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

including Eustatia, Mosquito, Necker, Prickly Pear, Saba Rock, The Dog Islands, Broken Jerusalem, Fallen Jerusalem, and Round Rock

island resources FOUNDATION

OTEP

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The Houwer Family

Sir Richard Branson

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A Report of Island Resources Foundation

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Cover Photo:

THE BATHS NATIONAL PARK, VIRGIN GORDA

Photo Courtesy of the BVI Tourist Board

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ACRONYMNS

ARK	Association of Reef Keepers
ATV	All-terrain Vehicle
BEYC	Bitter End Yacht Club
BMP	Best Management Practice
BVI	British Virgin Islands
BVICCHA	British Virgin Islands Chamber of Commerce and Hotel Association
BVIEC	British Virgin Islands Electricity Corporation
BVIHCG	BVI Heritage Conservation Group
CA	Central America
CCCC	Caribbean Community Climate Change Centre
CDC	Conservation Data Centre, University of the Virgin Islands
CDEMA	Caribbean Disaster Emergency Management Agency
CDERA	Caribbean Disaster Emergency Response Agency
CDM	Comprehensive Disaster Management
CEHI	Caribbean Environmental Health Institute
CERMES	Centre for Resource Management and Environmental Studies
CITIES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CPN	Caribbean Philanthropy Network
DCF	Department of Conservation and Fisheries
DDM	Department of Disaster Management
DFID	Department for International Development (UK)
DOA	Department of Agriculture
DPU	Development Planning Unit
DSW	Department of Solid Waste
DTCP	Department of Town and Country Planning
ECLAC	Economic Commission for Latin America and the Caribbean
ECNAMP	Eastern Caribbean Natural Areas Management Programme
EIA	Environmental Impact Assessment
EMT	Environmental Management Trust
ECACC	Enhancing Capacity for Adaptation to Climate Change in the Caribbean UK Overseas Territories
EPA	Environmental Protection Areas
FATF	Financial Action Task Force
GA	Greater Antilles
GHG	Green House Gas
GoBVI	Government of the British Virgin Islands
HLSCC	H. Lavity Stoutt Community College
ICC	International Coastal Cleanup
ICNL	International Centre for Not-for-Profit Law
IPCC	Intergovernmental Panel on Climate Change
IRF	Island Resources Foundation
IUCN	International Union for the Conservation of Nature
JVD	Jost Van Dyke
LBS Protocol	Protocol Concerning Pollution from Land-based Sources and Activities
MNRL	Ministry of Natural Resources and Labour
NDDP	National Disaster Development Plan
NEAP	National Environmental Action Plan
NGIS	National Geographical Information System
NGO	Nongovernmental Organisation
NIDP	National Integrated Development Plan
NIDS	National Integrated Development Strategy
NOAA	National Oceanic and Atmospheric Administration
NPDP	National Physical Development Plan
NPT	National Parks Trust
OECS	Organisation of Eastern Caribbean States
ONB	Oil Nut Bay
OTEP	Overseas Territories Environment Programme
SA	South America
SPAW Protocol	Protocol Concerning Specially Protected Areas and Wildlife
STEP	Sustainable Tourism Environmental Programme
TNS	The Natural Step
UK	United Kingdom
UN	United Nations
UNEP	United Nations Environment Programme
UNFCC	United Nations Framework Convention on Climate Change
USEPA	U.S. Environmental Protection Agency
USVI	U.S. Virgin Islands
UVI	University of the Virgin Islands
VI	Virgin Islands
VIEC	Virgin Islands Environmental Council
VIRP	Virgin Islands Recycling Partnership
VISR	Virgin Islands Shipping Registry
VOICES	Voices of Interest for Economic and Social Stability
WCMC	World Conservation Monitoring Centre
WI	West Indies
WIN	World Island Network
YCCS	Yacht Club Costa Smerelda

ABBREVIATIONS

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

ac	acre	**lb**	pound
cm	centimetre	**m**	metre
ft	foot	**m^2**	square metre
ha	hectare	**m^3**	cubic metre
in	inch	**mi**	mile
kg	kilogram	**mm**	milimetre
km	kilometre	**yd**	yard
km^2	square kilometre	**yd^3**	cubic yard

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Page xviii	Jim Kelly
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Photo 13	Fr. Alejandro Sanchez, Puerto Rico
Photos 24 and 25	BVI Department of Disaster Management
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Photo 120	Cromaglass Corporation
Photos 131-133	BVI Department of Land and Survey (2002)
Photo 136	Jeff Brown Superyacht Media

PREFACE AND ACKNOWLEDGEMENTS

In the 1990s, Island Resources Foundation (IRF) produced eight Environmental Profiles for six OECS Caribbean states and two UK Overseas Territories. These profiles were funded by the U.S. Agency for International Development and the United Nations Development Programme. At the time, no environmental profile was produced for the British Virgin Islands. A decade later, IRF was asked to join with the Jost Van Dykes Preservation Society to prepare an environment profile for the island of Jost Van Dyke (JVD). Funding for this joint effort was secured from the UK's Overseas Territories Environment Programme (OTEP), and the first environment profile for the BVI was published in 2009. (The profile is downloadable at ***http://www.jvdgreen.org/files/JVD_Environmental_Profile_Final.pdf***.)

The Jost Van Dyke profile project was based on the premise that there is considerable value in taking a retrospective look at environmental change in order to assess priority environmental issues. Island Resources Foundation believes that the premise guiding the JVD profile holds equally true for other areas of the BVI. The lessons learned about Jost Van Dyke's environmental future through the profiling process could also provide a fresh approach to understanding environmental change in the Territory as a whole.

In 2010, IRF began to plan for an expansion of the profile process, and by 2011 had successfully identified further funding to support two new environmental profiles for the British Virgin Islands. The first of these is this document, an environmental profile for the island of Virgin Gorda and its nearby smaller islands and islets. By the end of 2012, a third profile, for the island of Anegada, will be completed. Depending on the further availability of funding, IRF would like to extend and complete the process by preparing an environmental profile in 2013 for Tortola and its adjacent islands.

Funding for the *Virgin Gorda Environmental Profile* was made possible in part through support provided by the Overseas Territories Environment Programme of the UK Foreign and Commonwealth Office. IRF's OTEP funding for the Virgin Gorda and Anegada profiles is administered in the BVI by the Office of the Governor, and we thank His Excellency Governor W. Boyd McCleary for his kind support during the execution of this project. Claire Hunter, Project/Consular Officer in the Governor's Office, was our project liaison, and we thank her for her helpful assistance during all phases of this project.

Additional funding was provided by the Government of the Virgin Islands through the office of the former Premier, the Honourable Ralph T. O'Neal, currently the District Representative for Virgin Gorda and Anegada in the House of Assembly, to whom we extend our appreciation for his early support of the project. We also extend our appreciation to Mrs. Rosalie Adams, Permanent Secretary in the Premier's Office, who was instrumental in securing the support of Government for continuation of the profile series. The endorsement and funding support of the BVI Government were critical in identifying additional funds for this initiative.

The enthusiastic encouragement and assistance of the Hokin family of the Bitter End Yacht Club have been instrumental in moving this project forward. The patriarch of the Hokin family, the late Myron Hokin, was an early supporter of Island Resources Foundation in the 1970s and 1980s. It was a joy for all of us at Island Resources Foundation to reunite with the Hokins three decades later in the execution of this project. We thank in particular Justin Hokin (Myron's grandson) whose enthusiasm for the profiles has been contagious and whose fundraising skills have helped us to achieve this publication. We also extend appreciation to his father, Richard, and sisters, Lauren and Dana, and to the staff at the Bitter End Yacht Club who were particularly helpful in accommodating profile researchers.

The J.A. Woollam Foundation of Lincoln, Nebraska, has been exceedingly generous in its support of the Virgin Gorda and Anegada profiles. We thank its trustee, Dr. John A. Woollam, for joining with our Foundation in bringing these profiles to fruition, and also to the Houwer family of Virgin Gorda whose kind donation has supported publication of this profile.

It is our hope that the information contained within the *Virgin Gorda Environmental Profile* will assist the community of Virgin Gorda and the Government of the Virgin Islands to make more informed decisions about the island's future and to more fully assess the consequences of their actions (or inactions) on the long-term security of the richly diverse and equally splendid environmental resources of Virgin Gorda.

—Judith A. Towle (May 2012)

Vice President of Island Resources Foundation
Project Director for the Virgin Gorda Environmental Profile

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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 Virgin Gorda Environmental Profile.

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Virgin Gorda, British Virgin Islands.
Photo taken from Long Bay looking toward Savannah Bay.
Photo courtesy of Jim Kelley, *www.onlinebvi.com*.

1. INTRODUCTION TO THE ENVIRONMENTAL PROFILE ISLANDS

1.1 Setting the Scene

If all the tiny islets, offshore cays and rocky formations are included, the Territory of the British Virgin Islands comprises over 60 "islands" but with four primary land masses—Anegada, Jost Van Dyke, Tortola, and Virgin Gorda. With the exception of Anegada (the anomaly of the group), the Environmental Profiles being prepared for each of remaining three cannot be limited to a single island. Even the Environmental Profile for Jost Van Dyke—the smallest of the four primary Virgin Islands—included its nearby neighbours of Little Jost, Sandy Cay, Green Cay, and Sandy Spit (IRF/JVDPS, 2009).

Similarly, in Virgin Gorda, Profile researchers recognised that the target island was not an isolated land mass but is bordered by and linked to a number of smaller, neighbouring islands and islets that would contribute to the larger milieu of the *Virgin Gorda Environmental Profile*. These smaller islands are connected to Virgin Gorda in a number of ways—environmentally as well as economically.

The research team from Island Resources Foundation (IRF) identified a total of 13 "islands" that would—in addition to Virgin Gorda itself—constitute the geographic scope of the *Virgin Gorda Environmental Profile* (see **Table 1**).

Table 1.
The offshore islands of Virgin Gorda.

North Sound	West of Virgin Gorda	South of Virgin Gorda
Eustatia	Cockroach	Broken Jerusalem
Mosquito	George Dog	Fallen Jerusalem
Necker	Great Dog	Round Rock
Prickly Pear	Seal Dogs	
Saba Rock	West Dog	

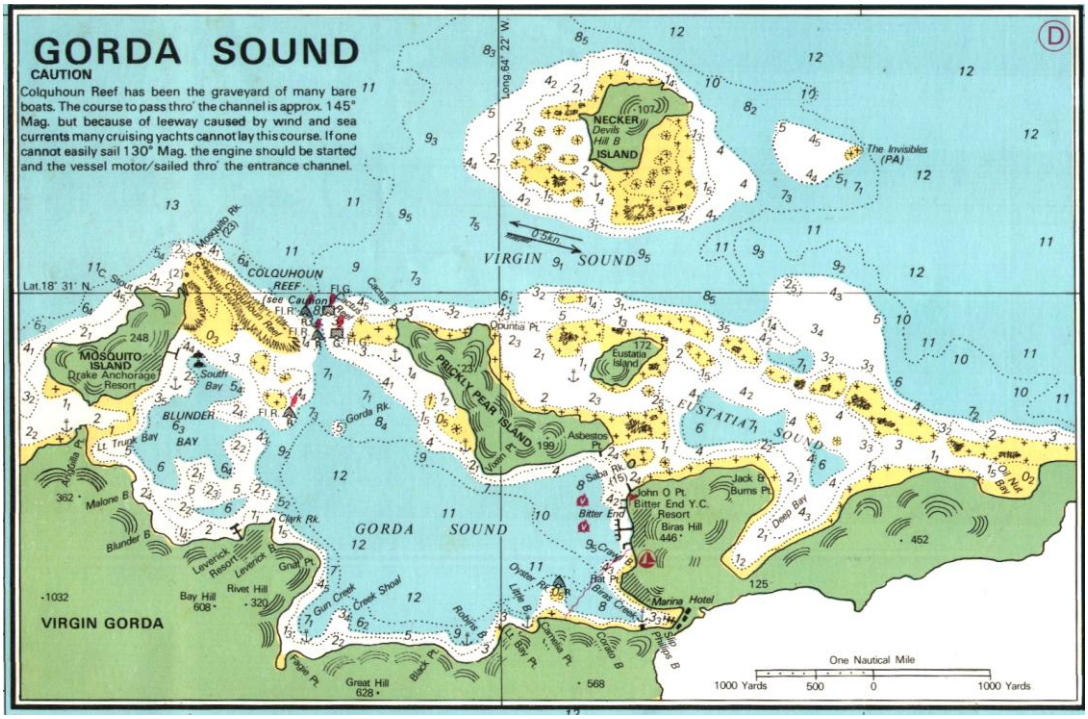


Figure 1.
The North Sound of Virgin Gorda.
Shown as "Gorda Sound" on the nautical charts of the Caribbean Sea compiled by Donald M. Street, Jr., Chart #A232 (January 1999).

But of course, Virgin Gorda remains at the centre of this Environmental Profile, with the second largest population in the Territory and the third largest land mass (after Tortola and Anegada). It also takes its place of honour as both the birthplace and heart of the BVI's tourism economy.

1.1.1 The Islands of North Sound

Of the smaller offshore islands near to Virgin Gorda, those with the closest ties to the main island are to be found in the North Sound, the large, semi-enclosed embayment found on Virgin Gorda's northern shore that has played host to legions of international sailors and recreational visitors for almost half a century. A view of the islands of North Sound (sometimes referred to as Gorda Sound) is found on **Figure 1**, displayed appropriately on a nautical chart, given the area's key role in the BVI's marine industry.

The North Sound was described in a 1970 report by long-time District Representative for Virgin Gorda and former Premier of the BVI, the Honourable Ralph T. O'Neal, as follows:

> *… The North Sound Harbour Area is almost landlocked and several visitors have described it as being similar to Lake Gennesaret* [Sea of Galilee]. *The Harbour begins at Anguilla Point, and is bounded on the south by the mainland of Virgin Gorda, on the east partly by the mainland of Virgin Gorda, partly by the islet known as Little Saba, to the north by the island of Prickly Pear and partly by a reef, and to the west by the island of Mosquito. There are entrances between Mosquito and Anguilla Point, the mainland of Virgin Gorda and Little Saba, Little Saba and Prickly Pear and between Prickly Pear and the Reef* (O'Neal, *circa* 1970).

A snapshot overview of Virgin Gorda's North Sound islands follows (see also **Photo 1**).

Photo 1.
North Sound, Virgin Gorda with several "offshore" islands identified.

(1) Eustatia Island

Eustatia is a 12 ha (30 ac) volcanic island that is privately owned with three luxury accommodations. It is located slightly north of Virgin Gorda and Prickly Pear and overlooks Eustatia Sound (**Figure 2**). Eustatia is protected by an extensive reef which is a prime spot for snorkelers. It is a declared Bird Sanctuary.

Photo 2.
Eustatia Island, North Sound.

(2) Mosquito Island

Former home to the celebrated Drake's Anchorage Resort and its owner, the legendary marine archaeologist Bert Kilbride, the 48.5 ha (120 ac) Mosquito Island is now owned by Sir Richard Branson. It is being developed as an eco-resort to include luxury villas and a private residence for the owner. Mosquito has the highest elevation of Virgin Gorda's offshore islands (76 m/251 ft), with two salt ponds, and many beaches and nearshore seagrass beds that attract sea turtles. The island is an officially declared Bird Sanctuary, with White-tailed and Red-billed Tropicbirds regularly nesting along the north and northeastern cliffs.

Photo 3.
Mosquito Island, from Leverick Bay, Virgin Gorda.

(3) Necker Island

A small rocky landmass almost completely encircled by coral reefs, the 32 ha (80 ac) Necker Island has been the island retreat of UK businessman Sir Richard Branson for more than 30 years. It is operated as a luxury vacation destination. In the words of its owner, Necker "is marked by scenic contrast…sandy beaches punctuate jutting headlands and cactus-studded ridges top panoramic hillsides" *(privateislandsonline.com/neckerisland)*. The island is also a declared Bird Sanctuary.

Photo 4.
Two views of Necker Island, North Sound.

(4) Prickly Pear Island

At 73 ha (180 ac), Prickly Pear is the largest of Virgin Gorda's offshore islands. The island is a designated Bird Sanctuary and was declared a National Park in 1988. It has four salt ponds, and its beaches attract sea turtle nesting as well as recreational users. Its vegetation has been degraded by the unchecked grazing of feral goats. There are ongoing concerns about the quality of the concessions operating within the National Park.

Photo 5.
Prickly Pear Island and National Park.

(5) Saba Rock Island

Just under one acre in size (0.16 ha/0.40 ac), tiny Saba Rock is entirely occupied by the infrastructure of the Saba Rock Resort, including a full-service marina. Very little of the natural environment remains. It was formerly owned and operated by the late Bert Kilbride, a locally and internationally known archaeologist and self-styled treasure hunter. The island was designated a Bird Sanctuary in 1959, obviously prior to the modern buildings that now totally cover the island.

Photo 6.
Saba Rock, entirely occupied by resort infrastructure.

1.1.2 The Dog Islands

A second cluster of offshore islands—known collectively as The Dogs—also lie in the "neighbourhood" of Virgin Gorda. The Dog Islands are six small and uninhabited islets, with very rugged terrain. They consist of George, Great and West Dog; East and West Seal Dog; and Cockroach Island. Opportunities for exceptional scuba diving and snorkeling recreation abound throughout this entire area, with a variety of dive and snorkel sites and an abundance of fish and colourful coral reefs.

The Seal Dogs lie 1.8 km (1.1 mi) northwest of Mountain Point on Virgin Gorda, and the remaining Dogs (George Dog, West Dog, Great Dog, and Cockroach Island) are 4 km (2.5 mi) due west of Virgin Gorda's Nail Bay (**Photo 7 and Figure 2**).

It has been speculated the islands received their name from sailors who heard what sounded like dogs barking when sailing in the area. Undoubtedly, the noise was made by Caribbean Monk Seals, a species now believed to be extinct in the Caribbean. However, the original "dog" name remains.

Photo 7.
Four of the six Dog Islands.

