special" is used to refer to species of plants that are restricted (endemic) to the West Indies, including some found only on the Puerto Rico and Virgin Islands Banks, as well as at least one species that is found only on Tortola (*Miconia thomasiana*), commonly named the St. Thomas Melastome (**Photo 171**). There are at least 128 of these special plants to be found in this landscape (see **Table 55**). These plants are the true "*belongers*" of Tortola.

Table 55.
Belonger plant species of Tortola, including Beef Island.

REGION	SYMBOL	#s
Tortola Endemics	TOR	1
British Virgin Islands Endemics	BVI	2
Virgin Island Endemics	VI	4
Puerto Rico Bank Endemics	PR	20
Greater Antillean Endemics	GA	22
West Indian Endemics	WI	79

STATUS	SYMBOL	NUMBERS
Extinct	●	1
Endangered	♦	38
Threatened	♦	14
Vulnerable	♦	34
Stable/Least Concern	♦	41

Family	Species	Growth Form	Status	Origins/ Comments
Pteridophytes - Fens & Fern Allies				
Dennstaedtiaceae	*Odontosoria aculeata* (L.) J. Sm. **Photo164**	V	♦	PR
Dryopteridaceae	*Arachniodes chaerophylloides* (Poir.) Proctor **Photo 165**	H	♦	PR
Pteridaceae	*Pityrogramma chrysophylla* (Sw.) Link var. *gabrielae* Domin	H	♦	WI
Thelypteridaceae	*Thelypteris hispidula* (Decaisne) Reed var. *inconstans*	H	♦	WI
	Thelypteris dentata x inconstans	H	♦	WI *WI Endemic, though from a potentially unnaturally intro-duced species.*
Monocots - One Cotyledon-seeded Plants				
Araceae	*Anthurium cordatum* (L.) Schott	H	♦	WI
	Anthurium crenatum (L.) Kunth	H	♦	PR
	Anthurium x selloum K. Koch	H	♦	PR
	Philodendron lingulatum (L.) K. Koch	V	♦	WI
	Philodendron sp.	H	♦	WI *Unknown form*
Arecaceae	*Prestoea montana* (R. Graham) G. Nicholson	T	●	WI *Extinct*
	Roystonea borinquena O.F. Cook	T	♦	PR
	Sabal causiarum (O.F. Cook) Becc.	T	♦	WI
Asparagaceae	*Agave missionum* Trel.	H	♦	PR
Bromeliaceae	*Pitcairnia angustifolia* Sol. ex Aiton var. *angustifolia*	H	♦	WI *May represent a species complex in the BVI.*

Family	Species	Growth Form	Status	Origins/ Comments
	Tillandsia fasciculata x setacea	H	♦	BVI Endemic? The two-parent spp. seems to hybridise when growing together, producing this new form.
	Tillandsia x lineatispica Mez	H	♦	WI
Cyperaceae	*Cyperus nanus* Willd.	H	♦	WI
	Cyperus unifolius Boeckeler	H	♦	GA
Heliconiaceae	*Heliconia caribaea* Lam.	H	♦	WI
Orchidaceae	*Epidendrum boricuarum* Hágsater & L. Sánchez	H	♦	WI
	Psychilis kraenzlinii (Bello) Sauleda	H	♦	PR *Species presence on Tortola remains in question.*
	Psychilis macconnelliae Sauleda	H	♦	PR
	Tetramicra canaliculata (Aubl.) Urb. **Photo 166**	H	♦	WI
	Tolumnia prionochila (Kraenzl.) Braem	H	♦	PR
	Tolumnia variegata (Sw.) Braem	H	♦	WI
Poaceae	*Digitaria eggersii* (Hack.) Henrard	H	♦	PR
Smilacaceae	*Smilax coriacea* Spreng.	V	♦	WI
Dicots - Two Cotyledon-seeded Plants				
Acanthaceae	*Oplonia microphylla* (Lam.) Stearn	S	♦	WI
	Oplonia spinosa (Jacq.) Raf. subsp. *spinosa*	S	♦	WI *Declining as habitat areas are developed.*
	Ruellia coccinea (L.) Vahl	H	♦	WI
Annonaceae	*Guatteria blainii* (Griseb.) Urb.	T	♦	GA
Apocynaceae	*Metastelma decipiens* Schltr.	V	♦	WI
	Plumeria alba L.	T	♦	WI
	Rauvolfia nitida Jacq.	T	♦	WI
Aquifoliaceae	*Ilex urbaniana* Loes.	T	♦	PR
Asteraceae	*Lepidaploa glabra* (Willd.) H. Rob.	S	♦	WI
	Lepidaploa sericea (Rich.) H. Rob.	S	♦	PR
	Piptocoma antillana Urb.	S	♦	PR
Bignoniaceae	*Tabebuia heterophylla* (DC.) Britton	T	♦	WI

Family	Species	Growth Form	Status	Origins/ Comments
	Tabebuia pallida (Lindl.) Miers	T	♦	WI
Boraginaceae	*Cordia rickseckeri* Millsp.	T	♦	PR
	Cordia sulcata DC.	T	♦	WI
	Euploca microphylla (Sw. ex Wikstr.) Feuillet	H	♦	WI
Burseraceae	*Tetragastris balsamifera* (Sw.) Kuntze	T	♦	GA
Cactaceae	*Consolea rubescens* (Salm-Dyck ex DC.) Lem. **Photo 167**	T	♦	WI *Plants on Tortola more closely resemble C. moniliformis; needs reassessment.*
	Hylocereus trigonus (Haw.) Saff.	V	♦	WI *A very different plant from Lesser Antillean populations and therefore needs further study.*
	Mammillaria nivosa Link ex Pfeiff.	S	♦	WI
	Melocactus intortus (Mill.) Urb. subsp. *intortus*	S	♦	WI *The plants of Tortola do not conform to the parameters for this species. Requires reassessment.*
	Opuntia antillana Britton & Rose	S	♦	WI
	Opuntia dillenii x *O. repens*	S	♦	VI
	Opuntia repens Bello	S	♦	PR
	Opuntia sp.	S	♦	WI *Similar to O. repens, but hangs in festoons from cliffs. May just be an eco-morph.*
	Opuntia x *lucayana* Britton	S	♦	WI
	Pilosocereus royenii (L.) Byles & Rowley	T	♦	WI *The species in the VI need further study since they do not conform to plants in the Lesser Antilles.*
	Stenocereus fimbriatus (Lam.) Lourteig	T	♦	GA
Capparaceae	*Morisonia americana* L.	T	♦	WI
Celastraceae	*Elaeodendron xylocarpum* (Vent.) DC.	T	♦	WI
	Maytenus laevigata (Vahl) Griseb. ex Eggers	T	♦	WI
Convolvulaceae	*Ipomoea eggersii* (House) D.F. Austin	V	♦	GA
	Ipomoea repanda Jacq. **Photo 168**	V	♦	WI
	Ipomoea steudelii Millsp.	V	♦	PR
	Jacquemontia cumanensis (Kunth) Kuntze	V	♦	WI
Erythroxylaceae	*Erythroxylum brevipes* DC.	T	♦	WI