(1) Cockroach Island

This island is the smallest of The Dog group (1.2 ha/3 ac). It is barely 15 m (50 ft) in elevation but is marked by very rugged cliffs all around. Sparse vegetation—mostly grasses and low shrubs—covers the top of the island. The area is known for its excellent dive site, "The Visibles," situated south and west of the land mass. Cockroach is a declared Bird Sanctuary and has been proposed for inclusion in the Territory's Protected Areas System (Gardner, *et al*., 2008).

Photo 8.
Cockroach Island

(2) George Dog Island

Located just 800 m (0.5 mi) north of Great Dog, George Dog Island is the second largest of The Dogs (16.6 ha/41 ac), and at 73 m (240 ft), it is the highest of the group. The island is covered with shrub-like vegetation, with a coastline of mostly rugged bedrock except for a short tombolo beach on the southeast side. George Dog is a declared Bird Sanctuary and has been proposed for inclusion in the Territory's Protected Areas System.

Photo 9.
South End of
George Dog Island.

(3) Great Dog Island

Great Dog is the largest of The Dog Islands (35.6 ha/88 ac), with an elevation of 64 m (210 ft). It has a rugged coastline except for a small section on the south side known as South Bay. Just inland from the South Bay shoreline is a small salt pond with some mangrove species occurring in association with the pond. Most of the island is covered with dry shrub vegetation. On the south side, an abandoned aircraft has been deliberately sunk as a recreational dive site. Like the other Dogs, Great Dog is an official Bird Sanctuary and is designated for inclusion in the Territory's Protected Areas System.

Photo 10.
Great Dog Island.

(4) Seal Dog Islands (West and East)

The small and rugged Seal Dog Islands comprise West Seal Dog (2.6 ha/6.5 ac) and East Seal Dog (1 ha/2.5 ac) and lie barely 100 m (328 ft) apart from each other. The area is highly favoured for its diving potential. West Seal Dog is the larger of the two, with an elevation of 33.5 m (110 ft). Both Seal Islands have been designated as Bird Sanctuaries and are proposed for inclusion in the Territory's Protected Areas System.

Photo 11.
East and West Seal Dog Islands.

(5) West Dog Island

West Dog Island was established as a National Park in 1974; it was recognised earlier in 1959 as a Bird Sanctuary. The island is 9.7 ha (24 ac) in size with a healthy coral reef system and extensive *Acropora* re-establishment. It has rugged steep cliffs that offer ideal habitat for nesting seabirds.

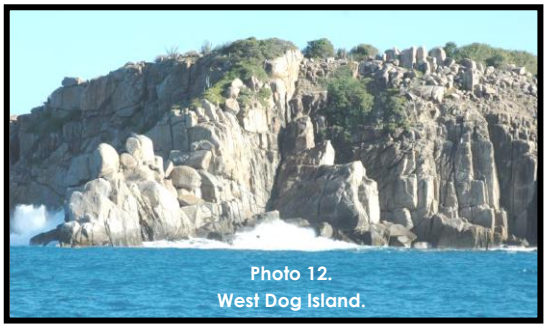


Photo 12.
West Dog Island.

1.1.3 Islands to the South of Virgin Gorda

(1) Fallen Jerusalem Island

Fallen Jerusalem is located 1.2 km (0.75 mi) off the southwest tip of Virgin Gorda. The 19.4 ha (48 ac) island is uninhabited and covered with boulder fields similar in geological formation to those found at The Baths on Virgin Gorda. The area is used by nesting seabirds. The island was declared a Bird Sanctuary in 1959 and a National Park in 1974. Its name reportedly derives from the volcanic boulders scattered across its landscape, which, supposedly, gave the island the semblance of a destroyed city.

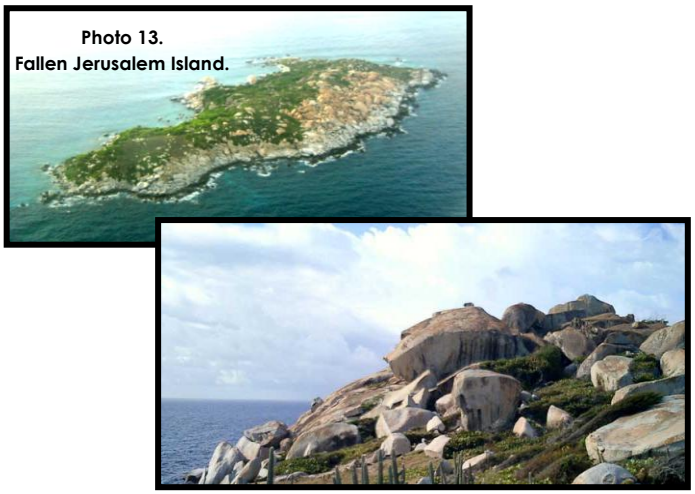


Photo 13.
Fallen Jerusalem Island.

(2) Broken Jerusalem Island

Broken Jerusalem is located between Fallen Jerusalem and Round Rock, some 300 m (984 ft) off the southern point of Fallen Jerusalem. It consists of three groups of above-water rocks spread over one kilometre (0.62 mi), a rocky 1.6 ha (4 ac) land mass that has been the bane of sailors for generations past and present. Like Fallen Jerusalem, the area is important for nesting seabirds. Under the BVI's Protected Areas System Plan (Gardner, *et al*., 2008), the site has been proposed for national park status.

Photo 14.
Broken Jerusalem Island.

(3) Round Rock Island

This 6 ha (15 ac) island is situated 1.65 km (1 mi) southwest of Fallen Jerusalem. It is marked by steep rocky cliffs along most of its coastline except along the northwest facing side. Its height reaches about 53.3 m (175 ft) and has been characterised as a table top tilting toward the northwest. Vegetation is sparse and xerophitic due to the extremely dry conditions and the island's exposure to strong winds. Round Rock has been proposed as a habitat management area in the BVI's Protected Areas System Plan.

Photo 15.
Round Rock Island.

NOTE: *Figures on the size of the offshore islands surrounding Virgin Gorda were provided by Norval Young, Cadastral Information Manager, Department of Lands and Survey. Data were taken from the Cadastral Data Sheets of 1970.*

1.2 The Physical and Natural Setting

1.2.1 Physical Geography

Virgin Gorda, the third largest island in the Territory, is located about 16 km (10 miles) east of Tortola. The island is irregular in shape and is characterised by a rectangular central landmass with two peninsulas projecting east and south (**Figure 2**).

The eastern peninsula extends eastwards from Gun Creek to Pajaros Point. The south peninsula generally extends south-southwest from Pond Bay to Penn Hill, the most southern tip of the island. Spanish Town—the island's urban centre—as well as most of the population and commercial activity is centred in the southern peninsula.

In all, the island is about 15.3 km (9.5 mi) long. The total area (excluding satellite islands) is about 2,130 ha (5,264 ac). As noted in Section 1.1, Virgin Gorda is surrounded by many islands. The five largest are: Prickly Pear 73 ha (180 acres), Mosquito 48.5 ha (120 acres), Great Dog 35.6 ha (88 acres), Necker 32 ha (80 acres), and Fallen Jerusalem 19.4 ha (48 acres).

The central landmass of Virgin Gorda is dominated by Gorda Peak 414m (1,359 ft). This massive mountain is steep-sided and generates a radial drainage system, with short distances to the sea. The eastern peninsula is an elongated ridge interrupted by a topographic low at Biras Creek. It has four peaks with Great Hill attaining 174 m (571 ft). Both the eastern peninsula and the central landmass are typical of the BVI's steep physical geography, with efficient and rapid surface runoff (**Figure 3**).

The southern peninsula, for the most part, has a rather flat to undulating topography with elevations of roughly 30 m (100 ft), thereby producing slower runoff conditions. Highest elevations are located adjacent to Little Dix Bay with Cow Hill reaching 136 m (448 ft).

Highest elevations in the Profile islands are listed in **Table 2**. All are on Virgin Gorda. Most surrounding islands have elevations below 100 m (328 ft), with Mosquito Island attaining the highest at 76 m (251 ft).

Virgin Gorda and its surrounding island and cays are endowed with an extraordinarily scenic and diverse coastline, a product of its geological history, topography and ocean dynamics. Here one finds dramatic rugged cliffs with numerous embayments marked by sandy beaches and, in some areas, quiet shorelines fringed with mangroves. Most impressive are the cliffs extending about 50 m (164 ft) above sea level along the southeastern coastline of the eastern peninsula (**Photo 16**), while the largest stretches of fringing mangroves occupy both sides of Deep Bay (**Photo 17**). Without exception, the most impressive beach system in the Profile islands lies within Savannah Bay (**Photo 18**).

Table 2.
Highest known elevations for Virgin Gorda.

Name	Location	Elevation
Gorda Peak	Central Landmass	414 m (1,359 ft)
Great Hill	East Peninsula	174 m (571 ft)
Cow Hill	South Peninsula	136 m (448 ft)
Biras Hill	East Peninsula	132 m (432 ft)
Minton Hill	South Peninsula	114 m (375 ft)
Black Rock	South Peninsula	94 m (309 ft)
Windy Hill	South Peninsula	76 m (251 ft)
Mine Hill	South Peninsula	73 m (241 ft)

Source: UK Directorate of Overseas Surveys, Series E 803 (D.O.S. 346); Edition 5-D.O.S. 1984.

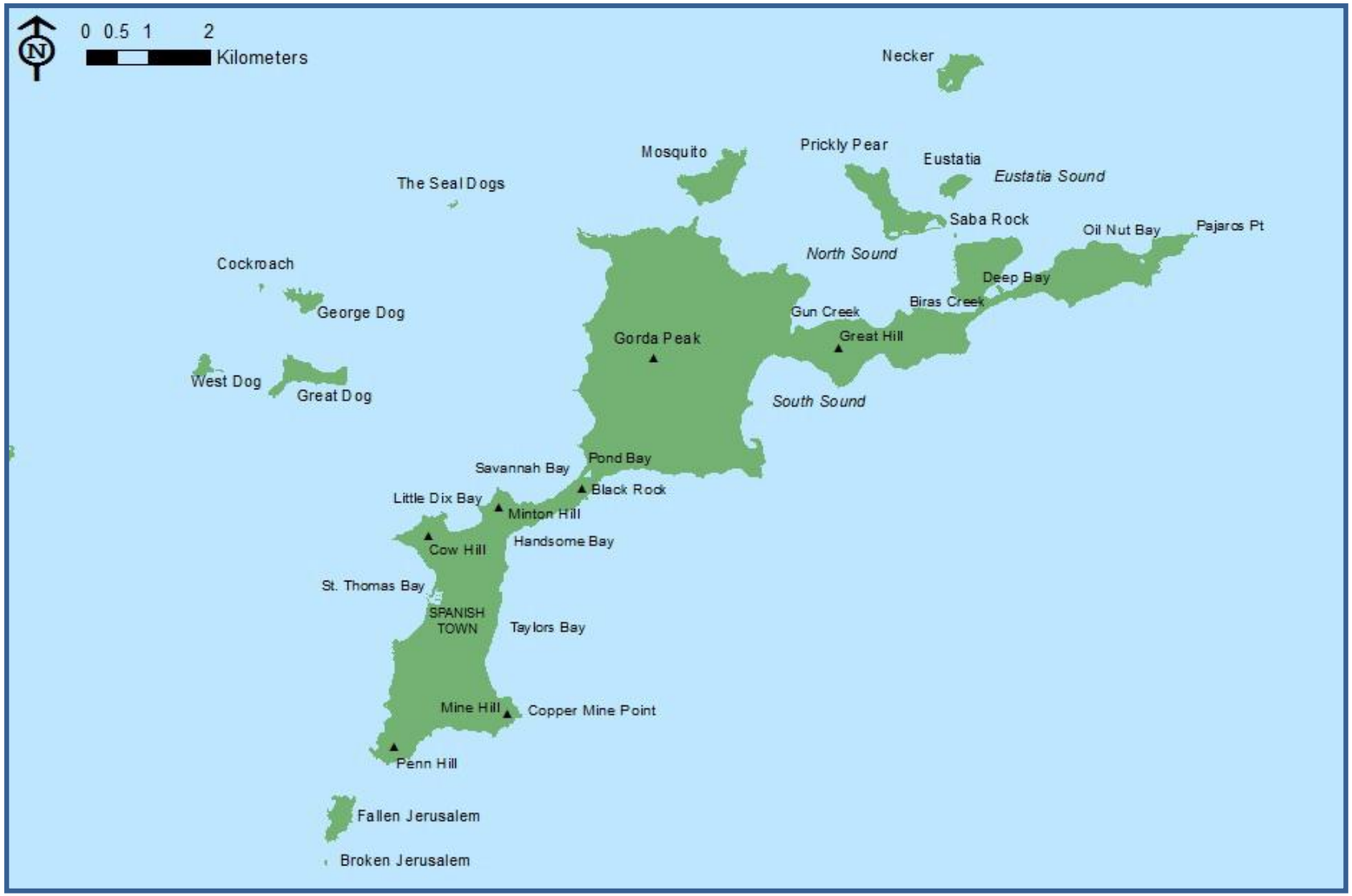


Figure 2.
General location map of Virgin Gorda and nearby smaller islands and cays, with key location points identified (source: adapted from the BVI National Geographical Information System).

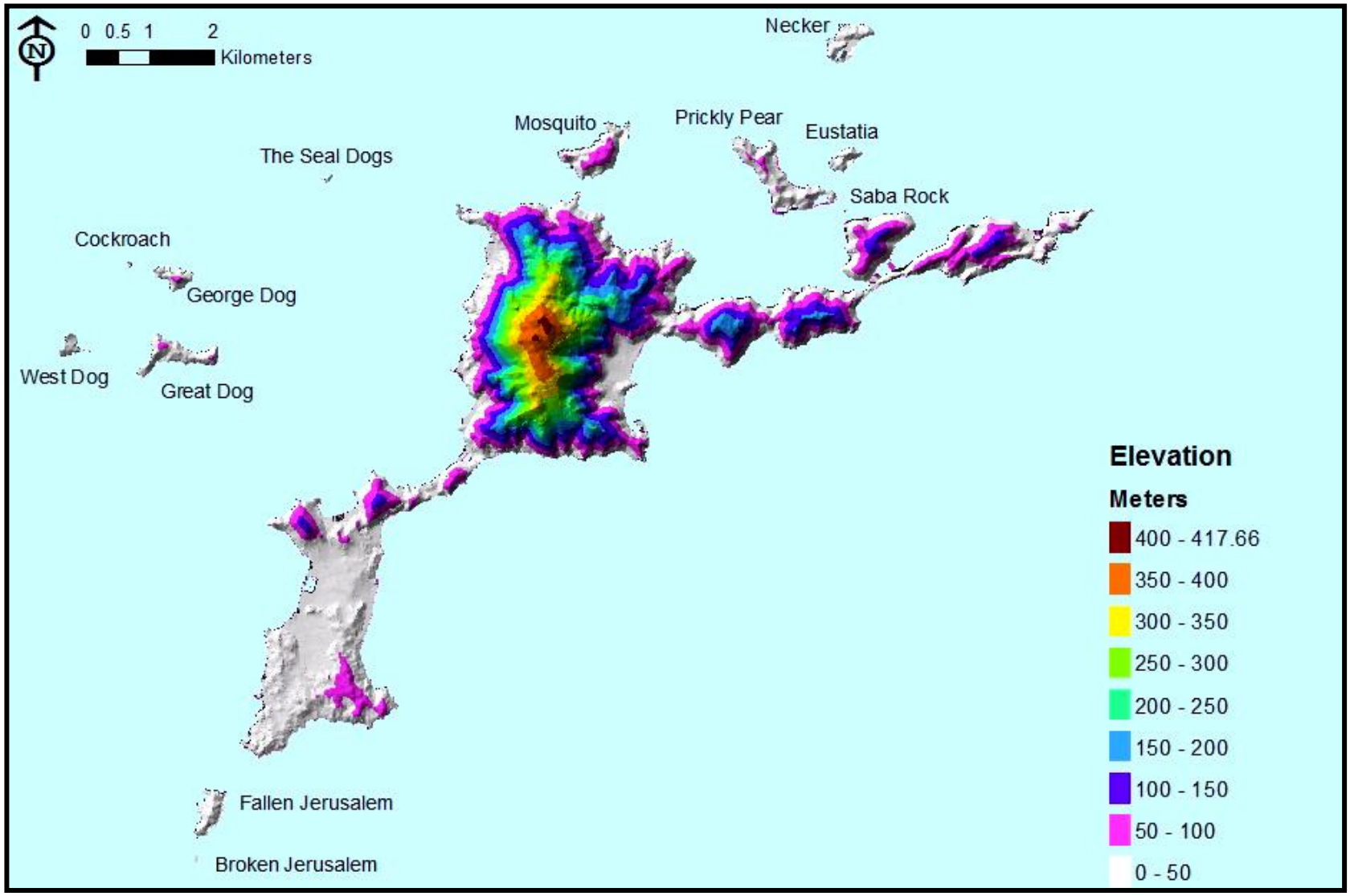


Figure 3.
The topography of Virgin Gorda and nearby smaller islands
(source: adapted from the BVI National Geographical Information System).

Photo 16.
View east along the rugged southern coastline of the eastern peninsula, Virgin Gorda.

Photo 17.
From Biras Hill looking south toward Deep Bay Beach and the extensive fringing red mangroves lining the southern shore of Deep Bay, Virgin Gorda.

Photo 18.
Largest and most impressive beach and dunes system in Virgin Gorda located along Savannah Bay.

1.2.2 Watersheds, Drainage and Groundwater

Literature on the watersheds of the BVI is scarce, with a single document by Abul Alam (*circa* 1990) providing most of the available information. Alam's report summarises the basic characteristics, land uses and land capability of eleven watersheds on Virgin Gorda, most of which are located in the central landmass and the southern peninsula. By selectively focusing on well-delineated watersheds, the study provides incomplete coverage and needs to be expanded.