Family	Species	Growth Form	Status	Origins/ Comments
Euphorbiaceae	*Acalypha pruinosa* Urb.	H	♦	GA Possible error for Tortola
	Argythamnia candicans Sw.	T	♦	WI
	Croton astroites Dryand.	S	♦	WI
	Croton betulinus Vahl	S	♦	WI Declining
	Croton fishlockii Britton	S	♦	VI
	Euphorbia articulata Aubl.	S	♦	WI
	Euphorbia tithymaloides L. subsp. padifolia (L.) V.W. Steinm.	S	♦	WI An introduced form is cultivated. The wild form is very rare.
	Flueggea acidoton (L.) G.L. Webster	T	♦	GA
Fabaceae	*Erythrina corallodendron* L. var. *corallodendron*	T	♦	WI
	Galactia dubia DC. var. *dubia*	V	♦	WI
	Galactia eggersii Urb.	V	♦	VI
	Guilandina ciliata Bergius ex Wikstr.	S	♦	WI
	Mimosa ceratonia L. var. *ceratonia*	V	♦	WI
	Pictetia aculeata (Vahl) Urb.	T	♦	GA
	Poitea florida (Vahl) Lavin **Photo 169**	T	♦	PR
	Senegalia muricata (L.) Britton & Rose	T	♦	WI
	Senna nitida (Rich.) H.S. Irwin & Barneby	V	♦	WI
	Vigna antillana (Urb.) Fawc. & Rendle	V	♦	WI
Lythraceae	*Ginoria rohrii* (Vahl) Koehne	T	♦	GA
Malpighiaceae	*Malpighia woodburyana* Vivaldi	T	♦	GA
	Stigmaphyllon diversifolium (Kunth) A. Juss.	V	♦	WI
	Stigmaphyllon emarginatum (Cav.) A. Juss.	V	♦	WI
Malvaceae	*Bastardiopsis eggersii* (Baker f.) Fuertes & Fryxell	T	♦	PR
	Helicteres jamaicensis Jacq.	S	♦	GA
	Quararibea turbinata (Swartz) Poiret	T	♦	WI
Marcgraviaceae	*Marcgravia rectiflora* Triana & Planch. **Photo 170**	V	♦	GA
Melastomataceae	*Miconia thomasiana* DC. **Photo 171**	S	♦	TOR
	Tetrazygia angustifolia (Sw.) DC.	T	♦	WI
	Tetrazygia elaeagnoides (Sw.) DC.	T	♦	WI
Myrtaceae	*Calyptranthes kiaerskovii* Krug & Urb.	T	♦	BVI
	Eugenia cordata (Sw.) DC. var. *cordata*	T	♦	WI
	Eugenia sessiliflora Vahl	T	♦	GA

Family	Species	Growth Form	Status	Origins/ Comments
	Pimenta racemosa (Mill.) J.W. Moore var. *grisea* (Kiaersk.) Fosberg	T	♦	GA
	Psidium amplexicaule Pers.	T	♦	WI
Nyctaginaceae	*Neea buxifolia* (Hook. f.) Heimerl	S	♦	PR
	Pisonia subcordata Sw.	T	♦	WI
Oleaceae	*Forestiera eggersiana* Krug & Urb.	T	♦	WI
Polygonaceae	*Coccoloba krugii* Lindau	T	♦	WI
	Coccoloba krugii x *uvifera*	T	♦	WI
	Coccoloba microstachya Willd.	T	♦	WI *Possibly declining in some areas.*
	Coccoloba swartzii Meisn. f. *swartzii*	T	♦	WI
Primulaceae	*Ardisia obovata* Desv. ex Ham.	T	♦	WI
Rhamnaceae	*Reynosia guama* Urb.	T	♦	VI
	Reynosia uncinata Urb.	T	♦	WI
	Ziziphus reticulata (Vahl) DC.	T	♦	WI
	Ziziphus rignonii Delponte	T	♦	WI
Rubiaceae	*Psychotria domingensis* Jacq.	S	♦	WI
	Psychotria glabrata Sw.	S	♦	WI
	Rondeletia pilosa Sw.	S	♦	GA
	Scolosanthus versicolor Vahl	S	♦	WI
Sabiaceae	*Meliosma herbertii* Rolfe var. *herbertii*	T	♦	WI
Sapindaceae	*Cupania triquetra* A. Rich.	T	♦	WI
	Paullinia plumieri Triana & Planch.	V	♦	WI
	Serjania lucida Schumach.	V	♦	GA
Sapotaceae	*Manilkara pleeana* (Pierre ex Baill.) Cronquist	T	♦	PR
	Sideroxylon obovatum Lam.	T	♦	WI *Some plants that fall under this species are quite distinct.*
Solanaceae	*Brunfelsia americana* L.	S	♦	WI
	Cestrum diurnum L.	S	♦	GA *Introduced as an orna-mental to parts of the world*
	Cestrum macrophyllum Vent.	S	♦	GA *Listed by Mirecki, et al., 1976*
	Solanum polygamum Vahl	S	♦	GA

Family	Species	Growth Form	Status	Origins/ Comments
Urticaceae	*Pilea margarettae* Britton **Photo172**	H	♦	GA
	Pilea sanctae-crucis Liebm.	H	♦	GA
Verbenaceae	*Stachytarpheta strigosa* Vahl	S	♦	GA
Vitaceae	*Cissus obovata* Vahl	V	♦	WI

<u>Key to Growth Form Column</u>:

H = herb
S = shrub
T = tree
V = vine

Photo 164.
The spiny large fern *Odontosoria aculeata* at Sage Mountain.

Photo 165.
The rare Greater Antillean endemic fern *Arachniodes chaerophylloides* at Sage Mountain.

Photo 166.
The grass orchid *Tetramicra canaliculata*.

Photo 167.
The tree cactus *Consolea rubescens* on Tortola.

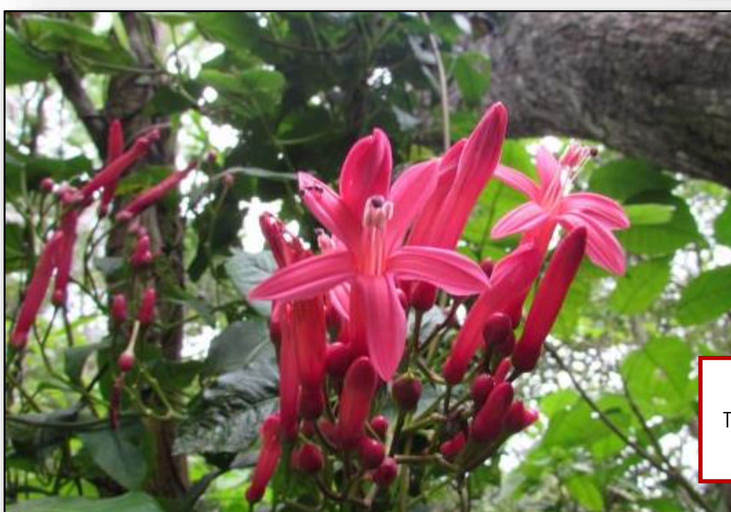


Photo 168.
The flower of the vine *Ipomoea repanda* at Sage Mountain.