There are 15 primary watersheds on the island (**Figure 4**). The size of each is provided in **Table 3**. These watersheds were generated from the original watershed dataset of the BVI's GIS database maintained by the Department of Town and Country Planning. This dataset comprises over 67 sub-watersheds and catchment basins for Virgin Gorda including, also, Mosquito, Prickly Pear, Necker, and Eustatia Islands. The units deemed too small in size have been consolidated for the purpose of the Profile to form fifteen primary watersheds and for, practical purposes, limited to Virgin Gorda.

Most well developed and larger watersheds occupy Virgin Gorda's central landmass and drain in a radial fashion from Gorda Peak. Watersheds along the eastern peninsula are poorly developed due to the narrow and lengthy nature of the peninsula. Most of the watersheds of the southern peninsula exhibit non-distinct boundaries due to the peninsula's irregular and undulating topography.

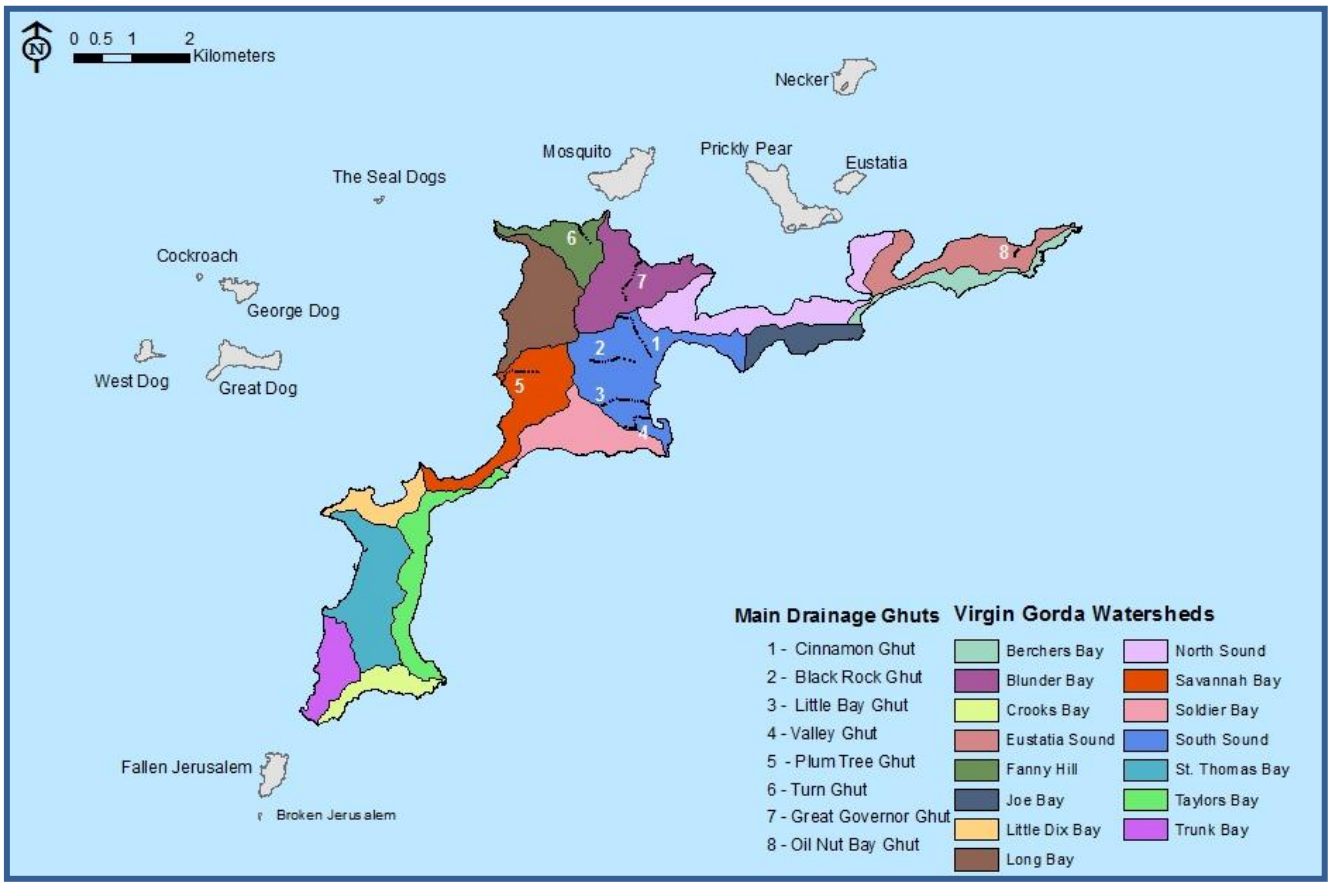


Figure 4.
Primary watersheds and drainage ghuts of Virgin Gorda
(*source*: adapted from the BVI National Geographical Information System).

Table 3.
Size of the primary watersheds of Virgin Gorda.

Watershed Name	Area (hectares)	Area (acres)
Berchers Bay	67	166
Blunder Bay	196	484
Crooks Bay	69	170
Eustatia Sound	152	376
Fanny Hill	91	225
Joe Bay	75	185
Little Dix Bay	65	161
Long Bay	190	470
North Sound	211	521
Savannah Bay	185	457
Soldier Bay	148	366
South Sound	282	697
St. Thomas Bay	220	544
Taylors Bay	136	336
Trunk Bay	90	222

Source: Adapted from the BVI NGIS System.

There are no permanent streams on Virgin Gorda. Streams (locally called ghuts) are generally dry during most of the year. They flow mainly during intense rainfall; due to steep topography and the small size of watershed basins, stream flow responds quickly to precipitation. The majority of Virgin Gorda's ghuts have their source originating from Gorda Peak, and the main ones flow eastward into South Sound.

Great Governor Ghut is the longest and flows northeast into the North Sound's Blunder Bay. **Figure 4** shows the locations of the primary ghuts, and **Table 4** provides additional information such as length, elevation and slope characteristics.

Water supply on Virgin Gorda is scarce due to climate, size of watersheds, topography and geology. Steep topography, combined with the small size of the island's watersheds, contributes to rapid runoff, which further hinders rain infiltration. Additionally, bedrock types covering most of the island show low porosity and therefore are not useful water-bearing rock formations. Surficial alluvial deposits and valley deposits present the only potential sources of groundwater.

Today, the island relies on rainwater as its primary source of water, collected from rooftop catchments and stored in cisterns. Desalinated seawater is a secondary source. Although there are many old wells on the island, few are useable for domestic purposes due to the excessive depth of groundwater, intrusion of seawater, and contamination of aquifers by wastewater and petroleum-based fluids. The depletion of groundwater supply is also attributed to loss of forest cover and to urban development. The latter has increased the amount of impervious surfaces which in turn has contributed to runoff and evaporation.

Table 4.
Primary drainage ghuts of Virgin Gorda.

Ghut Name	Watershed	Length (metres)	Elevation (metres)	Slope (%)
Windy Hill	Taylors Bay	500	77	16
Crab Hill	Taylors Bay	700	53	7
Plum Tree Bay	Savannah Bay	1500	411	28
Turn Ghut	Fanny Hill	900	221	26
Great Governor	Blunder Bay	1700	414	24
Cinnamon Ghut	South Sound	1200	251	21
Black Rock Ghut	South Sound	1500	381	26
Little Bay Ghut	South Sound	1600	320	20
Valley Ghut	South Sound	900	229	27
Oil Nut Bay	Eustatia Sound	900	69	8

Source: Earle (1997).

Very little is known about the status and locations of springs on Virgin Gorda. Martin-Kaye (1954) describes the existence of two known springs: the Devil's Bay Spring, located in Trunk Bay in a remote area beneath overhanging rocks, and Sound Spring in the North Sound. The later is described as a perennial spring located more or less directly inland from Wailing's Well. Approximately two dozen wells are described in Martin-Kaye's report.

1.2.3 Geology

The British Virgin Islands archipelago can be viewed as a series of topographical highs situated on the Puerto Rico Bank, a submerged platform generally defined by the 183 m (600 ft) depth contour (Rogers and Teytaud, 1988). At one point in the Virgin Islands' geological history—during the Pleistocene glaciations period—sea levels were much lower, and a continuous emerged landmass extended eastward from Puerto Rico across the US and British Virgin Islands. Subsequent sea level rise due to post glacial meltdown is primarily responsible for the current sea level.

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). The bedrock geology of Virgin Gorda and surrounding smaller islands is similar to that of Beef Island and the eastern tip of Tortola. Most of Virgin Gorda is formed of igneous rock and their sedimentary products that formed over a period of 80 million years. These rocks are all the product of volcanic activity relating to tectonic activity along the Caribbean Island Arc. The deposition of volcanic rocks and other volcanically derived sediments took place in sub-aerial conditions. Subsequent intense tectonic activity and submersion by sea level rise caused metamorphism and deformation of these rocks as well as the emplacement of intrusive rocks.

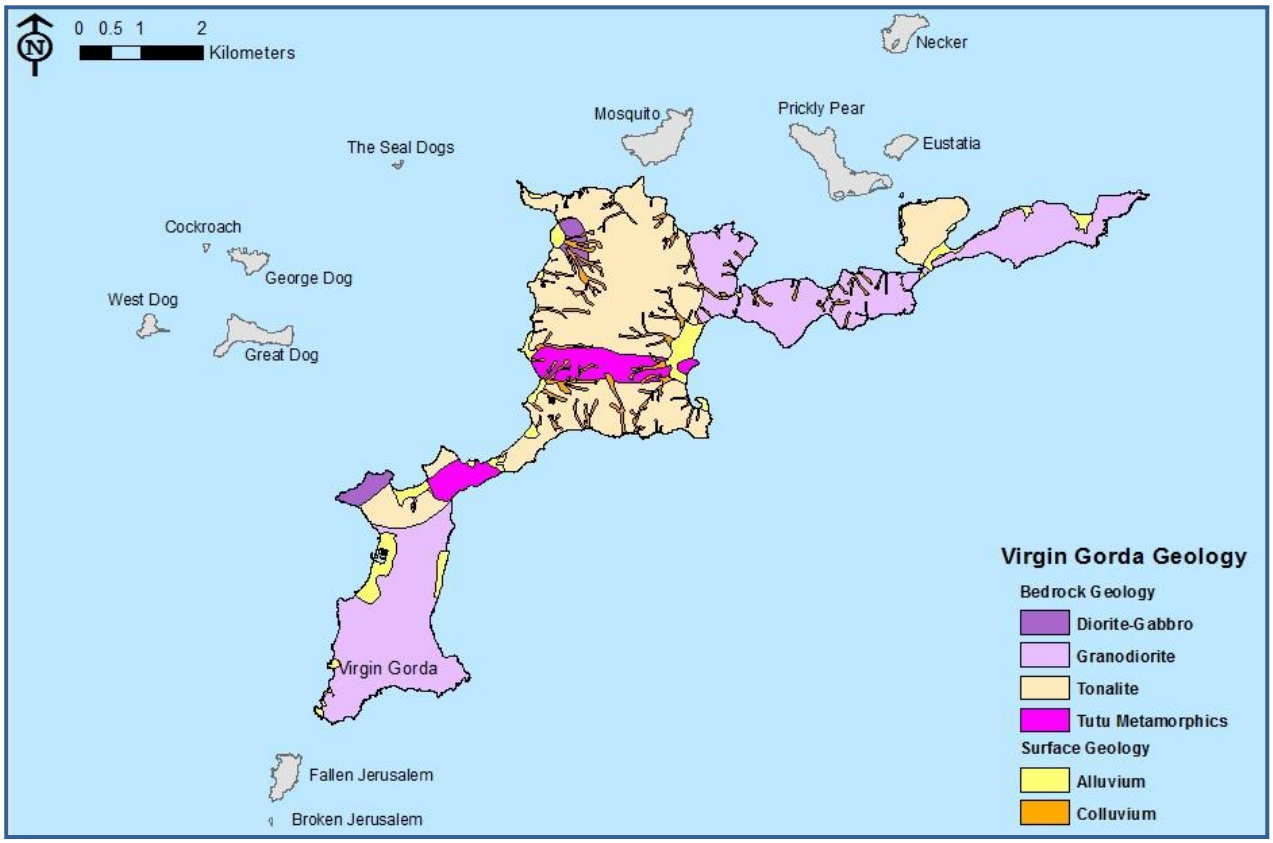


Figure 5.
The geology of Virgin Gorda (source: Joyce, 2006).

There are four main bedrock types on Virgin Gorda. Three are of igneous origin (Diorite-Gabro, Granodiorite, and Tonalite), and one is of metamorphic origin from the Tutu formation (**Figure 5**). A brief description adapted from Joyce 2006 follows.

(1) Diorite-Gabro. Diorite-Gabro is found primarily in two areas of Virgin Gorda. One site is located northwest of the central landmass adjacent to Long Bay, and the other occupies a good portion of Cow Hill. This type of igneous rock is coarse grained and composed of 50 percent or more dark-coloured minerals giving it its dark-coloured appearance. These rocks tend to weather more deeply and completely than any other rock type in the Virgin Islands. Steep slopes formed on these weathered rocks tend to be prone to slope failure.

(2) Granodiorite. Granodiorite rocks cover most of the eastern and southern peninsula. The rock is light coloured due to its composition of lighter coloured plagioclast feldspar with 20 to 50 percent quartz and less than 20 percent dark-coloured mineral. The primary feature of this rock is its spheroidal weathering pattern, which in certain areas produces the amazing boulder field landscape that is encountered at Virgin Gorda's southern peninsula, the nearby smaller island of Fallen Jerusalem, and the western end of Beef Island on Tortola. A more detailed description of the boulder field landscape is in Section 1.2.3.1 of this Chapter.

(3) Tonalite. Tonalite rocks cover most of the central landmass. This coarse-grained, igneous rock is mainly composed of light-coloured plagioclase mineral with less than 40 percent amphibole, a dark-coloured magnesium and iron-rich mineral. It also contains minor amounts

of quartz, up to 15 percent. As a result, the rock is grayish in colour. The rock is hard and exhibits little chemical weathering and soil formation. Slopes where these rocks occur tend to be very steep and high, reflecting their resistance to erosion.

(4) Tutu Formation. The Tutu Formation is mostly composed of metamorphic rocks which originally had been sedimentary layered, and deformed and transformed by metamorphism. On Virgin Gorda, this formation is limited to small exposures in the southern half of the central landmass. These meta-sediments rocks also form most of Minton Hill where the rock types include amphibolites, quartzites and granulites.

1.2.3.1 Surficial Geology

Surficial geology is defined in the Profile as recent depositional landforms, including: colluvium, alluvium, beaches and sand dunes. These are essentially unconsolidated landforms that have resulted through the action of gravity, rain, waves, and wind. As such, they are constantly dynamic and subject to morphological change.

(1) Colluvial. Colluvial deposits are gravity induced. They exhibit a wide range of particle size from clay to sand and gravel, and even boulders. Their compositions largely reflect the nature of original mass that failed.

Joyce (2006) identifies two types of colluvial deposits on Virgin Gorda: the channelised and non-channelised. Most widespread are the channelised deposits, generally found within ghuts and their tributaries. These deposits typically cover steep valley walls and terminate at drainage channels.

Non channelised colluvial deposits are similar in form and composition but do not lie within or at the base of ghut channels. These deposits tend to be formed along and at the base of steep slopes and hillsides as a result of bedrock erosion, soil creep, landslides, and debris flow (see landslide **Photo 25**, in Chapter 3).

(2) Alluvial. Alluvial deposits usually occupy low-lying coastal areas between the shoreline and the base of large ghuts and hillsides. Alluvial deposits largely represent reworked colluvial deposits from hillside slopes and ghut channels. Sediments tend to be more sorted through the process of rainwater washing from slopes and drainage ghuts. Material size varies but usually trend to finer grain sediment as they are transported further.

Large alluvial deposits are found along the South Sound, Spanish Town, and the Biras Creek–Deep Bay area.

(3) Beach. Beach deposits are numerous in the Profile area and reflect some variability in form and texture within a relatively small area. A recent study on beach morphology targeted 12 sites on Virgin Gorda and 7 on nearby islands (Gore, *et al*., 2012). **Table 5** provides a summary of these beach characteristics. Note that the list does not include all beaches within the Profile area. Selection of beaches was primarily based on ease of access.

Most beaches are characterised as sandy in texture and mainland embayed. During the winter season, a few of these sandy beaches may completely lose their sand veneer and thereby expose their underlying coral rubble.

Savannah Beach (**Photo 18**) is the largest and most impressive beach formation within the Profile area. It lies between the central landmass and Minton Hill (south peninsula), forming part of an isthmus between the two (**Figure 6**).

Coral rubble beaches are uncommon and are usually found along exposed coastline where wave energy is strong. The coral rubble spit in the South Sound is an illustrious example (**Photo 19**) as is the beach fronting the Manchioneel Bay Pond on Mosquito Island (see **Photo 56**, in Chapter 4).

(4) Sand Dune. Sand dunes of significant size are limited to the Savannah Bay area (**Figure 4**). Such features do not exist elsewhere in the BVI except on Anegada.

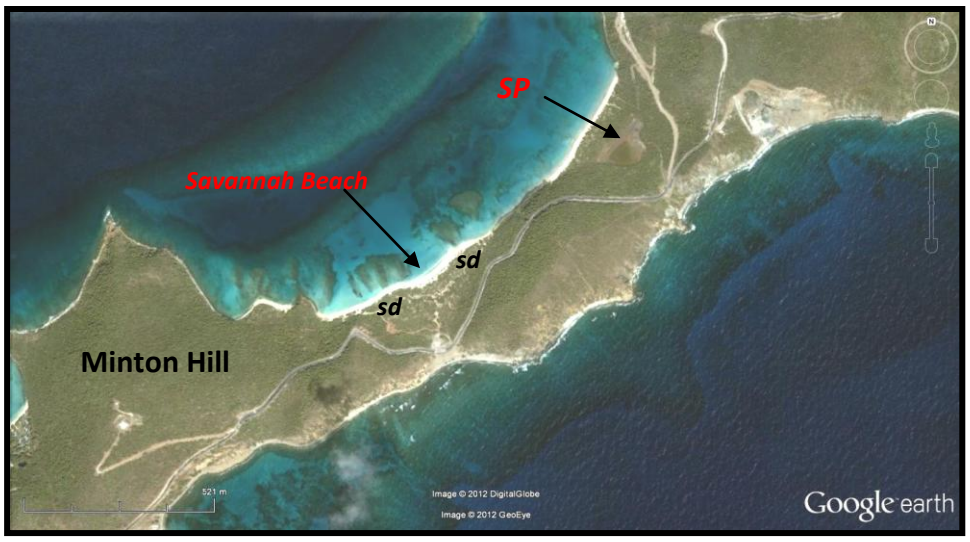


Figure 6.
Savannah Beach located along the narrow isthmus that links the south peninsula to the central land mass of Virgin Gorda. A large sand dune system (**sd**) lies behind the beach. Pond Bay Salt Pond (**SP**) is located northeast of Savannah Beach (*source*: Google Earth, 2012).