Photo 169.
A burst of spectacular mauve flowers of *Poitea florida*, commonly seen after the first rains at the end of the dry season.

Photo 170.
The rare vine *Marcgravia rectiflora* on a rotten log, at the base of the equally rare fern *Nephrolepis rivularis*.

Photo 171.
The Tortola endemic shrub *Miconia thomasiana*.

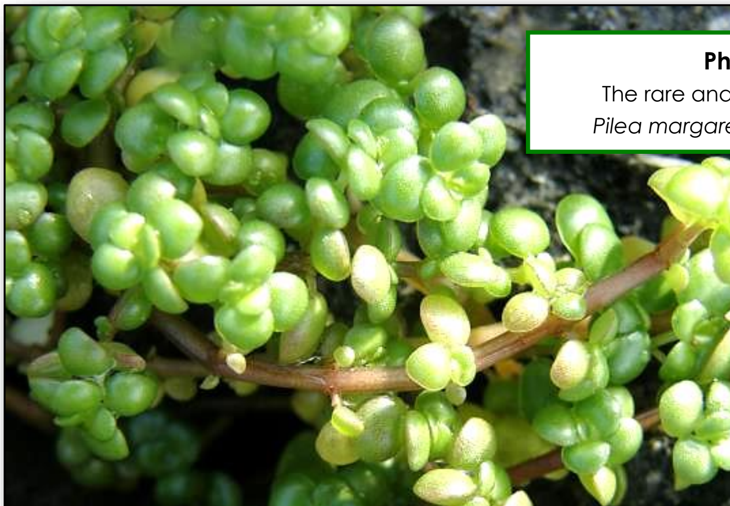


Photo 172.
The rare and unusual succulent *Pilea margarettae* at Beef Island.

9.2.2 Plant Species Requiring More Study

There are several plant species of Tortola, including Beef Island, that require further taxonomic and conservation study to determine their exact status and to understand where they fit into the overall biodiversity fabric of the Virgin Islands, as well as their "*belonger*" status. **Table 56** shows a preliminary list of these species. The IRF team uses the term "preliminary" since there may well be many more, but this will not be known until further research, including field surveys, are carried out.

Also, for a fuller discussion about some of these species as well as a few more photos, see the Biodiversity Chapter of this profile (Chapter 4).

Table 56.
Plant species of Tortola and Beef Island requiring more study.

STATUS	SYMBOL
Endangered	♦
Threatened	♦
Vulnerable	♦
Stable/Least Concern	♦

Family	Species	Habitat	Origin	Status	Comments
	Pteridophytes - Fens & Fern Allies				
Aspleniaceae	*Asplenium cristatum* Lamarck	H	N	♦	*Plants on Tortola are smaller and less dissected than are known for this species. Needs further study.*
Blechnaceae	*Blechnum appendiculatum* Willd. **Photo 173**	H	N	♦	*Possibly present at Sage Mountain and may hybridise with B. occidentale.*
	Blechnum appendiculatum x *occidentale*	H	N	♦	

Family	Species	Habitat	Origin	Status	Comments
Hymenophyllaceae	*Hymenophyllum polyanthos* (Swartz) Swartz	H	N	♦	
Pteridaceae	*Adiantum* cf. *fragile Sw.* var. *fragile* **Photo 174**	H	N	♦	***WI Endemic. The ID here is tentative since plants are somewhat different to those on other islands.***
Thelypteridaceae	*Thelypteris dentata* (Forssk.) E.P. St. John	H	I	♦	***Hybridises with T. hispidula.***
	Thelypteris germaniana (Fée) Proctor	H	N	♦	
	Thelypteris cf. *kunthii* (Desv.) Morton	H	N	♦	
	Thelypteris sp.	H	N	♦	***Possibly a form of T. patens.***
	Thelypteris dentata x *inconstans*	H	N	♦	***WI Endemic, though from a potentially unnaturally introduced species.***
Monocots - One Cotyledon-seeded Plants					
Araceae	*Philodendron* sp.	H	N	♦	***WI Endemic. Unknown form.***
Arecaceae	*Coccothrinax barbadensis* (Lodd. ex Mart.) Becc. **Photo 175**	T	N	♦	***The sp. of the VI was until recently listed as C. alta.***
	Prestoea montana (R. Graham) G. Nicholson	T	N	**Ext.?**	***WI Endemic. Listed by Beard, 1949. Should be searched for near Sage Mountain..***
Asparagaceae	*Agave* sp.	H	N	♦	***Possibly introduced. Similar to plants at Belmont (West), but not as glaucous. The occurrence of this species in these areas is strange.***
Bromeliaceae	*Pitcairnia angustifolia* Sol. ex Aiton var. *angustifolia*	H	N	♦	***WI Endemic. May represent a species complex in the BVI.***
	Tillandsia fasciculata Sw. var. *fasciculata*	H	N	♦	
	Tillandsia fasciculata x *setacea*	H	N	♦	***Endemic? The two-parent spp. seem to hybridise when growing together, producing this new form.***
	Tillandsia utriculata L.	H	N	♦	***Need to determine where this species fits within other Tillandsia sp. and their hybrid offspring.***
	Tillandsia setacea Sw. **Photo 176**	H	N	♦	
	Tillandsia sp.	H	N	♦	***Possibly T. utriculata but has bright red-to-pink leaves.***
	Tillandsia variabilis Schltdl.	H	N	♦	***Listed here as tentative.***
	Tillandsia x *lineatispica* Mez	H	N	♦	***WI Endemic***
	Vriesia sp.	H	N	♦	***Possibly Vriesea ringens. It is also possible two species are present.***
Commelinaceae	*Commelina* cf. *benghalensis* L. **Photo 177**	H	I	♦	***Widespread in distribution across Tortola, but only in localised places.***
Cyperaceae	*Rhynchospora* sp.	H	N	♦	***Sage Mountain***
	Rhynchospora sp.	H	N	♦	***Sage Mountain***

Family	Species	Habitat	Origin	Status	Comments
	Scleria sp.	H	N	♦	*Sage Mountain*
Poaceae	*Paspalum* cf. *notatum* Flüggé	H	N	♦	
	Paspalum sp.	H	N	♦	*The species grows high on cut cliff faces, is maroon in colour, but species unknown.*
	Paspalum sp.	H	I?	♦	
	Pharus cf. *latifolius* L.	H	N	♦	
	Spartina cf. *spartinae* (Trin.) Merr. ex Hitchc.	H	N	♦	
	Dicots - Two Cotyledon-seeded Plants				
Apocynaceae	*Rauvolfia biauriculata* Müll. Arg. **Photo 178**	S	N	♦	*Very Rare. There is a species near sage that is unlike any other local Rauvolfia and fits this species.*
Asteraceae	*Chromolaena* sp.	S	N	♦	*A scandent shrub often with oblanceolate serrated leaves.*
	Tithonia diversifolia (Hemsl.) A. Gray	H	N	♦	*Possibly native on Tortola.*
Bignoniaceae	*Tabebuia* sp.	T	N	♦	*Large-leaved form.*
Boraginaceae	*Heliotropium* sp.	H	N	♦	*A small species with obovate leaves and small inflorescence unlike H. angiosper-mum.*
Cactaceae	*Consolea rubescens* (Salm-Dyck ex DC.) Lem.	T	N	♦	*WI Endemic. The plants on Tortola more closely resemble C. moniliformis. Needs re-assessment.*
	Hylocereus trigonus (Haw.) Saff.	V	N	♦	*WI Endemic. This is a very different plant from Lesser Antillean populations, and there-fore, needs further study.*
	Melocactus intortus (Mill.) Urb. subsp. *intortus*	S	N	♦	*WI Endemic. The plants of Tortola do not conform to the parameters for this species. Needs reassessment.*
	Opuntia antillana Britton & Rose	S	N	♦	*WI Endemic.*
	Opuntia dillenii (Ker Gawl.) Haw.	S	N	♦	*O. stricta is also reportedly present, but is somewhat difficult to distinguish from this species.*
	Opuntia dillenii x *O. repens*	S	N	♦	*WI Endemic.*
	Opuntia sp.	S	N	♦	*WI Endemic. Similar to O. repens, but hangs in festoons from cliffs. May just be an eco-morph.*
	Opuntia stricta (Haw.) Haw.	S	N	♦	
	Opuntia x *lucayana* Britton	S	N	♦	*WI Endemic.*
	Pereskia aculeata Mill.	V	N?	♦	*Likely native.*
	Pilosocereus royenii (L.) Byles & Rowley	T	N	♦	*WI Endemic. The species in the VIs needs ur-gent study since they do not conform to plants in the Lesser Antilles.*
	Selenicereus grandiflorus (L.) Britton & Rose	V	N?	♦	*Possibly native.*
Euphorbiaceae	*Acalypha pruinosa* Urb.	H	N	♦	*WI Endemic. Possibly an error for Tortola.*
	Adelia sp.	T	N	♦	

Family	Species	Habitat	Origin	Status	Comments
Fabaceae	*Chamaecrista* sp.	S	N	♦	*Large form with large leaves and numerous fruits. Possibly an unusual form of C. glandulosa.*
	Sphagneticola trilobata (L.) Pruski	H	N	♦	*Several cultivars have been introduced to the region, leading some authorities to declare this as an exotic. It also may represent a species complex. Introduced forms are very invasive.*
Lamiaceae	*Salvia thomasiana* Urb.	H	N	♦	*Possibly listed for Tortola in error.*
Malpighiaceae	*Bunchosia polystachia* (Andrews) DC.	T	N	♦	*Possibly more than one sp. of Bunchosia on Tortola.*
Melastomataceae	*Miconia* sp.	S	N	♦	
Moraceae	*Maclura tinctoria* (L.) D. Don ex Steud. subsp. *Tinctoria*	T	N	♦	*Mirecki, et al. (1976) listed a Morus sp. for Sage Mountain.*
Myrtaceae	*Eugenia* cf. *confusa* DC.	T	N	♦	
Nymphaeaceae	*Nymphaea* cf. *elegans* Hook. **Photo 179**	H	N	♦	
Rubiaceae	*Guettarda scabra* (L.) Lam.	T	N	♦	*Plants at Sage Mountain are exceptional in appearance. See comment immediately below.*
	Guettarda sp.	T	N	♦	*Plants at Sage Mountain are exceptional in appearance and do not resemble G. scabra.*
Sapotaceae	*Sideroxylon obovatum* Lam.	T	N	♦	*WI Endemic. Some plants that fall under this species are quite distinct.*
Urticaceae	*Cecropia* sp.	T	N	♦	*Possibly a new form on Tortola.*

<u>Table Key</u>:

H Herb
S Shrub
T Tree
V Vine
N Native
I Introduced
Ext. Extinct
? Questionable

Photo 173.
The fern *Blechnum appendiculatum* (bright redish leaf) growing in upland savanna at Sage Mountain.

Photo 174.
Adiantum fragile var. *fragile, an unusually large and robust-leaved form on Tortola.*

Photo 175.
Coccothrinax barbadensis on the West End of Tortola.

Photo 176.
A *Tillandsia* sp., perhaps *T. setacea*, on the cliffs at Balsam Ghut, Tortola.

Photo 177.
A large-leaved Commelina sp.,
possibly *Commelina* cf. *benghalensis*, at Brewers Bay.

Photo 178.
An unknown milk-shrub, possibly *Rauvolfia* cf. *biauriculata,* near Sage Mountain.

Photo 179.
The water lily, possibly *Nymphaea* cf. *elegans*.

9.2.3 Plant Species and Habitats of Special Concern

Many plants of special concern on Tortola that are declining are those that are restricted to the islands of the West Indian region, meaning they are found only on a handful of islands. Their decline is due primarily to deforestation, impacts from feral livestock, and overall landscape deterioration as a result of human actions such as infrastructure development, including residences and road construction.

A list of plant species of special concern on Tortola, including Beef Island, is provided in **Table 27** in Chapter 4. Some of these plants are not regional endemics—that is restricted to islands of the West Indies—but they nevertheless are native and are an important component of the island's natural heritage. Some species are endemic to the Puerto Rican Bank, including the British Virgin Islands, and they are listed in **Table 56** earlier in this chapter, with plants species of interest (mostly threatened species) shown in **Figure 51**. These plants are usually located in key habitats ranging from xerophytic rainforest at Sage Mountain to mixed forest and dry shrubland communities with succulents.

To determine the status of plant species and habitats, the IRF biodiversity team conducted field assessments throughout much of Tortola and Beef Island, consulted local and international experts, and combed through reports and results from previous studies. Nevertheless, the data and tables presented in the *Tortola Environmental Profile* are by no means complete, and should be used as an incentive for further research. We still need to determine more precisely: (1) the conservation requirements of plant species of special concern, (2) the impacts of potential threats and how to address them, (3) the identity of other potentially threatened species, and (4) those species presenting taxonomic challenges.