Photo 19.
South Sound spit composed of coral rubble. Note the heavy surf.

Photo 20.
A bohio shelter that has collapsed due to shifting sand dunes from the land side and seasonal storm waves from the water side. Beach vegetation is slowly covering the site and provides some stability.

The dunes that have formed in Savannah Bay can be classified as transverse dunes in that the long axes of the ridge is roughly perpendicular to the easterly and south-easterly wind direction.

These dunes are an accumulation of loose, wind-sorted, very-fine-to-medium sand in ridges that have a gentle windward slope and a steeper leeward slope. Average maximum heights have been estimated at 15 m (49 ft).

For the most part the dune system is well covered with low shrubs and small grasses providing its stability. However, the system is constantly dynamic and will tend to migrate following predominant winds. Along the shoreline, where dune and beach systems meet, a dynamic equilibrium is formed. Any man-made structures along this zone—such as the bohio shelters—are prone to attack by storm waves or overcome by migrating dunes (**Photo 20**).

Table 5.
Beach morphology of Virgin Gorda and nearby islands.

Beach Name	Island	Morphology Class	Morphology Subclass	Beach Texture
Jerusalem Beach	Fallen Jerusalem	Mainland	Embayed	Sandy
Honeymoon Bay	Mosquito	Mainland	Embayed	Sandy
Lime Tree Bay	Mosquito	Mainland	Embayed	Sandy
Long Bay	Mosquito	Barrier	Linear	Sandy
Manchioneel	Mosquito	Mainland	Embayed	Sandy
Manchioneel Pond	Mosquito	Barrier	Linear	Coral rubble
Vixen Point	Prickly Pear	Barrier	Linear	Sandy
Devils Bay	Virgin Gorda	Mainland	Embayed	Sandy
Fishers Cove	Virgin Gorda	Mainland	Embayed	Sandy
Handsome Bay	Virgin Gorda	Mainland	Embayed	Sandy
Long Bay	Virgin Gorda	Mainland	Embayed	Sandy
Murdering Hole	Virgin Gorda	Mainland	Embayed	Sandy
Oil Nut Bay	Virgin Gorda	Barrier	Embayed	Sandy
Oil Nut Bay East	Virgin Gorda	Mainland	Linear	Coral rubble
Savannah Bay	Virgin Gorda	Mainland	Embayed	Sandy
South Sound	Virgin Gorda	Mainland	Embayed	Sandy
South Sound Spit	Virgin Gorda	Spit	-	Coral rubble
Spring Bay	Virgin Gorda	Mainland	Embayed	Sandy
The Baths	Virgin Gorda	Mainland	Embayed	Sandy

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

1.2.3.2 The Baths

The geological landscape of The Baths has long fascinated visitors to the island. The area with its amazing piles of giant boulders, sculptured rocks and array of caves is a testament to geological and geomorphological processes that occurred millions of years ago and are still ongoing. How did the rocks take on such extraordinary shapes? What forces sculpted them?

Geologists believe the face of this modern landscape was born some 40-50 million years ago during the Eocene Epoch, toward the end of the volcanic period. At that time, molten rock (known as magma), heated by continuous movement of earth's crust, oozed upward and cooled while still below the surface. Eventually the large magma mass gradually solidified and formed a massive body of coarse-grained granite, consisting mainly of feldspar and quartz. About 15 to 25 million years ago, ongoing crustal uplifting and faulting caused the granite to emerge from the seafloor forming what is now known as the Virgin Islands Batholith. This formation is now found on the east end of Tortola, Beef Island, Fallen Jerusalem, and almost the entire island of Virgin Gorda.

The release of a great deal of pressure by the removal (through erosion) of kilometres of overlying rock, combined with a cooling of liquid magma to solid granite (shrinkage), caused the rock to develop a system of rectangular joints and fractures. In typical granite, the fractures tend to grow at right angles to one another creating rectangular blocks known as polyhedral boulders (Putley, 2005).

Over time, the process of chemical and physical weathering has removed the sharp edges of polyhedral boulders, making them in the rounded shape we see today at the so-called "boulder fields" (**Photo 21**).

Weathering and erosion are ongoing. One of the most important sources of erosion is rainwater. Rain reacts with carbon dioxide, and a very weak form of carbonic acid results. As a consequence, all granite minerals except quartz react with the carbonic acid, and erosion, pitting, and a fluting of boulders occurs (**Photo 22**).

Caves and tunnels carved out of the rocks are additional features of The Baths. It is believed that these were formed by prevalent easterly and southeasterly winds combined with high moisture on exposed rock surfaces. Exfoliation is another common erosion feature. It is attributed to a weathering process that weakens surface tension and causes the rock to peel away in concave sheets.

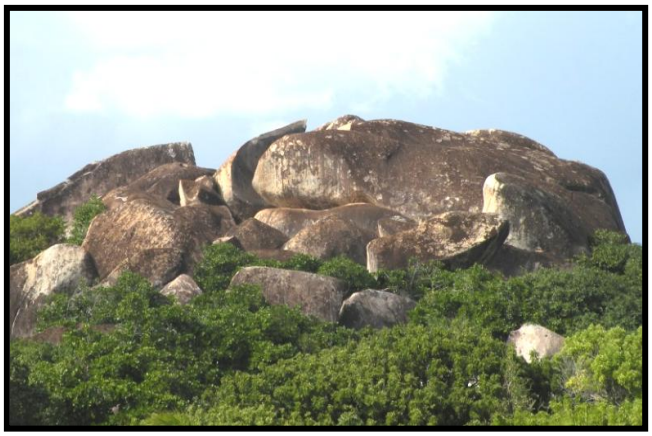


Photo 21.
A pile of huge boulders settled one on top of the other. Most boulders show rounded edges except for the ones recently split along a joint line due to the constant gravity-induced shifting of the boulder pile.

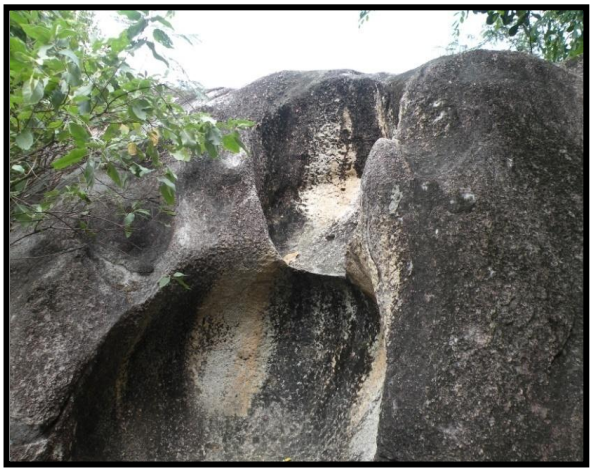


Photo 22.
The ongoing chemical and mechanical weathering process is creating a common feature known as "pitted boulders" at the boulder fields of The Baths.

1.2.4 Soils

Virgin Gorda soils tend to reflect a mix of inorganic minerals eroded from local bedrock and organic material. The common minerals originate from granite-related rocks and include calcite, quartz, feldspar, hornblend, and mica. In many well-developed soils, the addition of humus in the form of decayed leaves, tree bark and plant fragments, as well as animal remains, helps to retain moisture and provides important nutrients to surrounding vegetation. Thus, soils continue to develop in a moist shaded environment.

There is no comprehensive soil survey for Virgin Gorda. Information is therefore very limited and generally derived from dated reports such as from Alam (*circa* 1990). The descriptions below are general observations from site reconnaissance by Profile researchers and their familiarity with other islands.

Soils for most of the island are strongly affected by underlying geology, topography, weather and land use. Soil formation tends to be thinner and less developed as elevation increases and slopes steepen. Thicker and more developed soils can generally be found on gentle slopes, within low-lying areas, or where terrain is of flat-to-moderate topography.

According to Alam (*circa* 1990), soils of the British Virgin Islands contain a large quantity of sand particles, little silt and variable amounts of kandoid clays.

Except for a few areas (for example, **Photo 23**), the soil profile is very shallow at 15-30 cm (6-12 in), generally stony, friable, well-drained and ranges in reaction from slightly acid (pH 6.5) to strongly alkaline (pH 8.8).

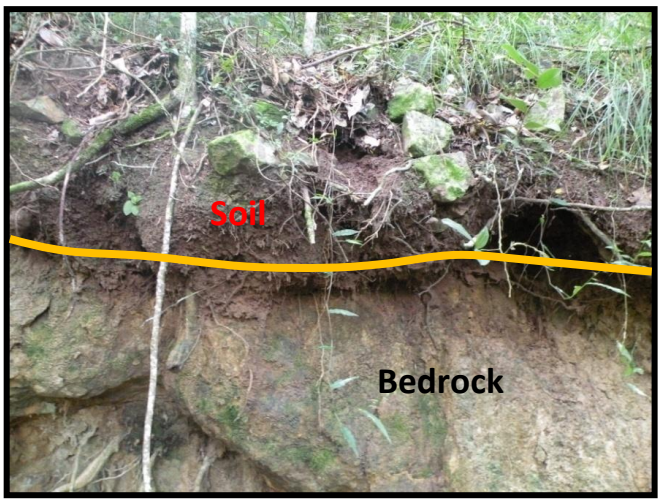


Photo 23.
Thick and rich soils found along the Old Rockefeller Road, located on the gentle northwest slopes of Gorda Peak National Park. Average soil thickness was estimated at 50 cm (20 in).

On Virgin Gorda the major soil type is sandy clay loam. When wet, it possesses great cohesive properties (such as stickiness and plasticity). The soil tends to become very hard when dry.

Land use associated with forest clearing plus years of overgrazing by cattle and feral goats has altered soil characteristics and the landscape. Such activity has contributed to soil compaction and to thinner and harder, claylike soils able to support only xerophitic (very dry) vegetation.

Most of the soils are base saturated, and many contain quantities of free calcium carbonate. As a whole, the soils are phosphate deficient with a moderate to low potassium status.

1.2.5 Climate

Like the other islands in the Virgin Islands chain, Virgin Gorda 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.

The easterly trade winds are a dominant weather feature. The average wind direction varies throughout the year according to the following pattern:

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

Normally, except for the occasional hurricane, the highest wind speeds are experienced from December to February and also in June and July. Average wind speeds for the months of June-July are around 12-20 kilometres (7-12 miles) per hour), while, in October, average wind speeds can drop to 7 kilometres (4 miles) per hour. Wind velocity varies locally based on topographic conditions. Leeward slopes are generally protected against the full force of the trade winds.

Virgin Gorda and its neighbouring islands also lie within the Hurricane Belt. Most of these intense storms develop 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 6**).

Table 6.
Recent storms and hurricanes in 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 17 September	Hurricane Hugo
1995 19 August	Hurricane Iris
1995 4 September	Hurricane Luis
1995 15 September	Hurricane Marilyn
1996 6 July	Hurricane Bertha

Date	Storm
1996 6 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 15 October	Hurricane Omar
2009 2 September	Tropical Storm Erika
2010 29 August	Hurricane Earl
2010 8 October	Hurricane Otto

There has been no systematic weather collection data for Virgin Gorda; the only reliable source of information is from Tortola. Temperature records from the Paraquita Bay Agricultural Station (Tortola) from 1971to 1977 are summarised in **Table 7**. Although these datasets are more than three decades old, they represent the most current published data available to the Profile team and are consistent with more recent localised temperature reporting.

Under the Territory's Climate Change initiative, the collection and archiving of weather and climate data for the BVI is to be upgraded within the Department of Disaster Management (*pers. comm*., Angela Burnett Penn, Environment Officer for Climate Change, Department of Conservation and Fisheries, interview with Judith Towle and Jean-Pierre Bacle, 7 February 2012).

Records show that temperature varies 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.

Typical daily maxima are around 32 C (89.6 F) in the summer and 29 C (84.2 F) in winter. Typical daily minima are around 24 C (75.2 F) in the summer and 21 C (69.8 F) in 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 data collected by the BVI Water and Sewerage Department in Tortola indicates that the annual rainfall in 95 years of measurement 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).

There is no sharp distinction between the wet and dry seasons (**Table 8**). Typically the wettest period is from September to November, which coincides

with the hurricane season. The driest period is from January to August with May showing an isolated rainy peak. Major rainfall events are usually associated with major weather systems especially during the passage of easterly tropical waves.

The most common cause of local rainfall is associated with orographic lifting of moist air over hilly terrain. The amount of precipitation increases as elevation increases. Rainfall amounts vary monthly and annually, with the general trend of dry-to-wet from east-to-west, and south-to-north. However, the amount of precipitation on Virgin Gorda is likely to be less in comparison with Tortola due to Virgin Gorda's comparatively smaller land mass and lower mountains.

Table 7.
Temperature data from Paraquita Bay, Tortola (1971-1977).

MONTHS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVE
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 (1C)	25	25	25	26	27	27	28	28	28	27	27	25	26

Source: Earle (1997).

Table 8.
Average monthly precipitation.

MONTH	PRECIPITATION (centimetres)	PRECIPITATION (inches)
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).

1.3 The Community Setting

1.3.1 Population Characteristics

The census of the British Virgin Islands is an exercise carried out by the Development Planning Unit (DPU) every ten years. The last completed census was in 2001, while the data for the 2010 census are still being compiled and analysed. The 2010 population for the Territory is currently projected by the DPU at approximately 27,800, which is down from original projections that had placed the 2010 figure at 30,000 (Raymond Phillips, DPU Director, quoted in *www.bviplatinum.com* on 13 March 2012).

This downward projection, according to the DPU, is due mainly to a reduction in overseas hiring since the 2008 global recession and a subsequent decrease in immigration. Undoubtedly, this will surprise many Virgin Islanders as there is a generally widespread assumption in the Territory that the BVI's system of human services has been overburdened by the rapid growth of the population, primarily from immigration.

In the 2001 census, the territorial population was reported at a little over 23,000 persons, with over 80 percent of the population residing on Tortola. Fourteen percent resided on Virgin Gorda, and the remaining three percent included figures for Anegada, Jost Van Dyke, other inhabited islands and boaters. **Table 9** summarises this information.

Table 9.
BVI population figures
from last completed census in 2001.

Island	Population	% of Total
Tortola	19,282	83%
Virgin Gorda	3,203	14%
Anegada	250	3%
Jost Van Dyke	244	
Other Islands	86	
Boaters	96	
TOTALS	**23,161**	**100%**

Source: BVI Government, Development Planning Unit.

DPU projections for Virgin Gorda show the island's population growing from 3,200 at the 2001 census to 4,085 in 2010 and to 4,250 for 2012. However, given that the DPU has already lowered expectations for the entire Territory, it is possible that these projections for Virgin Gorda might also be less than originally anticipated. Nonetheless, all projections moving forward from the 2001 census continue to show Virgin Gorda's population as a significantly smaller portion of the Territory's total population (less than 15 percent), with Tortola continuing to be home for over four-fifths of the Territory's population.

The most recently confirmed demographic figures from 2001 indicate that there is an equal gender balance for Virgin Gorda's population, with approximately the same number of men and women residing on the island.

The age demographics from the same census indicate that Virgin Gorda's population is very young, with well over half (*i.e.*, 60 percent) of the population being under the age of 35. An even more dramatic 86 percent of the total Virgin Gorda population is under the age of 50, with less than 15 percent over 50 years of age (**Table 10**). Such a demographic tilt has implications for a variety of social and economic issues in Virgin Gorda, such as employment opportunities, societal expectations, education, health care, infrastructure, and so forth.

Table 10.
Age distribution of Virgin Gorda's
population, 2001 census.

Age Group	% of Population
0 - 19	30%
20 - 34	29%
35 - 49	27%
50- 85+	14%

Source: BVI Government, DPU.

Of the ethnic origins of the resident population of Virgin Gorda, the vast majority of residents are of African descent (87 percent), followed by those of Caucasian descent, comprising only six percent of the residents. The remaining population, according to the last census, was a mix of East Indian descent (three percent), mixed racial groups (three percent), and a handful of other ethnic groups comprising the remaining one percent.

Again, based on the best census data available from the DPU (2001), it is possible to identify the population centres of Virgin Gorda, which are predominately located within the southern peninsula of the island, the area that extends southward from Pond Bay at the northern end of the southern peninsula to Penn Hill at the southern tip of the island (**Figure 2**). The population is mostly centred in the greater Spanish Town area, the Government's administrative centre for Virgin Gorda. This area is generally referred to as The Valley, and the following named areas were reported in the 2001 census as being the most populous:

- Princess Quarters (631 persons)
- Crab Hill (543 persons)
- Handsome Bay (360)
- South Valley (327)

Together, the four areas comprise almost 60 percent of the island's population.

The only competing population centre on Virgin Gorda is that of North Sound which had a recorded population of 481 in the 2001 census (15 percent of the island's total population).

It was on Virgin Gorda that a political issue arose in the late 1960s concerning the island's changing demographics during that period. The construction of the Territory's first luxury tourism property at Little Dix Bay in 1964 opened a period of expanding economic development coupled with a construction boom for the island. The building of the resort by Laurance Rockefeller required the concurrent development of the island's entire infrastructure since such basic services as piped water, electricity and paved roads had not yet reached all areas of the island.

Virgin Gorda's, as well as the BVI's, labour force, was too small to absorb the new demands of the construction sector, as well as the need for service sector and management personnel. This resulted in an unprecedented increase in immigration, including immigrants from other Eastern Caribbean islands, many of whom began to settle permanently in the BVI.

According to Maurer (1997), the term "belonger" began to appear for the first time in ordinances enacted in the late 1960s to restrict the actions of "persons not deemed to belong to the territory of the Virgin Islands" but who wished to enter and reside in the Territory. From that time forward, the issue of "belonger" status and citizenship has been at the core of discussions about the BVI's future—an issue that came to the forefront of public discussion with the economic expansion of Virgin Gorda and tourism in the 1960s.

1.3.2 Historical Development and Economic Trends

1.3.2.1 The Historical Development of Virgin Gorda

The name Virgin Gorda was first used by Christopher Columbus to describe the island which today is the second most populace of the British Virgin Islands group of islands, islets and cays. Whilst passing through the archipelago during his second voyage to the West Indies in late 1493, Columbus christened the entire group in memory of St. Ursula and her martyred followers and, in particular, identified one of the islands as the "Fat Virgin" because of its robust appearance, which in Spanish translates to *Virgin Gorda* (literally meaning "virgin fat woman").

The human history of Virgin Gorda begins with the arrival of migratory pre-Colombian Indians who most likely originated from either the Orinoco Basin in Venezuela or neighbouring Guyana. Artefacts from the Indian occupation in the form of Ostionoid pottery have been unearthed close to the north landing in Spanish Town (Packer, nd), at Little Dix Bay and Gun Creek (Figueredo, 1974), and on Mosquito Island (Kent, 2007), thus providing physical evidence of pre-Columbian habitation in the immediate area.

Documentary research, undertaken by local historian Jill Tattersall, records a massacre instigated by the Spanish against the Indians in the early sixteenth century:

> *By that time, the first Virgin Gordans (Indians) had been plaguing Ponce de Leon's people with their dreaded raids on Puerto Rico. Retaliation had been forbidden by the Spanish Crown, but after the Virgin Islanders had dared to burn and loot Governor Ponce's first Capital, the long awaited license to hunt Caribs was issued which legalized punitive expeditions against the native people. This was all Ponce needed to authorize Captain Juan Gil to lead a force of 60 Puerto Ricans in two barquentines to a victorious if one sided engagement against the Indians main stronghold in Virgin Gorda in 1514* (Tattersall 2004).

Figueredo (1974) asserts that rather than being an invasive culture such as the Caribs or Kalinagos, evidence at Gun Creek on Virgin Gorda suggests that the area was a Taino Chicoid complex supporting a group which had evolved through both the Saladoid and Ostionoid cultures. Evidence of this occupation at Little Dix Bay and Gun Creek has for the most part been destroyed by development. However, other evidence discovered at Little Fort Point, which is a National Park, may still be intact at the site which—apart from an eighteenth century British fortification—remains unchanged.

The subsequent and deliberate genocidal elimination of the pre-Colombian occupants allowed pioneers from Puerto Rico to investigate the potential for copper ore on the island, which eventually led to the establishment of a small Spanish settlement of people who mined the metal.

According to Tattersall (2004), the island became an official landfall for the two annual fleets sailing to the West Indies from Spain and was the first port of call for the Northern Fleet. This subsequently attracted English sailors to the frontier outpost, who traded regularly with the miners and named the island "Spanish Town." Some of the earliest maps illustrating the island attest to this, including one by Captain John Walton, hand-draughted in 1717 (**Figure 7**).

Occasionally, and only temporarily, Spanish Town was corrupted to "Penniston." A map from 1797 (**Figure 8**) records the island as both Virgin Gorda and Spanish Town, whilst the documentary evidence indicates that even as late as the early nineteenth century, the name Spanish Town persisted as a reference for the entire island. Subsequent maps produced after 1820 only identify the island as Virgin Gorda, a name which has endured to the present.

To date, there is only limited information describing the early Spanish occupation of Virgin Gorda. However, what has been uncovered suggests that the Spanish were present on the island during the 1530s for a short period of time.

Figure 7.
"Spanish Town Island" map by Captain John Walton, 1717.

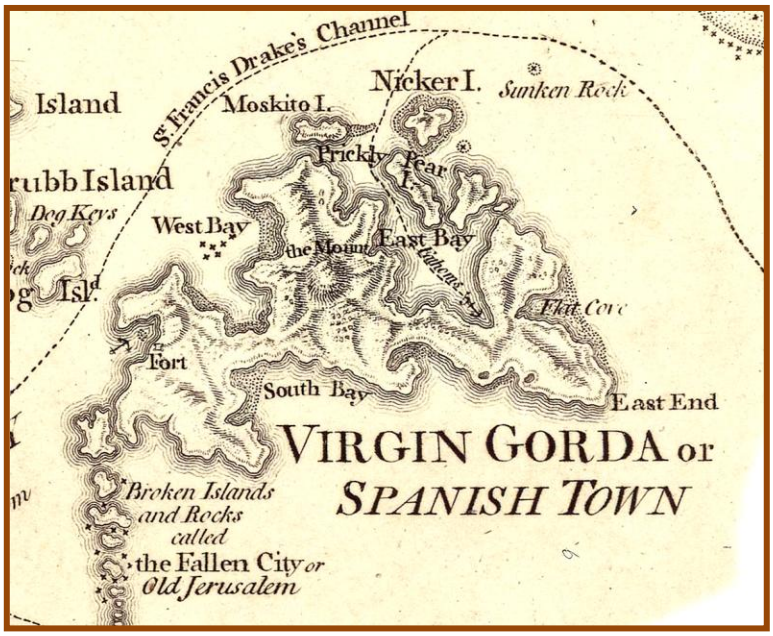


Figure 8.
Virgin Gorda or Spanish Town map by J. Jeffreys, 1797.

It is likely that the Archivo General de Indias in Seville, Spain and the Puerto Rico Archives in San Juan contain more information describing the Spanish mining settlement which, when combined, with archaeological evidence, may point to Virgin Gorda as the earliest organised settlement of Europeans in the entire Lesser Antilles.

Once the Spanish had left the island, it appears to have remained uninhabited for approximately 150 years until a group of English settlers from Anguilla expressed an interest in occupying the area on behalf of the English Crown. The English had obtained sovereignty of the entire group at the beginning of the Third Dutch War (1672-1674). Neighbouring Tortola had been settled as early as 1640, but there is no reference to Virgin Gorda being occupied until February of 1690 when it was reported that:

> *A well known merchant from this Government was at Spanish Town, where there were then but fourteen men, a few women and three Negroes. They made cotton and carried that cotton in small canoes to St. Thomas* (CSP America and West Indies 1696-98, No. 1,347, p. 621).

Initially, these settlers had wanted to leave Anguilla for Crab Island (today called Vieques). However at just six-and-a-half miles from the southeast coast of Spanish Puerto Rico, the issue of defence was raised and instead the planters decided to re-colonise Spanish Town. It was from here that the exponential settlement of the BVI began. By 1696, Spanish Town was recorded as having "*fifty good men, well armed, and their families, and seventy to eighty choice Negroes*" (CSP America and West Indies 1696-97, No. 1,347, p. 620). Nevertheless, settlement was slow and the inhabitants lived in abject

poverty. A report from 1701 for both Anguilla and Spanish Town states that:

> *There is two islands more belonging to ye same government that are inhabited viz. Anguilla and Spanish Town, but there is so few inhabitants, and most of them so poor, that whosoever hath, or will have them, will be very little ye better for them* (CSP America and West Indies 1701 No. 640, Col. Fox to the Council for Trade and Plantations).

Land in the English Leeward Islands was becoming both scarce and valuable by this time, leaving few opportunities for indentured servants who had recently been released from their oppressive contracts. Islands like Virgin Gorda offered an opportunity to purchase property cheaply, guaranteeing settlement however precarious.

As they struggled to survive, the quality and loyalties of the colonists inhabiting Virgin Gorda were at best dubious. Writing in November of 1701, Christopher Codrington, Governor of the Leeward Islands, described his difficulty in maintaining law and order in the northern English Leeward Islands. In a letter to the Lords of Trade and Plantations describing an effort to muster an expeditionary force against the French, he wrote that he intended to:

> *Draw off a great many (men) from Anguilla and Spanish Town, where the people are perfect outlaws, and work together for the Danes and Dutch, which tis impossible for me to prevent* (CSP America and West Indies 1701 No. 897).

Over the course of the eighteenth century, a plantation economy evolved on Virgin Gorda primarily centred around cotton, which was considered to be some of the best produced in the Americas (Walton to Council for Trade and Plantations CSP America and West Indies 1710-11 No. 705). There was some sugar grown in the areas of Plum Tree Bay, Nail Bay, and Long Bay. Indigo was also produced, and the planters found a ready market for their crops in neighbouring St. Christopher (St. Kitts) (CSP America and West Indies 1717-18, No. 639, part 1, July 8, 1717, pages 339-340).

In common with all of the British Virgin Islands, productivity was limited, and the viable profitability of practicing plantation agriculture had diminished significantly by the beginning of the nineteenth century. In 1815, sugar production had ceased, and only 145 acres of land were being cultivated with cotton. The population had declined to just 102 whites, 130 free coloureds, and 507 slaves.

Eight years later in 1823, the white population had slipped to 98, whilst the free black population had risen to 221 with the slave population falling to 435 (Colonial Office, 1823), suggesting that a number of slaves had either purchased their freedom or been manumitted by their former owners.

The emancipation of the slave population in 1834 and full freedom in 1838 heralded a new era of subsistence farming for Virgin Gordians, supplemented by fishing and charcoal burning.

Subsequent to the collapse of the apprenticeship system, there was renewed interest in the potential of mining. The first exploratory shaft was sunk in 1838, with a mining operation functional from 1839-1841. Records dating to the 1840s illustrating shaft plans and technical data once existed, but these were destroyed in 1940-1941 during the London Blitz of World War II (Packer, nd).

Eighteen years after the closure of the first mine operation, in 1859 a second group of Cornish miners determined to take advantage of the rich veins of copper ore on Virgin Gorda. Ore was once more extracted and transported by road to Spanish Town from which location it was shipped to Wales for processing. Some 150 people, mainly local islanders, were employed at the site, providing a temporary economic boon for the local economy. The mine finally ceased operations in 1862, closing an industry which still today is considered to have future potential (see also Chapter 6, Section 6.2.1 on the Copper Mine as an Industrial Heritage Site and designated BVI National Park).

For almost a century, Virgin Gordians survived by practicing farming and animal husbandry, until 1961 when the Government of the Virgin Islands leased 365 acres of Crown Land to Mr. Laurance S. Rockefeller, an American entrepreneur and philanthropist. Three years later in 1964, Rockefeller

opened a luxury fifty-room resort hotel at Little Dix Bay, ushering in the age of modern tourism for the British Virgin Islands.

1.3.2.2 Modern Development of Virgin Gorda

In his captivating memoir, *Life Notes* (O'Neal, 2004), Virgin Islands' businessman and conservationist, Joseph "J.R." O'Neal wrote of his early years (*circa* 1916) as a boy in Virgin Gorda:

> *On Virgin Gorda, life seemed very close to nature. Nearly everyone appeared to be related by marriage or by birth. Properties were unfenced, separated mainly by Ping Ling fencing. (Ping Ling was a member of the Pine family, with a tendency of increasing "fenced" areas with new shoots while lessening the area on the other side.) One usually got from one place to another by the shortest route, often over a neighbour's land. The roads were all dirt roads. There were no motor vehicles and, like Tortola, no electric lights ….*

The Virgin Gorda O'Neal witnessed during the early twentieth century would persist until the development of Little Dix Bay in the 1960s. Essentially, the construction of the Little Dix Bay Resort catapulted not only Virgin Gorda but also the rest of the Territory into the modern era, and on the island of Virgin Gorda, Virgin Gordians would find new employment opportunities in construction and tourism.

A primary nexus of the new tourism economy in Virgin Gorda would be the North Sound. The Sound is that part of Virgin Gorda where the road abruptly ends at Gun Creek and the island meets an inland sea surrounded by smaller islands and delicate coral reefs. It is an area that has emerged as a focal point of modern economic development on Virgin Gorda.

The North Sound is considered the principal resort and yachting location in the BVI, including, most recently, the area promoting mega or super yachts as part of a yachting tradition that has developed over the past 40-50 years. The North Sound's many attractions focus on its protected waters and proximity to abundant watersports and a variety of marinas and luxury resorts. In combination, these amenities have provided pleasure and convenience for the countless sailors, yachters, divers, snorkelers, photographers, explorers, adventurers and other tourists who flock to the North Sound each year.

The story of the Bitter End Yacht Club provides one illustration of the North Sound's close association with Virgin Gorda's marine tourism and the rapid expansion of that tourism niche in the last half of the twentieth century. When sailing the waters of the Caribbean in the 1960s, Myron and Bernice Hokin of Chicago discovered the North Sound and were enchanted. At the time, Bitter End was a waterside pub and a handful of rustic cottages with minimal accommodations owned by an eccentric Englishman, Basil Symonette. The Hokins offered to buy or lease an acre to build their own cottage, but, instead, Symonette offered to sell them the entire enterprise.

That was 1973, and, through three generations, the Hokin family has been the proprietor of the resort and marina they established on the site of the former Symonette outpost. Along with Bitter End, a variety of world class resorts, watersports centres, and marinas have emerged and are now a part of the synergy that is the North Sound—including Biras Creek, Saba Rock, Leverick Bay, Necker Island, Oil Nut Bay, Mosquito Island, and the Yacht Club Costa Smerelda. The area continues to anchor the economic development of Virgin Gorda.

The pace of life and the pace of development would remain slower on Virgin Gorda than that on Tortola, the more populated commercial and political centre of the British Virgin Islands. Virgin Gorda—despite development—retains its special charm and much of its traditional island character, albeit while marching to the drumbeat of tourism, now the main GDP contributor to the economy of Virgin Gorda.

2. THE INSTITUTIONAL ENVIRONMENT

2.1 The Public Sector

2.1.1 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 Federation from 1872 to 1956, at which time British colonial rule in the Caribbean began to break up and the Leeward Islands Colony was dissolved.

In the 1960s and into the early 1970s, the possibility of a political merger was explored by the governments of both Virgin Islands (British and American), a not unreasonable concept given that the two territories share social, cultural, economic, and geographic ties. Eventually, the idea of a political union was dropped and is no longer pursued by either territory.

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 U.S. dollar was also established as the official national 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, and the public service. The BVI also enjoys a high level of self-government, based on a Westminster Parliamentary model of government. A new Constitution Order (2007) further defined the political relationship between the United Kingdom and the BVI.

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 is collectively responsible to the House of Assembly. The Premier (replacing the office of Chief Minister in 2007) is appointed by the Governor from the elected members of the House, as are the other four ministers of government. There are at present six ministries, or portfolios, for the following: Premier, Finance, Natural Resources and Labour, Health and Social Development, Education and Culture, and Communications and Works.

Recent governments have considered creation of a new ministry for tourism, which currently is under the Premier's portfolio. The Minister of Natural Resources and Labour has suggested that establishment of a new ministry combining tourism and the environment could become increasingly important if the Territory is to safeguard the economic gains from tourism (the Honourable Dr. Kedrick Pickering at the opening session of the "Greening the Economy" Seminar on 22 February 2012).

Additionally, it is arguable that the collection of departments styled "the Governor's Group" form a residual ministry. Included in that grouping are the Governor's Office, the Deputy Governor's Office, the Attorney General's Chambers, the Department of Human Resources, the Department of Disaster Management, the Royal Virgin Islands Police Force, the Registry of the High Court, the Magistrate's Court, and the Elections Office (*pers. comm*., Elton Georges, former Deputy Governor, to Judith Towle, 9 May 2012).

Section 29 of the 2007 Constitutional Order states:

> *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 the present and future generations, through such laws as may be enacted by the legislator.*

In 2010, a panel of lawyers and environmentalists assembled for a public meeting at the H. Lavity Stoutt Community College to argue for a clean and healthy environment as a basic human right under the Constitution. Advocates contended that the applicability of Section 29 could be legally tested and that, hypothetically, the Constitution could obligate the government to confront legal ramifications for its actions or inactions if such infringed on the *environmental rights* of the people of the Virgin Islands (www.bvibeacon.com, 21 April 2010).

2.1.2 Sister Islands Programme

The Sister Islands Programme was established in 2003 as part of the Deputy Governor's Office to monitor, promote and facilitate the delivery of Government services to the sister islands of Virgin Gorda, Anegada, and Jost Van Dyke. To achieve that objective, a Sister Islands Programme Coordinator works with and supervises District Officers on each of the three sister islands. The Coordinator serves, in effect, as a liaison from the Deputy Governor's Office to the sister islands through the District Officers on each island.

The primary function of Virgin Gorda's District Officer is to coordinate Government's activities on the island and serve as a focal point for official inquiries from residents. Responsibilities include participating in disaster planning and disaster response on the island. A Government Administration Building and related facilities are provided in Spanish Town, under the management of the District Officer (*pers. comm.*, Yvette Faulkner Grant, Virgin Gorda District Office).

The relationship between the administrative centre of government in Tortola and the sister islands is periodically a strained one. Such tension is not uncommon in other twin-island and tri-island nation states of the Caribbean.

The association of any central unit of authority with a secondary, "sister" unit will almost inevitably lead to feelings of perceived neglect on the part of the secondary community and an assumption of inequity in the distribution of public resources. In Virgin Gorda, this has perhaps been most evident in ongoing demands for an improved airport facility and upgraded medical services such as are available in Tortola.

The stress lines in the relationship between Tortola and Virgin Gorda will likely continue to be a dynamic in the social and economic development of the latter, even as Virgin Gordians assess their future options for both economic expansion and environmental protection.

2.1.3 Environmental Units of Government

The notion that the "environment," broadly speaking, is government's business is not disputed in the small islands of the Eastern Caribbean, including the British Virgin Islands. Government control of Crown Lands, public health, ports, harbours, and some 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.

What is also new in the region since the 1980s and 1990s (although to a lesser extent in the British Virgin Islands) is the growth of community groups, civic organisations, and NGOs attempting to take action when environmental abuses become obvious, to protect the public from environmental hazards, and to guarantee the survival of selected environmental amenities (Towle, 1991).