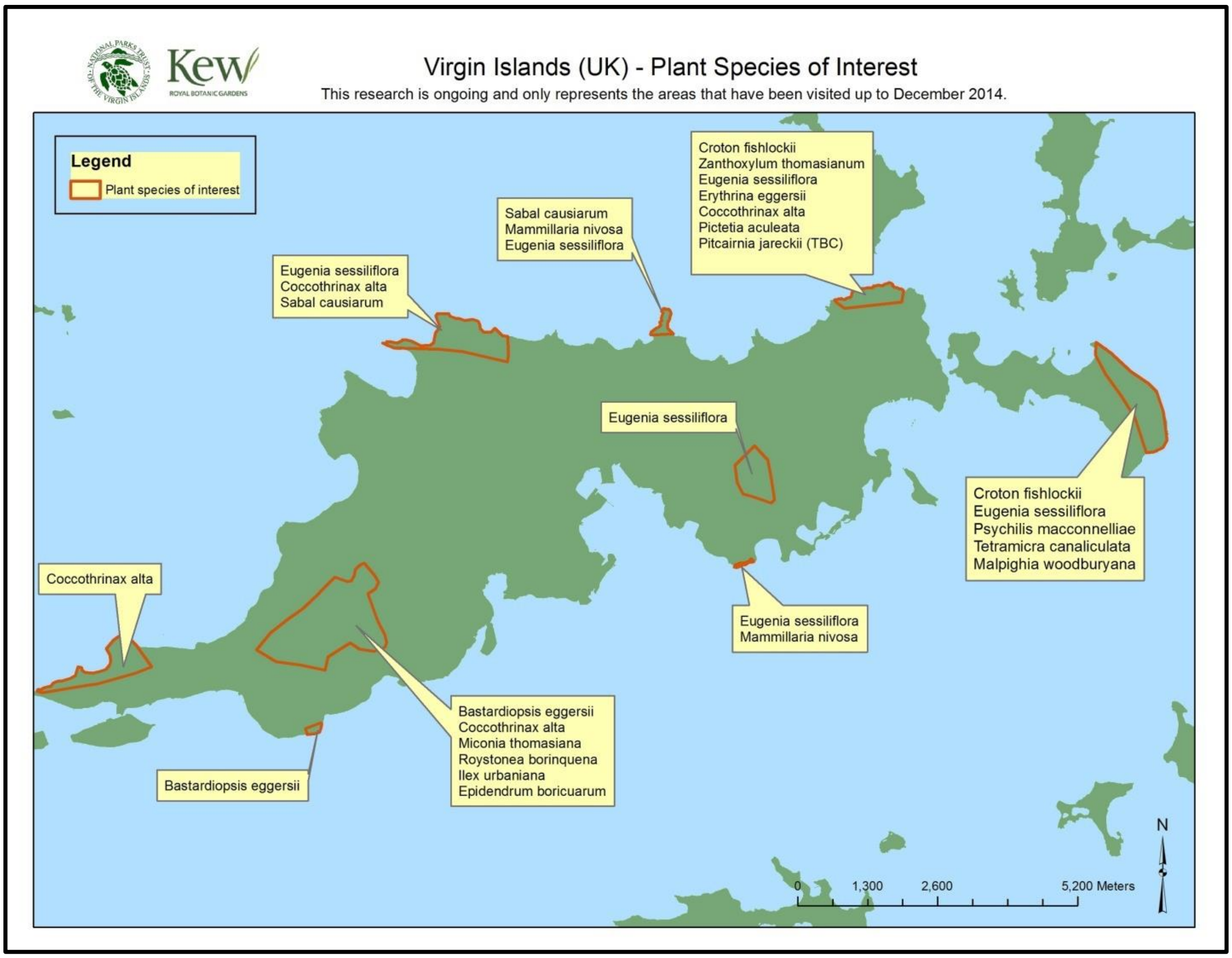


Figure 51.
Tortola plant species of interest, as identified by the National Parks Trust of the Virgin Islands and the Royal Botanic Gardens, Kew.

9.3 The Specialness of Tortola: Its Fauna

As it is for the plant species and their habitats, native fauna and their related and dependent ecosystems are similarly important, and continued efforts are needed to protect and conserve the integrity and value of these species and systems. A list of the native fauna of special concern is provided in **Tables 30–32**, and **34** (Chapter 4). **Figure 52** of this chapter displays wildlife species and habitats of special concern documented during field surveys carried out by the environmental profile biodiversity team in January, May, August and October of 2014. The number of sites and species are likely to increase with future surveys.

Many of the species of native animals listed are widely distributed over Tortola, moving from place to place, dependent on the availability of habitat, food, and shelter and the need to reproduce. It is for this reason that conservation and management of many of these species is dependent on a multi-disciplinary approach involving: (1) critical habitat protection and restoration, (2) population management, (3) invasive species control, (4) captive breeding and species restoration, and (5) linking patches of forests, woodlands, wetlands and coastal habitats through ecologically stable corridors, especially because many species migrate seasonally—from one side of the island to the other, moving up and down the slopes during wet and dry periods or during major food shifts, and during the approach of fall and spring months.

There are habitat areas on Tortola and Beef Island that also require protection, including:

1. All wetlands.
2. Freshwater systems, including riparian corridor from headwaters to their coastal outlets.
3. Wild beaches, including cobblestone aggregate communities.
4. Forests, woodlands and scrublands on the eastern, northern, southwestern and western ends of Tortola and the Mount Alma range, boulder fields and connecting lowland woodland corridors on Beef Island.
5. Increased size for the protected rainforest area on Sage Mountain, including connective corridors with riparian and forest sites on other summits situated south, east and west of the protected area.
6. Coastal woodland on the southern slopes of Frenchman's Cay.

9.4 Critical Protection Priorities

Tortola's steep, elevated landscape offers little low land for development, and residences and other infrastructure are largely built high on the slopes of the island's hillsides. To gain access, sharp road cuts are made, sometimes at very precarious gradients vertically upslope, or by gouging deep gashes into the landscape. Unfortunately, this practice also occurs along the coast. The end result has been a disjointed and patchy development overlay spreading across Tortola and distinctly visible from kilometres offshore.

In the process, unique biodiversity habitats and species assemblages as well as Tortola's characteristic vistas and views have been and continue to be degraded or destroyed. Critical ecosystems for animals and plants, especially migratory pathways up and down slopes or across the island, even from the north side to the south side, have fallen prey to the march of economic growth.

The ecological decline started with European colonisation and continues to the present with many of Tortola's native species and ecosystems under threat, primarily because of human activities—historically and today. Although local situations and events present the most direct challenge to species, habitats, landscapes and ecological processes, global conditions and events such as climate change and attendant sea level rise increasingly place Tortola at risk.