How well 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 in the BVI resides within the **MINISTRY OF NATURAL RESOURCES AND LABOUR** (MNRL), there are other units of government that also have responsibilities related to the environment. These include:

- **DEPARTMENT OF TOWN AND COUNTRY PLANNING**, within the Premier's Office, responsible for physical development planning and development control functions.
- **DEPARTMENT OF DISASTER MANAGEMENT**, within the Deputy Governor's Office and the coordinating agency for the Territory in preparing for, responding to, and recovering from natural and other disasters.

- **MINISTRY OF HEALTH AND SOCIAL DEVELOPMENT**, with responsibility for environmental health and waste management discharged through the Division of Environmental Health and the Department of Solid Waste.
- **TOURIST BOARD**, a part of the portfolio of the Premier with responsibility for development of the tourism sector, which relies upon the attractiveness and healthy state of the Territory's natural features and amenities.
- **MINISTRY OF COMMUNICATIONS AND WORKS** with responsibility for the BVI Electricity Corporation and for the enabling legislation that currently directs energy policy in the Territory.

However, it is the Ministry of Natural Resources and Labour that carries primary responsibility for the Territory's environmental resources. Within the Ministry, three agencies execute specific responsibility for the management and protection of the environment:

- **DEPARTMENT OF CONSERVATION AND FISHERIES**
- **NATIONAL PARKS TRUST**
- **DEPARTMENT OF AGRICULTURE.**

These agencies are discussed in the sub-sections that follow, and a summary of BVI public agencies currently charged with primary responsibilities for the management and protection of the environment is provided in **Table 11**.

2.1.3.1 Department of Conservation and Fisheries (DCF)

The Department of Conservation and Fisheries was established in 1989 as a line agency within the Ministry of Natural Resources and Labour to manage the natural resources of the Territory in a sustainable manner. At present, the department carries out its responsibilities within five functional divisions: administration and human resources; coastal zone management; policy and planning; environmental information; and fisheries management (www.bvidcf.org). To a large extent, the department's current activities focus on environmental education; environmental information management (including resource mapping); and environmental monitoring (although much of the latter, such as monitoring of BVI coastal waters, is in response to site-specific problems or incidences rather than as a part of a standardised 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 14 protected areas, all fisheries reserves, only two of which are designated for Virgin Gorda—South Sound and Taylor Bay (see also Chapter 8 of this Profile).

The Department carries out an equally compelling *resource **development** mandate* in the area of fisheries development. The coupling of the two functions—resource conservation and resource development—within the same government unit carries a potential for conflict (in policy direction, the setting of priorities, and assignment of departmental resources), although this does not appear to have been the case in the Virgin Islands.

Much of the Department'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, this impressive publication brought to life a marine world with which many residents and visitors were not familiar. It focuses not only on the species and habitats of the marine environment, but also on safety and danger issues for resource users, plus conservation concerns and existing laws (Gore, S., 2008 and 2011).

With the exception of the Fisheries Act (1997), the department's legislative mandate is relatively weak as many extant laws supporting its regulatory and resource protection functions are outdated (*e.g.*, the Wild Birds Protection Ordinance of 1959/1980, the Turtles Ordinance of 1959, and the Beach Protection Act of 1985). Existing 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 are therefore only informally administered.

2.1.3.2 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 same minister to whom the DCF is answerable). The Trust's long-standing mission has been to preserve and manage designated natural and cultural areas in the BVI. It is currently responsible for the Territory's Protected Areas System Plan (Gardner, L., *et al.*, 2008) and for management of the 21 sites under its jurisdiction (*www.bvinationalparkstrust.org*). In 2011, the NTP celebrated its Fiftieth Anniversary, an impressive record for a small island territory.

The protected areas currently managed by the NPT encompass a wide variety of sites, many of which have also been designated as protected areas under other legislation, *e.g.*, the Wild Birds Protection Ordinance (1959), 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*).

The 21 sites protected under the National Parks Act comprise the following (with sites in Virgin Gorda and surrounding areas **highlighted**):

- One marine park (Wreck of the *RMS Rhone*).
- Three historic sites (Mount Healthy in Tortola and **Copper Mine Point** and **Little Fort** in Virgin Gorda)
- Two urban parks (the Queen Elizabeth II Park and the J.R. O'Neal Botanic Gardens in Road Town).
- Two forested sites (Sage Mountain in Tortola and **Gorda Peak** in Virgin Gorda).
- Three protected areas that encompass one of the BVI's primary tourist attractions (**The Baths**, **Spring Bay and Devil's Bay**).
- Eight small islands and cays lying offshore of the Territory's major islands, many of which are also designated as bird sanctuaries (**West Dog**, **Fallen Jerusalem**, Dead Chest, **Prickly Pear**, Diamond Cay, Great Tobago, Little Tobago, and Sandy Cay).
- Two coastal parks (Shark Bay on the north shoreline of Tortola and Cam Bay on the eastern coast of Great Camanoe).

In the Government-approved Protected Areas System Plan, 2007-2017, the Trust has designated additional areas of national significance that are proposed for incorporation within the protected areas system (see Section 8.3 for identification of proposed sites in Virgin Gorda).

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

2.1.3.3 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 the prevention of deforestation. Seven such protected areas are currently under the authority of the Department, including one forestry area (Sage Mountain on Tortola) and six water protected areas. None of these are on Virgin Gorda.

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

The BVI does not have a strong tradition of forestry management, a sector where early traditions of resource management and conservation were fostered elsewhere in the Eastern Caribbean. Forestry units in Trinidad, St. Lucia, and Dominica, for example, groomed each country's earliest

cadre of natural resource management specialists, an opportunity not available in the BVI.

2.1.3.4 Department of Town and Country Planning (DTCP)

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 development 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 Geographical Information System (NGIS).

The department and an *ad hoc* inter-agency planning review committee screen all applications for land development in the Territory (whether commercial or private) before forwarding them 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 EIA go through a more detailed approval process, including development of an environmental management plan to guide oversight and monitoring of approved projects. The implementation of both processes—EIAs and environmental monitoring—are the responsibility of the Town and Country Planning Department.

The Planning Authority (a statutory body within the Premier's Office established by the Physical Planning Act of 2004) includes representatives from several government agencies (Chief Planner, Chief Conservation and Fisheries Officer, the directors of Public Works and of 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 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 2.1.4.2). This legislation also provides provisions related to protecting environmental, historic, and cultural values and resources. As such, the DTCP has worked collaboratively with other government sectors, for example, to produce a Wetlands Management Plan for the BVI. This was drafted in 2005, although it has not yet been finalised or formally approved.

Provisions of the Act also provide for the designation of environmental protection areas by the department, although "protected areas" are usually designated by the DCF and the NPT. DTCP does not currently have a process in place for designating EPAs and, if employed in the future, the department would do so as part of the review phase for individual development applications (see also Section 8.4).

The department has drafted a number of area development plans in the Territory, although none has been formally approved. In Virgin Gorda, an area development plan has been proposed for Spanish Town/The Valley but, at present, is only accorded medium priority in the department's biennial work plan (*pers. comm.*, Ronald Beard, Deputy Director and Dylan Penn, Physical Planner, DTCP, interview with Lloyd Gardner, 25 November 2011). The current land use plan for Virgin Gorda is outdated.

The Department of Town and Country Planning is also responsible for physical development planning for the Territory as a whole. The most recent national Physical Development Plan was drafted by TCPD in 2006, but, like its predecessors, it has not been adopted by Government (see below Section 2.1.5.5).

2.1.3.5 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—

* Development of the seabed falls under the jurisdiction of the Ministry of Natural Resources and Labour. Application is made to the Ministry, which will generally require inclusion of an "environmental assessment." Decisions are made by Cabinet on applications forwarded to it by the Minister. A technical review committee assists the Ministry in reviewing applications.

including all sectors of government and civil society—in planning for and responding to hazards of all kind. 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 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. Additionally, assessing hazard potential has been incorporated by the DDM in 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 has been under review. In the December 2011 Speech from the Throne, Government listed the enactment of legislation to strengthen the disaster management legal framework as a priority objective for the new Government (His Excellency, the Governor Mr. Boyd McCleary, 8 December 2011).

2.1.3.6 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 Solid Waste with responsibility for solid waste (see also Chapter 7) 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 Department of Environmental Health is hindered in addressing these issues because this ordinance is so outdated, while the regulations authorised in the legislation were never enacted.

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 Department of Environmental Health is also hampered by the lack of legislated environmental health standards.

2.1.3.7 Tourist Board

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 (Coopers & Lybrand, 1996), marketing has been the dominant activity of the Board, taking precedence over other functions.

Coopers & Lybrand's Tourism Development Strategy provides two conclusions that are of importance for this Environmental Profile:

(1) The most important principle (of five identified principles) to guide the BVI's vision for tourism development is the importance of safeguarding the environment.

(2) Virgin Gorda is identified as the primary tourist destination in the Territory.

A recent commitment by the Tourist Board to the environment is its "green tourism" programme, called STEP, to promote environmentally friendly initiatives in the industry. Among other strategies, the Sustainable Tourism Environmental Programme (STEP) promotes the international environmental certification of pilot properties in the BVI, one of which, according to the Tourist Board, is in Virgin Gorda (Gordian Terrace).

Environmental assessments of properties began in late 2011 to determine each property's environmental impact in such areas as the use and management of energy, water, chemicals and solid wastes. The Tourist Board envisions that the introduction of greening approaches in the Territory will provide a new marketing platform for BVI tourism and will demonstrate cost savings options for the industry (*pers. comm.*, Natasha Chalwell, Policy and Product Development Mngr., Tourist Board, email to Rosemary Delaney-Smith, 15 November 2011).

The BVI Protected Areas System Plan, 2007-2017 (see Section 2.1.5.6) 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 officially been put in place, although a proposed revision of the tourism development strategy in 2012 provides an opportunity to strengthen and formalise this important institutional relationship (see also Section 8.4.2).

In April of 2012, Government appointed a Tourism Liaison Officer within the Premier's Office, who is tasked with responsibility for the review and development of tourism policy, while the Tourist Board will continue to focus on tourism marketing. The new post within the Premier's office is a cross-ministry position and will allow the officer to work with other Government ministries in tourism-related areas.

2.1.3.8 Ministry of Communications and Works

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 Ordinance dates from 1970 and has recently been the target of efforts to effect its revision and thereby to encourage the development of renewable energy in the Virgin Islands.

Elsewhere in the Caribbean, and certainly at a global level, the green energy movement has attracted growing support for renewable energy sources. In the British Virgin Islands, 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 the electricity provided by the Electricity Corporation.

In the BVI, a virtual monopoly on the production of energy has been granted to the Electricity Corporation and prevents the provision of renewable energy as a primary power source in areas served by the BVIEC. The interests of the Corporation with regard to the generation and supply of electricity have precedence in law, while renewable sources of energy, such as solar or wind power, are not supported under the law. It is a case of legislative authority not keeping pace with technological advances.

The newly elected (2011) Government of the BVI has recognised this inadequacy in the Territory's energy policy and legislation and has pledged to encourage development of alternative energy approaches through a revision of the outdated legislation.

Table 11.
The primary environmental units of the BVI Government.

UNIT OF GOVERNMENT	ENVIRONMENTAL RESPONSIBILITIES
MINISTRY OF NATURAL RESOURCES AND LABOUR	• Environmental policy and international environment agreements. • Management of the seabed. • Climate change and global warming. • 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 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 Geographical 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 SOLID WASTE **(*Ministry of Health and Social Development*)**	• Responsibility for the management of solid waste (see also Chapter 7, Section 7.1).
DIVISION OF ENVIRONMENTAL HEALTH ***(Ministry of Health and Social Development)***	• Responsibility for environmental pollution control under the Public Health Ordinance.
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.

2.1.4 Environmental Legislation

A number of BVI legal and regulatory instruments are related to the protection and management of the environment. These are outlined in **Table 12**, along with certain global treaties and regional agreements that pertain to the BVI. Three fairly recently enacted laws are of particular relevance:

- **FISHERIES ACT (1997) AND REGULATIONS (2003)**
- **PHYSICAL PLANNING ACT (2004)**
- **NATIONAL PARKS ACT (2006) AND REGULATIONS (2008)**.

2.1.4.1 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 2.1.3.1) 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 authorise marine protection zones, and, pursuant to the Act, 14 fisheries protected areas were declared under the 2003 Regulations, two of which are associated with the island of Virgin Gorda: the South Sound Fisheries Protected Area and the Taylor Bay Fisheries Protected Area.

Under the legislation, 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 legislation 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.

An August 2011 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 an appeal for judicial review, initially brought by the Virgin Islands Environmental Council (VIEC) in 2007, the plaintiff alleged that Government's approval of an application submitted by Quorum Island (BVI) Limited—for the development of a five-star hotel, marina and golf course at Beef Island, Tortola—was illegal. VIEC maintained that the development would adversely affect a declared fisheries protected area, Hans Creek, pursuant to Regulation 51(1) of the 2003 Fisheries Regulations.

In the initial court ruling in September of 2009, the High Court judge held that the proposed project would adversely affect Hans Creek, a declared fisheries protected area. The developer appealed the decision, and in a ruling on 12 August 2011, the Court of Appeal overruled the earlier judgment and held that Hans Creek should have been declared a protected area under Section 13(1)(b) of the *Fisheries Act*, *not* under Regulation 51 of the *Fisheries Regulations*. By extension, the ruling effectively invalidated not only the protected status of Hans Creek but of all fisheries protected areas as declared under the Fisheries Regulations.

This ruling, based on technicalities of the Act and its Regulations, was a disappointment to the plaintiff, the Virgin Islands Environmental Council, whose spokesperson pointed out that "the ruling undermines confidence in legislation for environmental protection in the BVI" (*www.bviplatinum.com,* 17 August 2011). Environmentalists and others in the Territory have called for the immediate revision of the Fisheries Act and the re-designation of the 14 fisheries protected areas.

2.1.4.2 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 2.1.3.2). 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 process for development activities in the Territory, including future development projects on the island of Virgin Gorda. 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. Full and effective implementation of the legislation will be weakened until uniform controls and regulatory procedures are embodied in the law to guide all parties—public and private—when taking action under the Act.

The lack of a regulatory framework for the Act has already contributed to inconsistency in implementation on the island of Virgin Gorda, where the largest development project to come on line in several decades, the Oil Nut Bay Resort and the North Sound Yacht Club (renamed Yacht Club Costa Smeralda) in North Sound, was permitted to proceed without an EIA. Although most development activities took place following approval of the Physical Planning Act, the presence of a smaller, earlier incarnation of the project at the site, which began prior to the Act, allowed the more substantial resort project to be "grandfathered" into a development review process that precluded the requirement of an EIA, despite the significant environmental impacts anticipated.

Government did not require that the developer provide a full EIA, and instead an Environmental Management Plan was prepared for the site in 2009 and environmental monitoring was carried out by an independent environmental consultant. However, these—and other documentation provided by the developer (Victor International, 2009)—were prepared without benefit of the rigorous environmental review process that forms the basis of a comprehensive EIA or identification of environmental conditions and requirements that flow systemically from the EIA.

It therefore is encouraging that Government recently has pledged to strengthen 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 (Speech from the Throne delivered by His Excellency the Governor Mr. Boyd McCleary, 8 December 2011).

One area that needs to be reinforced in 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 subjected to the same requirements.

In 2010, the Ministry of Natural Resources and Labour moved ahead with a hydroponic agricultural project to construct greenhouses in Tortola at Paraquita Bay and in Virgin Gorda at South Sound. An application to the Department of Town and Country Planning for project approval was not submitted until *after* construction had commenced and DTCP had issued a non-compliance notice for construction to stop. An application was subsequently submitted, but it is not clear whether an EIA was completed by Government for the South Sound project or whether an approved environmental monitoring plan was provided.

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 delay in promulgating regulations to the BVI's Physical Planning Act can no longer be delayed.

2.1.4.3 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 above Section 2.1.3.2).

The legislation incorporates modern concepts of protected area management, including an internationally recognised system of categories for designating protected areas (see Section 8.1). The Act also incorporates provisions of international conventions to which the BVI is a party, such as the Convention on Biological Diversity (see **Table 2**).

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.

2.1.4.4 Other Environmental Legislation

Other BVI environmental laws are noted in **Table 2**. Although these laws remain in effect, for the most part they are outdated and therefore are no longer effective or adequate to protect and manage the natural resources of the Territory.

This table and the discussion in preceding sections on the Territory's three substantive and modern environmental laws illustrate that, although important legal and policy tools for environmental management have been established in the BVI, many challenges still lie ahead. For example:

- The Physical Planning Act requires regulations and until then, much of the law will operate as legislated guidelines rather than as enforceable policy.
- The area of pollution control needs to be strengthened, particularly in a community like the BVI that is growing and developing at a rapid pace.
- 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.

2.1.4.5 A New Direction: Proposed Environmental Management and Conservation of Biodiversity Bill

Since early in this century, Government has considered a more comprehensive approach to environmental protection and management. Most recently, the Law Reform Commission drafted a new framework for environmental management in the BVI. The Commission's report, *Environmental Management and Conservation of Biodiversity Reform*, was submitted to Cabinet in 2008 but has not yet been made available to the public and no further action has been taken. More recently, Government indicated its intent to bring an Environmental Management and Conservation of Biodiversity Bill before the House of Assembly (Speech from the Throne delivered by His Excellency the Governor Mr. Boyd McCleary, 8 December 2011).

This environmental legislation would 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 replace 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 would be retained under the new law.

Additionally, the legislation would permit the Territory to deal more holistically and effectively with the conservation of biodiversity as well as the BVI's obligations under multilateral environmental agreements to which the Territory is a party (see **Table 12**).

2.1.5 Environmental Policy

In addition to the units of Government tasked with primary environmental responsibilities (Section 2.1.3) and the legal framework comprising the Territory's extant environmental legislation (Section 2.1.4), a number of national policy agreements and planning documents are available to strengthen the objectives of environmental protection and resource sustainability in the Territory.

Primary among these are the following, which are reviewed in more detail in the sub-sections to follow:

- **ST. GEORGE'S DECLARATION OF PRINCIPLES FOR ENVIRONMENTAL SUSTAINABILITY IN THE OECS**
- **BRITISH VIRGIN ISLANDS ENVIRONMENT CHARTER**
- **NATIONAL ENVIRONMENTAL ACTION PLAN**
- **NATIONAL INTEGRATED DEVELOPMENT PLAN**
- **NATIONAL PHYSICAL DEVELOPMENT PLAN**
- **PROTECTED AREAS SYSTEM PLAN**
- **NATIONAL TOURISM DEVELOPMENT STRATEGY**

2.1.5.1 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. 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 recognises and 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 Declaration, the Territory is also bound by the principles stated therein.

2.1.5.2 British Virgin Islands Environment Charter

A second policy agreement—the BVI Environment Charter—was signed by the BVI Government in 2001 with the UK Government to provide guiding principles for the two governments in the area of the environment.

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).

Table 12.
BVI legal and regulatory instruments
related to the protection and management of the environment. *

NATIONAL LEGISLATION		
PLANNING AND DEVELOPMENT CONTROL	***Physical Planning Act*** (2004) (no regulations to date)	See Section 2.1.4.2 for details.
COASTAL RESOURCES	***Fisheries Act*** (1997) ***Fisheries Regulations*** (2003)	See Section 2.1.4.1 for details. See Section 2.1.4.1 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 a beach management policy framework or regulations.
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, none on Virgin Gorda.
PROTECTED AREAS	***National Parks Act*** (2006) ***National Parks Regulations*** (2008)	See Section 2.1.4.3 for details. See Section 2.1.4.3 for details.
WILDLIFE	***Wild Birds Protection Ordinance*** (1959/1980)	The law protects listed birds, their eggs, nests, and young throughout the country. Bird Sanctuaries Orders in 1959 and 1977 designated 20 bird sanctuaries in the Territory, 12 of which are cays and small islands surrounding Virgin Gorda.
	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*.
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 (Amended 2009)	Authorises appointment of litter wardens to issue warnings and tickets to violators of the litter law.

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 2.1.5.1.)
ENVIRONMENTAL SUSTAINABILITY	***British Virgin Islands Environment Charter*** Signed by UK and BVI Governments (September 26, 2001)	Guiding principles for the UK Government, the Government of the BVI, and the people of the British Virgin Islands (Section 2.1.5.2).
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 the BVI in 1976	The Convention requires national legislation as the Convention is not self-executing. The BVI's *Protection of Endangered Animals, Plants, and Articles (Removal and Possession) Ordinance* is outdated and does not fully comply as CITES legislation. Additionally, the BVI does not have general wildlife conservation legislation to reinforce compliance.

* For a more detailed discussion, see Lausche (2005).

- 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 guiding principles and commitments incurred by the BVI Government in the Environment Charter or the St. George's Declaration are actively consulted by Government in executing environmental policy, legislative, and management decisions. However, a number of national planning strategies and documents are available to the Government for incorporating the principles and commitments of both the Environment Charter and the St. George's Declaration. These are discussed in the sub-sections that follow.

2.1.5.3 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 ensure integration of environmental concerns into the national development planning process.

The NEAP was not approved by Cabinet, but its objectives and recommendations exist as a guide and planning tool for environmental action.

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

The National Integrated Development Strategy (NIDS) was adopted by the Government of the British Virgin Islands to promote the sustainable development of the Territory; it covered the five year period from 1999-2003. The Draft 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 in the Virgin Islands.

Individual ministries and departments of Government are responsible for implementing the strategies incorporated in the NIDS. Although it prepared the document, the DPU had no coordinating role in implementation (*pers. comm.*, Raymond Phillips, Director of DPU, interview with Lloyd Gardner, 7 December 2011).

Whether the National Integrated Development Plan will be revised and updated is not known at the present time.

2.1.5.5 National Physical Development Plan (NPDP)

Responsibility for 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 not formally adopted by Government, 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 discussions with the profile project team at the end of 2011, officials in the Town and Country Planning Department noted that the Government elected in November 2011 intends to update the National Physical Development Plan, with the DTCP to function as the coordinating agency (*pers. comm.*, Ronald Beard, Deputy Director and Dylan Penn, Physical Planner, DTCP, interview with Lloyd Gardner, 25 November 2011).

2.1.5.6 Protected Areas System Plan, 2007-2017 (System Plan)

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.

The first System Plan for Protected Areas in the BVI 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 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.

2.1.5.7 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 (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 Plan.

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

For example, the Development Planning Unit of Government (responsible not only for national development planning but also for the assemblage of tourism statistical data) is concerned that tourism data collection forms used by the Tourist Board are not sufficient for national development planning purposes. The data being assembled may not provide enough information to support comprehensive tourism planning such as the development of targeted niche marketing plans.

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 taken into consideration in development control decision making.

The National Tourism Development Strategy identified Virgin Gorda as the primary tourism destination in the Territory. Nevertheless, a tourism development plan has not been prepared for the island. Reportedly, revision of the tourism development strategy will be carried out in 2012 (*pers. comm*., Hadassah Ward, Director of Tourism, interview with Lloyd Gardner, 7 December 2011).

2.1.5.8 Comprehensive Disaster Management (CDM) Policy and Strategy, 2009-2013

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 being principally concerned with a response to events to one based on disaster risk reduction through greater attention to mitigation, preparedness and recovery.

The current CDM Policy (DDM, 2009/a) was developed in concert with the 2009-2013 Virgin Islands CDM Strategy and Programming Framework (DDM, 2009/b). The CDM Policy defines the vision, goal, purpose and priorities of Comprehensive Disaster Management in the BVI and provides the policy framework within which the DDM operates and implements its CDM strategy.

The CDM Strategy and Programming Framework for 2009-2013 is a strategic planning tool for the DDM that describes the activities to be implemented and the results to be achieved by the DDM in realising its overall goal of "reinforcing the development potential of the VI by reducing risks from all hazards" (DDM, 2009/b, page 9).

With the completion of the CDM Policy and the updating of the CDM Strategy and Programming Framework, the next anticipated step in territorial planning for disaster management is revision of the 2003 Disaster Management Act.

2.1.5.9 Climate Change Adaptation Policy and Strategy

Since 2007, the BVI Government has supported a climate change initiative under a programme entitled Enhancing Capacity for Adaptation to Climate Change in the Caribbean UK Overseas Territories (ECACC). The project is funded by the UK Department for International Development (DFID) and managed by the Caribbean Community Climate Change Centre (CCCC) in Belize.

ECACC funding was provided for:

- building institutional capacity in the BVI for climate change;
- implementing climate change educational activities;
- providing institutional structures to monitor the impacts of climate change in the BVI;
- carrying out vulnerability assessments; and
- preparation of a climate change policy paper for the British Virgin Islands (*pers. comm*., Angela Burnett Penn, Environment Officer for Climate Change, DCF, interview with Judith Towle, 7 February 2012).

A Virgin Islands Climate Change Green Paper was prepared in 2010 (Burnett Penn, 2010), and a Climate Change Adaptation Policy and Strategy was drafted for the Territory in 2011 (not yet public). Following extensive public consultations, the policy paper was approved by an inter-departmental Climate Change Committee, and now awaits final approval by Cabinet, after which it will be made public.

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.

2.2 The Private Sector

2.2.1 Environmental NGOs in the British Virgin Islands

In the area of the environment, the NGO (nongovernmental organisation) 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 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 trusts in the Caribbean had become important voices for a larger number of environmental concerns and were taking on more broadly-defined environmental agendas, for example, the National Trust in St. Lucia.

During 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 by legislation 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 BVI National Parks Trust often takes on roles and functions more attuned to that of a NGO. 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 "watchdog" role more naturally assumed by NGOs with no government affiliation.

Thus, in the BVI, there has always been room for an environmental NGO 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. Yet, this has not generally occurred.

2.2.1.1 NGOs with Single-issue or Single-activity Environmental Agendas

In the BVI, a few conservation-focused NGOs emerged in the 1980s and into the1990s, among them, the **BVI Historical Society** and the **BVI Botanic Society**. However, none have survived as active organisations today and none displayed—when active—a broad environmental agenda. Instead, the programmatic focus was a single "cause" (*e.g.*, the Botanical Gardens) or a single issue (*e.g.*, the preservation of historical and archaeological resources).

One NGO that attempted for a time to take on a more broadly based environmental agenda was the **Association of Reef Keepers** (ARK). Founded in the late 1990s, ARK was dedicated to promoting the conservation and preservation of the marine environment. However, its marine-based focus soon expanded, and the organisation became known not only for its annual coral reef monitoring (called Reef Check), but also for its non-partisan voice on behalf of environmental issues that extended beyond the marine sector.

ARK began to take on a variety of environmental activities and programmes which, in larger coun-

tries, might have been dispersed among several NGOs. An offshoot of ARK was a subsidiary programme that became known as **Island Erosion**, a collaboration of environmentalists and business sector interests—building contractors, architects, and engineers—who sought, together, to promote best management practices in construction to reduce soil erosion and sediment run-off.

Both ARK and Island Erosion fell victim to a pattern seen in many small organisations, particularly those staffed primarily by volunteers, namely, the leadership of both groups (often comprising the same individuals) become over-extended, over-committed, and overly exhausted. ARK currently concentrates on its original reef monitoring programme, and Island Erosion as an organised initiative has disappeared.

At about the same time that ARK was moving off centre stage as an institutional voice for environmental issues, two new organisations emerged: the **BVI Heritage Conservation Group** (BVIHCG) and the **Virgin Islands Environmental Council** (VIEC).

BVIHCG is an association led by BVI citizens and residents and supported by visitors, all of whom "are passionate about the preservation of the BVI's natural resources, history and culture," which the group maintains are threatened by widespread physical development in the Territory (see Mission Statement at www.bvihcg.com). Through its web site, the organisation provides information about pending development projects in the BVI and about eco-friendly, sustainable solutions. However, it provides little programming beyond the information services of its web site.

At the present time, **VIEC** is a single-issue NGO; in this case, its objective is to turn around Government support for a mega-resort development at Beef Island on the eastern end of Tortola. In July of 2007, VIEC initiated legal action seeking judicial review of the Government's decision to grant planning approval to the Beef Island Development Project. In August of 2011, the Court of Appeal of the Eastern Caribbean Supreme Court ruled against VIEC and effectively invalidated the protected area status of fisheries reserves in the BVI (see also Section 2.1.4.1). At this writing, it is not known whether, or in what direction, the Environmental Council will extend its mission or agenda.

Another new environmental group is **Worldhouse Caribbean**, which in January of 2012 launched an initiative to encourage the use of reusable shopping bags in the BVI and hopes to totally eliminate the use of plastic shopping bags in the Territory. In partnership with organisations such as Green VI (see Section 2.2.1.2) and BVI businesses, Worldhouse Caribbean plans to focus on other recycling issues in the future (www.bviplatinum.com, 6 January, 2012).

Two new groups in Virgin Gorda have joined this organisational mix of single-issue NGOs. The first is the **Virgin Gorda Green Team**, which is affiliated with the Clean-Up the World Programme. The group's mission focuses primarily on keeping Virgin Gorda and its marine environment clean.

The second group in Virgin Gorda is **Voices of Interest for Economic and Social Stability** (Voices), a community organisation formed in 2010 with the stated goal of bettering the community of Virgin Gorda. As stated at the time of its formation, Voices is focused on elevating the quality of life of the people of Virgin Gorda "so they can live a safe, vibrant, educated, and happy life" (www.bvinews.com, 27 November 2010). According to a group spokesperson, Voices will work with the community on greening projects and has already partnered with the Virgin Gorda Green Team on such initiatives as the annual coastal cleanup project sponsored by Ocean Conservancy (*pers. comm.*, Sharon Flax Mars, interview with Rosemary Delaney Smith).

The two groups—the Green Team and Voices—are the only not-for-profit groups in Virgin Gorda at the present time with an environment-related agenda, although neither supports a wide range of environmental issues or programmes.

2.2.1.2 NGOs with More Inclusive Environmental Agendas

Green VI was founded in Tortola in 2009 to help create "a green, clean, healthy, and prosperous BVI in which a balance is maintained between development and conservation of the natural en-

vironment" (www.greenvi.org). A primary focus of this NGO has been to address the problem of litter and waste accumulation in the Territory. With funding from OTEP and BVI businesses, the organisation created a waste recycling project that collects glass waste from restaurants in the Cane Garden Bay area of Tortola, recycles the glass in a furnace erected at Cane Garden, and then creates glass products for sale at its Glass Studio, also at Cane Garden Bay. The project provides a creative example of applying on-island technology to address solid waste concerns and recycling opportunities in the BVI.

Green VI has recently assumed leadership for development of an environmental education strategy for the BVI, with a focus on educating BVIslanders and BVI organisations in understanding and achieving sustainability in the Territory. The Natural Step (TNS) framework, first employed in Sweden in the 1980s, will provide the approach used by BVI project planners, and TNS/Canada has been engaged to train persons locally in The Natural Step framework.

Green VI's partners in this effort are the H. Lavity Stoutt Community College (HLSCC) and the Department of Conservation and Fisheries. Fifteen BVI facilitators will initially be trained in The Natural Step process. They will be drawn from seven sectors, including agriculture, schools, churches, tourism (*pers. comm*., Charlotte McDevitt, executive director of Green VI, interview with Judith Towle, 19 October 2011).

Another BVI NGO with a comprehensive environmental agenda is **Island Resources Foundation** (www.irf.org), the sponsoring organisation of the current Environmental Profile Programme for the British Virgin Islands. IRF was established as a non-profit, environment-focused NGO in the U.S. Virgin Islands in 1972. Its central mission is to assist small islands in meeting the challenges of social, economic and institutional growth while protecting and enhancing their environments. Under this framework, the Foundation has implemented over 200 externally funded, island-focused projects, primarily within the insular Caribbean. It has maintained an office in the British Virgin Islands since 1999, in a cooperative relationship with the H. Lavity Stoutt Community College.

The Foundation's relationship with the BVI dates back to its earliest years as an organisation. In 1976, IRF prepared for the BVI Government what may have been the Eastern Caribbean's first island-specific environmental guidelines for development planning (Howell and Towle, 1976), followed by economic feasibility studies for Anegada and Virgin Gorda (Towle, *et al*., 1976). In 1974, the BVI was included in a nine-island environmental survey and status report prepared by IRF for the UNDP, the first such assessment to be undertaken in the Eastern Caribbean (Towle and McEachern, 1974).

More recently, from 2000-2008, IRF, in partnership with NPT, carried out a major programme designed to strengthen the institutional framework for conservation and protected area management in the BVI. Funding for the programme was provided under a grant to IRF from philanthropist Laurance S. Rockefeller. An underlying goal of this effort was to achieve the eventual transfer of the island of Sandy Cay from Mr. Rockefeller's private ownership to BVI sovereignty under the management of the BVI National Parks Trust, a goal accomplished in May of 2008.

In 1997, the Foundation donated its regionally recognised environmental library to HLSCC. In January of 2010, this collection was renamed in honour of the Foundation's founding president, the late Dr. Edward L. Towle. The former IRF library is now housed at the College's Paraquita Bay campus in Tortola.

2.2.1.3 Single Island NGOs

There is one environmental NGO in the BVI that has a broad programme agenda but is focused on only one island area—Jost Van Dyke and nearby Little Jost Van Dyke. The **Jost Van Dykes Preservation Society** is new, yet it is also old. In the early 1990s, Foxy Callwood, a businessman in Great Harbour, launched the idea for a Preservation Society with his wife, Tessa, and other island residents who hoped to preserve the island's unique environment and traditions.

After a period of relative inactivity throughout most of the 1990s, the Society was revived, with its legal

establishment as a BVI not-for-profit organisation taking place in July of 2004. It now boasts an office and director based in Great Harbour and a number of community-based research and educational programmes including preparation of the *Jost Van Dyke Environmental Profile*, in partnership with the Island Resources Foundation.

What is missing from the above mix of NGOs is the presence of a NGO whose environmental mission is broadly stated, whose support comes from the community and a variety of funding sources, and who—through a combination of professional staff and citizen volunteers—is capable of taking on a diversity of environmental advocacy, environmental education, and environmental monitoring programmes and activities in the BVI. In many ways, this is what the single-island-focused Jost Van Dykes Preservation Society is doing.

But what is now needed for all of the BVI is either a similar NGO for Tortola, one for Virgin Gorda, another for Anegada—or a single NGO umbrella organisation for the territory, with branches of the parent organisation in each of the major islands, similar to the role of the Virgin Islands Conservation Society in the US Virgin Islands, with a chapter in St. Thomas-St. John and another in St. Croix.

2.2.2 BVI NGOs and the Legal Framework

Two recent studies by the Caribbean Philanthropy Network (CPN) provide an analysis of philanthropy law and the nonprofit sector in the Commonwealth Caribbean. The first (Towle, *et al*., 2010) focuses on the region and the second (Towle, 2011) focuses on the British Virgin Islands as one of two case studies.

The latter study found that the legal framework in the BVI supporting NGOs was very weak. It basically only provides for registration of not-for-profit organisations under the Territory's Company's Act. The Financial Services Commission, which oversees company registration, including NGOs, provides no further oversight or support for the nonprofit sector once registration has been completed.

As a result, NGOs and other nonprofit groups such as service organisations or professional associations are uncertain about their obligations and responsibilities as registered nonprofit "companies." Most interviewed by the CPN team agreed that clarification was needed in the legal code regarding registration, fund raising, tax exemption and related issues. Uncertainty was also expressed by government officials interviewed regarding nonprofit governance and how the sector was being regulated and supported in the BVI.

Additionally, the Territory's financial services sector must meet a 2012 deadline to comply with international standards for combating money laundering and the financing of terrorist activities. Since the international Financial Action Task Force (FATF) has determined that these activities often occur under the aegis of charitable institutions, FATF requires an updated and strengthened charities law in the BVI if the Territory is to remain in compliance with FATF standards. This requirement is now driving the Government's efforts to reform charity law in the Territory during 2012.