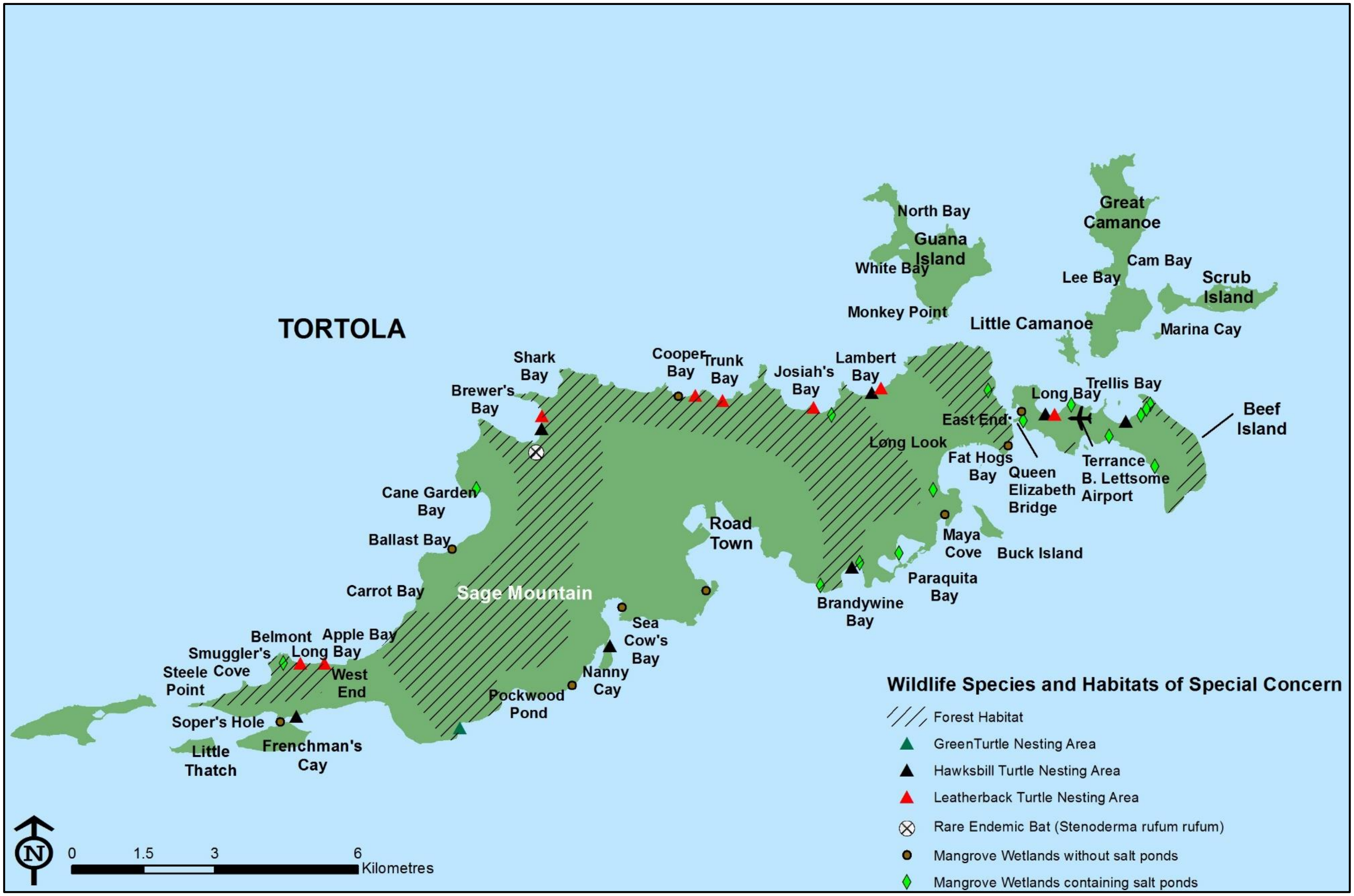


Figure 52.

Wildlife species and habitats of special concern for Tortola and Beef Island.

While it may be convenient and comfortable to momentarily ignore signs of environmental decline, it does not change the fact that too many of Tortola's mangrove and other coastal wetlands, seagrass beds and other marine communities are being degraded or even disappearing. Also vulnerable are the island's beautiful beaches, which provide nesting habitats for turtles, and the island's many diverse coastal woodland and shrub communities.

Native species and their habitats are key biological assets that illustrate the special character of Tortola and Beef Island. The pursuit of better options for the management and protection of these resources should be a top priority for decision-makers, both in the public and private sectors. This is why these biological assets have been highlighted in this the final section of the *Tortola Environmental Profile*.

9.4.1 Future Protection Priorities

As noted throughout the *Tortola Environmental Profile*, there are many areas of the island that require careful resource management and protection in order for ecosystems and ecological services, natural aesthetics, historical values, and biodiversity to be sustained.

Table 57 provides a summation of information on those areas with multiple parameters of significance or value for Tortola. These have been identified as priorities by the profile research team.

The cross-referenced format demonstrates that most of areas and sites included have multiple significance, and therefore judicious management and protection of these areas may be important not only to Tortola but to the long-term sustainable development of the entire British Virgin Islands as well.

Table 57.
Multiple parameters of value or significance for Tortola, including Beef Island.

Sites, Features, Assets Habitats, and Vegetation Communities	Parameters of Value or Significance																CONSERVATION STATUS
	Protection from Natural Hazard Impacts	Historical and Archaeological	Landscape Scenic Aesthetic	Recreational	Marine	Protected Areas and Reserves	Habitat Restoration and Specimen Management	Climate Change & Sea Level Rise Amelioration	Beach	Watershed Management	Wetlands	Science and Research	Pollution Control	Biodiversity	Fisheries	Economic	
GENERAL NATURAL ASSETS																	
Sage Mountain Rainforest System				1,3,4,5, 6 A,B,C								1,3,4,5 A,B,C		❀✸		1,4,5, A,B,C	E
Mount Alma Range Seasonal Woodland				1,3,4,5, A,B,C										❀✸		1,4, A,B,C	E
HABITATS																	
Mangroves, Marshes and Salt Ponds				1,3,4,5, B,C,F										❀✸		1,5,7	E
Forests, Woodlands, Shrublands, Grasslands, Rocky Coasts				1,3,4,5, A,B,C										❀✸			E
Beach Habitats				1,3,5,7, A,B,C										❀✸		1,3,5,6, 7	E
Coral Reefs and Seagrass Beds				1,3,5,7, B,C										❀✸		1,5,7	E
Freshwater Habitats/ Riparian Areas				1,3,5,7, B,C										❀✸			E
VEGETATION COMMUNITIES																	
Rainforest														❀✸			E
Drought Deciduous Dense Woodland														❀✸			E
Drought Deciduous Open Woodland														❀✸			E
Boulder Field Evergreen Woodland														❀✸			E
Boulder Field Evergreen Shrubland														❀✸			E
Evergreen Palm Woodland														❀✸			E
Xerophytic Rainforest				A,B,C										❀✸		1,4,5,6	V
Evergreen Gallery/ Riparian Forests														❀✸			E

Sites, Features, Assets Habitats, and Vegetation Communities	Parameters of Value or Significance																CONSERVATION STATUS
	Protection from Natural Hazard Impacts	Historical and Archaeological	Landscape Scenic Aesthetic	Recreational	Marine	Protected Areas and Reserves	Habitat Restora-tion and Species Management	Climate Change & Sea Level Rise Amelioration	Beach	Watershed Management	Wetlands	Science and Research	Pollution Control	Biodiversity	Fisheries	Economic	
Deciduous, Evergreen Mixed Forest and Shrub-land with Succulents														❀✸			E
Seasonal Evergreen and Evergreen Forest														❀✸			E
Semi-Deciduous and Drought-Deciduous Forest on Alluvium and Non-Carbonate Substrates				A,B,C										❀✸			E
Seasonal Evergreen Forest with Coconut Palm				A,B,C										❀✸			E
Mangrove				B,C										❀✸		1,4,5,7	E
Seasonally Flooded Sa-vannahs and Woodlands				B,C										❀✸			S
Herbaceous Agriculture (Cultivated Lands)				B,C										❀✸		2,3	E
Pasture, Hay or Inactive Agriculture				B,C										❀✸		2,3	E
Pasture, Hay or Other Grassy Areas				B,C										❀✸			S
Salt and Mud Flats				B,C,E										❀✸		1,4,5	E
Coastal Sand and Rock				A,B,C										❀✸			E
Water - Permanent				B,C,F										❀✸		2,3,7	E
P R O T E C T E D A R E A S — E x i s t i n g																	
Hans Creek Fisheries Protected Area				B,C										❀✸		1,2,3,4, 5,6,7	E
Beef Island Channel Fisheries Protected Area				B,C										❀✸		1,3,4,5, 7	E
Frenchman's Cay Fisheries Protected Area				B,C										❀✸		1,3,4,5, 6,7	E
Sage Mountain Forestry Area				A,B,C										❀✸		1,2,4,5, 6	V
Belle Vue Water Area														❀✸		3,4	V
Morning Rose Spring Water Area														❀✸		3,4	V

Sites, Features, Assets Habitats, and Vegetation Communities	Parameters of Value or Significance																CONSERVATION STATUS
	Protection from Natural Hazard Impacts	Historical and Archaeological	Landscape Scenic Aesthetic	Recreational	Marine	Protected Areas and Reserves	Habitat Restoration and Species Management	Climate Change & Sea Level Rise Amelioration	Beach	Watershed Management	Wetlands	Science and Research	Pollution Control	Biodiversity	Fisheries	Economic	
Purcell Water Area														❀✸		3,4	V
Harrigan and Long Bush Water Area														❀✸		3,4	V
Great Mountain and Gordon Water Area														❀✸		3,4	V
Joe's Hill, Abions and Nibb's Estate, Sea Cow's Bay Water Area														❀✸		3,4	V
Sage Mountain National Park and Sage Mountain Park Expansion				A,B,C										❀✸		1,4,5,6	V
J.R. O'Neal Botanic Gardens				A,B,C										❀✸		1,5,6	S
Mt. Healthy National Park				A,B,C										❀✸		1,5	S
Shark Bay National Park				A,B,C										❀✸		1,5,7	V
P R O T E C T E D A R E A S — P r o p o s e d																	
Sopher's Hole Marine Protected Area														❀✸		1,7	V
Great Carrot Bay Marine Protected Area				B,C										❀✸		1,3,4,5, 6,7	V
Cooten, Josiah's, Lambert Bay Marine Protected Area				B,C										❀✸		1,3,4,5, 6,7	V
Trunk Bay, Rogues Bay Marine Protected Area				B,C										❀✸		1,3,4,5, 6,7	V
Smuggler's Cove Marine Protected Area				B,C,D										❀✸		1,5,6,7	V
Beef Island Marine Protected Area				B,C,D										❀✸		1,5,6,7	V
Bar Bay Terrestrial Protected Area				A,B,C										❀✸		1,4,5	V
Belmont Terrestrial Protected Area				A,B,C, D,E										❀✸		1,3,4,5, 6,7	V
Banana Wharf/Bluff Bay Terrestrial Protected Area				A,B,C										❀✸		1,5	V
Hans Creek Marine and Terrestrial Protected Area				A,B,C										❀✸		1,5	V

Sites, Features, Assets Habitats, and Vegetation Communities	Parameters of Value or Significance																CONSERVATION STATUS
	Protection from Natural Hazard Impacts	Historical and Archaeological	Landscape Scenic Aesthetic	Recreational	Marine	Protected Areas and Reserves	Habitat Restoration and Species Management	Climate Change & Sea Level Rise Amelioration	Beach	Watershed Management	Wetlands	Science and Research	Pollution Control	Biodiversity	Fisheries	Economic	
Long Bay Marine and Terrestrial Protected Area				A,B,C										❀✹		1,5,6,7	V
Paraquita Bay Marine and Terrestrial Protected Areas				A,B,C, D,F										❀✹		1,3,4,5, 6,7	V

TABLE 57 LEGEND

ECONOMIC:
1=tourism
2=agriculture
3=commercial
4=real estate
5=organised tours
6=vendors
7=fisheries

RECREATIONAL:
A=walking/hiking/running
B=scenic/landscape/aesthetic
C=wildlife viewing/nature watching
D=swimming/snorkeling/diving/boating
E=camping
F=fishing

BIODIVERSITY:
❀=flora
✹=fauna

Habitats and Ecosystems

The habitats and ecosystems listed in this Table are broadly defined and encompass most of the systems found on Tortola (including Beef Island), though not all. By using broad definitions, the IRF team has attempted to include even the small and little known ecological systems and frameworks, even those that are just a few hectares in extent and/or have one location.

Conservation Status Definition and Approach

In the definitions below, the term "*area*" refers to *sites/habitats/communities* as provided in the Table. The four categories used to characterise status are ***endangered, threatened, vulnerable*** and ***stable***, defined as follows:

ENDANGERED: An area is considered *endangered* when the best available evidence indicates that it is considered to be facing a very high risk of being totally destroyed, with its systems, structure and functions disrupted and/or disabled in such a way as to render it retarded or irreparably damaged.

THREATENED: An area is considered *threatened* when the best available evidence indicates that it does not yet qualify for the category of *Endangered*. However, it is close to qualifying for or is likely to qualify as being endangered in the near and medium-term.

VULNERABLE: An area is considered *vulnerable* when the best available evidence indicates that it is facing a high risk of threats that may elevate its risk to severe damage and disruption, and may elevate its status to *threatened* or *endangered* in the near and medium-term.

STABLE: An area is considered *stable* when the best available evidence indicates that it does not qualify for *Endangered*, *Threatened*, or *Vulnerable*, and when prevailing circumstances do not or will not immediately cause severe damage or loss to the system.

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Tortola Environmental Profile Project Team

Judith Towle is the project director and profile editor for the BVI Environmental Profile Programme; in the 1990s she served as senior editor for eight Eastern Caribbean Environmental Profiles prepared for USAID and two UK Caribbean OT Profiles for UNEP. Ms. Towle is well familiar with the British Virgin Islands, having recently served as director of the Laurance Rockefeller-funded Sandy Cay Development Programme, overseeing implementation of the requirements preceding the transfer of Sandy Cay to the National Parks Trust.

Ms. Towle holds a Master's Degree in Public Administration from American University and has served as the chief administrative and financial officer of IRF since the organisation's founding in 1972. Her 40 years of Caribbean experience have focused on institutional development, NGOs, public policy, financial management, and—most recently—Caribbean philanthropy law.

Ms. Towle is the author of Chapter 2 of the *Tortola Environmental Profile* (Institutional Environment) and a contributor to Chapter 1 (Introduction to Tortola) and Chapter 9 (Directions for the Future).

Jean-Pierre Bacle is deputy project director and coordinator of field research activities for the BVI Environmental Profile Programme.

As the Foundation's senior natural resource analyst, Mr. Bacle has facilitated and coordinated IRF's applied research and field activities for over 20 years, primarily in the U.S. and British Virgin Islands. A Canadian national with a degree in geography from the University of Ottawa, Mr. Bacle has been affiliated with IRF since 1986, where he has specialised in resource management studies, environmental impact assessments, endangered species research, air-photo interpretation and natural resource mapping.

For the *Tortola Environmental Profile*, Mr. Bacle is lead author of Chapter 1 (Introduction to Tortola) co-author of Chapter 4 (Terrestrial Biodiversity), co-author of Chapter 7 (Pollution Risks), and a co-author of Chapter 9 (Directions for the Future).

A national of Antigua, **Kevel Lindsay** is a trained forester and biologist, with a degree in biodiversity conservation from Columbia University. He has been attached to the Foundation's regional Biodiversity Conservation Programme (initially based in Antigua) since 1995, currently serving as the programme's regional coordinator. Mr. Lindsay is an expert on Caribbean plant ecology and faunal species, particularly birds and bats. He is a principal contributor to several key biodiversity planning documents prepared by the Foundation, including a vegetation classification system for Antigua and Barbuda, St. Kitts and Nevis, and the U.S. Virgin Islands. Mr. Lindsay co-authored *The Wild Plants of Antigua and Barbuda* and is author of the forthcoming *The Ferns of Antigua*.

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Dr. Shannon Gore was affiliated with the BVI Department of Conservation and Fisheries for over ten years as senior marine biologist before launching her own business, Coastal Management Consulting. Since 2014, she has also been engaged in restructuring a BVI non-profit organisation, the Association of Reef Keepers (ARK), which is dedicated to the preservation and sustainability of the BVI's marine resources. She is currently the acting Managing Director for ARK. Dr. Gore earned her doctoral degree in coastal geomorphology from the University of Ulster in Northern Ireland; her Ph.D. thesis focuses on beach geomorphology and management in the British Virgin Islands.

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Clive Petrovic is a BVI-based marine scientist who formerly headed the Applied Marine Studies Centre at the BVI's H. Lavity Stoutt Community College. Additional BVI experience includes yacht chartering and nautical tourism. He currently heads Econcerns, which has completed Environmental Impact Assessments for many proposed development projects in the BVI. Mr. Petrovic is a leading expert on BVI avian fauna and aquatic marine wildlife. He was a member of the IRF profile team that prepared the *Jost Van Dyke, Virgin Gorda* and *Anegada Environmental Profiles*.

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Cynthia Rolli is a multi-disciplinary, international geological engineer with 20 years of experience in environmental and emergency management planning, including BVI experience in environmental impact assessment, disaster mitigation and planning, and GIS applications. Ms. Rolli was instrumental in drafting the earliest EIA guidelines for the BVI, and also worked as a physical planner with the BVI Department of Town and Country Planning and a senior technical planning manager in the BVI Department of Disaster Management.

For the *Tortola Environmental Profile*, Ms. Rolli served as the project's specialist for geospatial data and, with deputy project director Jean-Pierre Bacle, was responsible for preparation of profile mapping instruments. Ms. Rolli also prepared Chapter 3 (Natural Hazards and Environmental Risks) for the *Tortola Environmental Profile*.

Noni Mandisa Georges, a BVIslander, is an attorney, community advocate, and legal and environmental consultant with over 18 years of experience in BVI public policy, including the environment. Ms. Georges was a founding member of the Virgin Islands Environmental Council and one of the core volunteers for the Beef Island Court Case. She was a Research Associate at Island Resources Foundation for the Sandy Cay Project and a Policy Officer at the BVI Department of Conservation and Fisheries. She presently sits on the Scientific Committee established under the National Parks Act, acts as an occasional consultant for the Jost Van Dykes Preservation Society, manages the BVI Pro Bono Law Clinic, and is the Deputy Registrar for the Commercial Court in the Virgin Islands.

For the *Tortola Environmental Profile*, Ms. Georges was the author of Chapter 8 (Protected Areas and Resource Conservation).

Dr. Michael Kent is affiliated with the Virgin Islands Studies Programme at H. Lavity Stoutt Community College and is a leading expert on Virgin Islands history about which he has written extensively. He has served as editor-in-chief of *the Journal of Virgin Island Studies*, published by HLSCC. Dr. Kent was a member of the IRF team that prepared the *Jost Van Dyke, Virgin Gorda* and *Anegada Environmental Profiles*.

For the *Tortola Environmental Profile*, Dr. Kent is the author of Chapter 6 (Historical Heritage Resources) and a contributor to Chapter 1 (Introduction to Tortola), where he provided an overview of the early historical development of Tortola.

Charlotte McDevitt is currently the Executive Director of Green VI, a not-for-profit organisation based in the BVI. She completed her Master's Degree in Industrial Administration in 2008, and her dissertation focused on how the BVI can reduce waste and improve resource management. Before relocating to the Caribbean 15 years ago, Ms. McDevitt worked for the City of Cape Town, developing strategies to reduce litter, illegal dumping, and waste in landfills.

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Rosemary Delaney-Smith serves as the community coordinator and local liaison for the BVI Environmental Profile Programme, building on her experiences as community coordinator for the "Jost Van Dyke Community-based Programme to Advance Environmental Protection and Sustainable Development," a project that included preparation of the *Jost Van Dyke Environmental Profile*. With a Master's Degree in Marine Resources and Environmental Management from the University of the West Indies, Cave Hill campus in Barbados, Ms. Delaney-Smith has also served as environmental education officer at the BVI National Parks Trust and as fisheries officer with the BVI Department of Conservation and Fisheries. She currently is the Assistant Director of VIROTECH, a BVI-based environment-focused business.