Both CPN reports (2010, 211) point out the potential for tension when the law reform process for non-governmental organisations is driven by those approaching it from the perspective of regulation (*i.e*., the financial services sector) as opposed to those more concerned about legal requirements that strengthen philanthropy and civil society.

Legal reform for the BVI, according to the 2011 CPN report, is not simply a necessity for the BVI's financial services sector. Additionally, the CPN studies have shown that:

> … as governments create a legal and regulatory foundation that establishes certainty and stability ***for*** the nonprofit sector, it thereby increases confidence and trust ***in*** the sector by those wishing to support and contribute to specific charities and other NGOs (Towle, 2011).

2.2.3 Other Environmental Initiatives in the Private Sector

Environmental initiatives in the BVI, as promoted by the nongovernmental organisations identified in Section 2.2.1 are augmented by initiatives supported by civic groups and the business sector. For example, **Going Green on Gorda** is a new private enterprise interested in implementing a recycling programme on the island.

Service organisations like the **Valley Lions Club** actively participate in beach cleanups on the island several times a year, such as a cleanup at Hansome Bay in September of 2011. The group also supports ongoing tree-planting efforts with a current goal of planting at least 100 trees between 1 July 2011 and 30 June, 2012 (*pers. comm*., Norval Young, interview with Rosemary Delaney Smith).

The **BVI Chamber of Commerce and Hotel Association** (BVICCHA) (*www.bviccha.org*) does not support a comprehensive "green initiative" per se, although it has called upon Government to introduce legislation to move the Territory away from the use of fossil fuels toward alternative energy sources. Additionally, several members of the CCHA have their own green initiatives, such as the **Peter Island Resort**, which has installed wind turbines to provide backup power, and **The Moorings** yacht charter enterprise in Tortola, which has a recycling programme in place (*pers. com*., Birney Harrigan, Ph.D., former chairperson, BVI Chamber of Commerce and Hotel Association, interview with Rosemary Delaney Smith).

The CCHA's Green Award was presented for the first time in 2011 at its annual Awards Dinner. The recipient was the **Bitter End Yacht Club**, a resort and marina operating in the North Sound of Virgin Gorda. Bitter End was recognised for its green energy initiatives, including 24 separate energy-saving strategies that have been implemented at the facility, including operation of its own sewage treatment plant using all gray water to nourish vegetation on the property; monitoring of water consumption through installation of low-flush toilets, low-gallon-per-minute showerheads and multiple metering to ensure against leakage; and energy-efficient lighting that, among other things, reduces bright beach lights that can negatively impact nesting turtles (*pers. comm*., Sandra Grisham-Clothier, Chief Operating Officer, BEYC, email to Rosemary Delaney Smith, 21 January 2011).

Another resort facility in Virgin Gorda that exercises environmentally friendly practices—and has done so since its establishment in 1964 by Laurance Rockefeller as part of his Rockresorts enterprise—is the **Little Dix Bay Resort** (now named Rosewood Little Dix Bay Hotel). Long recognised as the property that launched modern tourism in the BVI, Little Dix also began a tradition of up-scale resort tourism in the Territory, particularly identified with the island of Virgin Gorda. Today, Little Dix supports its own "green team" that is internal to the property's management framework and has identified many environmentally friendly strategies similar to those at Bitter End (*pers. comm*., Sharon Flax-Mars, interview with Rosemary Delaney Smith).

Offshore from Virgin Gorda at **Mosquito Island**, Sir Richard Branson is developing a tourism project for the island that emphasises green technologies, green design principles, and carbon-neutral practices. The developer has planned a project that is designed for efficiency and sustainability, with solar and wind power used throughout and sewage from the island treated on-island and used for irrigation, thus eliminating the need for an outfall into the marine environment. Development of road infrastructure commenced in late 2011 under the watchful oversight of an independent environmental monitor.

Finally, the tourism sector of the BVI, along with the Tourist Board (see Section 2.1.3.7), is turning attention to the **Green Globe** international certification system, as developed in the 1990s to provide a uniform structure for measuring the environmental and social performance of hotel and resort properties around the globe. The **OBMI** architectural firm in the BVI recently began offering certification through the Green Globe process. Green measures adopted by certified properties can range from energy and water-saving technologies to waste-reduction policies, to a number of initiatives supporting local biodiversity and animal welfare (Fox, 2011).

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 remains uneven and fragmented, and many laws: – are very outdated and therefore ineffective; – lack regulatory authority to fully implement legislated mandates; – lack standards for monitoring and enforcement; and – are difficult to implement or enforce because implementing units of government lack the technical capabilities and personnel to do so.	If Government does not move forward in updating and/or revising several environment-related laws, as well as enacting new laws where critical legislative gaps are evident, the Territory's ability to do the following will be severely and continuously impeded: – ability to protect its resource base, – ability to enforce environmental standards and regulations, – ability to honour its treaty obligations, and – ability to provide for the sustainable development of one of the Territory's two primary economic sectors—tourism.	**SHORT-TERM OPTIONS** 1. Government should, without delay, draft and approve **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. In light of the 2011 court ruling in the matter of the Hans Creek Fisheries Protected Area, Government needs to move ahead quickly to revise Regulations to the Fisheries Act in order to **re-designate specific fisheries protected areas** in the Territory. 3. Government should give priority attention to initiating a comprehensive review of the report prepared by the Law Reform Commission in 2008 entitled **Environmental Management and Conservation of Biodiversity Reform**. Its review should include an inter-agency assessment within government and public meetings external to government. 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. 4. Outdated legislation from the 1970s that currently restricts development of alternative energy sources in the BVI needs to be revised, and a **new energy policy that encourages and supports green energy** for the Territory needs approval by Government. **LONG-TERM RECOMMENDATIONS** Beyond the four legislative recommendations listed above, all of which are in some form of readiness for near-term action, two areas of the BVI legal code for the environment require more long-term attention. 1. The first is **environmental pollution**. Environmental pollution is not defined in law 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 *(continued)*

Issues, Conflicts, and Areas of Concern	Impacts of No Action/No Change	Short-term Options Long-term Recommendations
		LONG-TERM RECOMMENDATIONS (continued) developed should take into consideration institutional capacities and resources for monitoring and enforcement. To fully implement pollution control legislation, a centralised environmental testing laboratory would need to be established. **2.** The second area requiring longer-term attention is that of **coastal area (or coastal zone) management**. In 1987, a draft Coastal Conservation Act was prepared by an environmental consultant undertaking a legislative review for the OECS. Even 25 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. The proposed act was eventually abandoned, but it is recommended herein 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. The task could initially be assigned to the Law Review Commission with the Commission tasked to initiate such a review and to present findings to Government. **3.** As new laws are enacted, such as those discussed above, 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 accessibility to necessary resources—including field equipment, electronic hardware, vehicles, boats, and the like—must be considered or the new and modern laws will remain relatively benign tools rather than powerful instruments of change.

Issues, Conflicts, and Areas of Concern	Impacts of No Action/No Change	Short-term Options Long-term Recommendations
		4. The BVI might consider preparation of a handbook as was prepared recently on environmental and sustainable development legislation for the Grenadine Islands of St. Vincent and Grenada. Prepared by the Centre for Resource Management and Environmental Studies (CERMES) at the University of the West Indies (Cave Hill Campus), this handy guidebook, in an easily accessible format, presents the "do's" and "don'ts" of environmental legislation for the Grenadines under major headings including biodiversity, coastal and marine environment, land use and development, pollution, and environmental health (see Blackman and Mattai, 2007).
ISSUE TWO Responsibility for the environment in the BVI is dispersed among a number of departments and statutory bodies within several ministries of Government. For a small island state, it may surprise BVIslanders to learn how many public sector institutions have environment-related responsibilities (see Section 2.1.3). 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 these many agencies with varying degrees of responsibility for a diversity of resource sectors.	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, namely, (1) The ability to execute coordinated environmental policy, and (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.	**SHORT-TERM OPTIONS** **1.** Many within Government interviewed by the Environmental Profile team pointed to blurred lines of coordination between agencies with planning 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 Development Planning Unit. **Clearer and more formal lines of coordination** are required, with **improved mechanisms for integrated and comprehensive national planning** in the Territory. **2.** Most of the Territory's **national planning documents need updating and/or strengthening** as well as (in most cases) official approval by Cabinet, for example: the National Environmental Action Plan, the National Physical Development Plan, and the National Integrated Development Strategy (see Section 2.1.5). **3.** Reporting requirements for national planning strategies are weak and therefore information on implementation, progress, need for revision, and lessons learned is generally unavailable and so does not feed into a **coordinated and continuous review and evaluation process**. **LONG-TERM RECOMMENDATIONS** **1.** The Territory has never had a National Development Plan, although a National Integrated Development Strategy was developed (1999-2003), but not updated. BVI Governments in the past have generally converted political manifestos into governing development plans, an option that confuses the purpose of development planning. *(continued)*

Issues, Conflicts, and Areas of Concern	Impacts of No Action/No Change	Short-term Options Long-term Recommendations
		LONG-TERM RECOMMENDATIONS (continued) What is required is a legally mandated or formally approved **national development plan** to provide a comprehensive framework for growth management and environmental protection. **2.** This Environmental Profile has called for **improved lines of coordination between the Tourist Board and the National Parks Trust** as each agency seeks to carry forward its institutional mandate, *i.e.*, promotion of tourism and support for national parks and protected areas. An interesting initiative in the French overseas territories might be worth pursuing in the BVI. A "biodiversity passport" was developed as a communi-cation tool that aims: (i) to educate travelers on the protection of biodiversity in France's overseas territories and (ii) to promote this biodiversity as an asset for the development of tourism (*www.iucn.org/news_homepage/news_by_date/2012/?9119/Green-passport-for-sustainable-tourism-in-France-overseas*). Adapted from the Green Passport initiative of the United Nations Environment Programme, the biodiversity passport for the French territories is distributed to passengers at airports and key tourism sites. The passport introduces the visitor to the richness of each territory's marine and terrestrial ecosystems and highlights specific natural sites to discover in the territories.
ISSUE THREE The framework for non-profit/charity law in the BVI is outdated, lacks cohesion, and provides little evidence of a structure of accounta-bility, transparency, or good governance for the NGO sector. Recently, external pressures related to the financial services sector have compelled the BVI to quickly address the issue of law reform to regulate the charity/NGO sector.	If the requirements of the financial services sector dominate the charities law reform process, the needs of environmental and other nonprofit organisations in the Territory will not be sufficiently addressed. Moreover, an opportunity to enact legislation that could strengthen NGOs and increase confidence and trust in philanthropy and the nonprofit sector will be lost.	**SHORT-TERM OPTIONS** **1.** The current process to draft new charities legislation must not be driven first and foremost by the need to bring the BVI in compliance with standards set by the international Financial Action Task Force. Certainly, new legislation must include provisions to combat money laundering and funding of terrorist activities through charitable organisations. However, new legislation must also create a **legal framework that inspires donor and government confidence in the objectives and programmes of the Territory's NGOs**. It must also strengthen oversight of the nonprofit sector by applying good governance and accountability standards to the sector and offer NGOs certainty about their obligations and responsibilities under the law.

Issues, Conflicts, and Areas of Concern	Impacts of No Action/No Change	Short-term Options Long-term Recommendations
		2. The **findings of the Caribbean Philanthropy Network**, particularly its study of the legal and regulatory framework for charities in the British Virgin Islands, should be consulted during the legal drafting process for new BVI legislation (Towle, J., 2010 and 2011). **LONG-TERM RECOMMENDATIONS** 1. Over the long-term, the British Virgin Islands needs to support initiatives that **increase public understanding of civil society**, including the contributions of civil society organisations to the social, economic, and environmental well-being of the Territory. Governments are often suspicious, even hostile, toward NGOs, while the nonprofit sector too often is almost instinctively distrustful of government and government regulation, even when regulation might enhance public trust in the mission and projects supported by individual NGOs. 2. The publications of the International Centre for Not-for-Profit Law (ICNL) in Washington, DC can be very helpful in designing programmes to build confidence in NGOs and in the civil society sector (www.icnl.org). ICNL recommends the preparation of simple documents that set out the nature of civil society organisations, their linkages with government (and how they differ from government), and the importance of legislation in supporting the operation of and confidence in NGOs. Such **awareness building** in the BVI is needed if stronger nongovernmental organisations focused on the environment are to emerge in the Territory.

3. NATURAL HAZARDS AND ENVIRONMENTAL RISKS

3.1 Natural Hazards Affecting Virgin Gorda

Virgin Gorda is vulnerable to a number of natural hazards which have the potential to cause significant loss of life and property, seriously disrupt the economy of the Territory, and cause damage to the environment.

The natural hazards that are likely to affect Virgin Gorda include:

- Hurricanes (and other severe wind storms)
- Excessive Rainfall and Flooding (including landslides and erosion)
- Earthquakes (and tsunami potential)
- Global Warming and Sea Level Rise.

Certain technological hazards, such as oil or hazardous materials spills can also impact the island.

Multiple studies and reports have been conducted to assess hazards and risks that are associated with the Virgin Islands. This chapter of the *Virgin Gorda Environmental Profile* will summarise those risks and will also identify the environmental issues resulting from the impacts of natural hazard events.

3.1.1 Hurricanes and Other Storms

The location of the British Virgin Islands at the northeastern tip of the Caribbean places it directly within the hurricane belt. Traditionally, there is a 25-to-30-year intensity cycle of tropical cyclone activity, and during that period the BVI may expect a Category 4 storm and several Category 2 or 3 storms (Department of Disaster Management [DDM], 2002). **Figure 9** shows the distribution of storm paths that surrounded the Virgin Islands from 1953-2010. **Table 13** summarises the damages incurred from selected hurricanes that impacted the British Virgin Islands from 1916 to 2010.

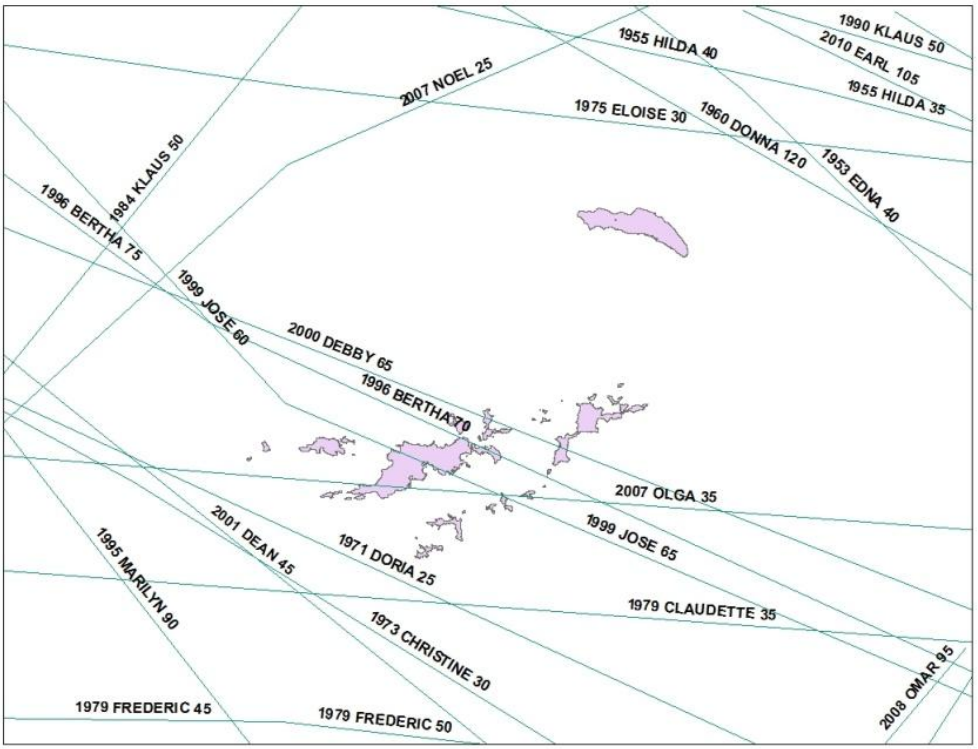


Figure 9.
Distribution of storms surrounding the British Virgin Islands;
numbers following storm name are the maximum winds recorded as miles per hour
(source: U.S. National Oceanic and Atmospheric Administration).

Table 13.
Selected hurricanes affecting the British Virgin Islands from 1916 to 2010 and estimated losses incurred.

Year	Hurricane	Category	Storm's Closest Position	Date	Estimated Loss
1916	Not Named	2	Lat. 18.0N, Long.64.8W	9 October	Fatalities and Property No Estimate Available
1924	Not Named	2	Lat. 18.3N, Long. 63.4W	29 August	Fatalities and Property No Estimate Available
1960	Donna	4	Lat. 18.4N, Long. 63.4W	5 September	Property No Cost Available
1989	Hugo	4	Lat. 18.2N, Long. 65.5W 40 miles SW of the VI	18 September	US$40 million
1995	Luis	4	Lat. 18.4N, Long. 63.0W 37 miles NE of Anegada	6 September	No Estimates
1995	Marilyn	3	Lat.18.5N, Long.65.2W 40 miles SW of Tortola	15 September	US$10 million
1996	Bertha	1	Lat. 18.6N, Long. 64.9W	8 July	US$2 million
1998	Georges	2	Lat.17.8N, Long.65.0W 46 miles south of Tortola	21 September	US$12 million
1999	Lenny	4	Lat. 17.7N, Long. 64.0W	17 November	US$29 million
2008	Omar	3	Lat.18.2N, Long.63.9W 40 miles east of Road Town	16 October	Minimal impacts
2010	Earl	4	To Be Determined	29 August	To Be Determined
2010	Otto	Tropical Storm	To Be Determined	8 October	To Be Determined

Source: Department of Disaster Management (DDM), Government of the British Virgin Islands (GoBVI).

3.1.2 Excessive Rainfall and Flooding Events

Flooding has been a major challenge for the British Virgin Islands in the past decade, specifically the events occurring in 2003, 2005, and 2010. The Territory suffered from flooded homes and businesses; landslides; severe sedimentation of the coastal waters; and substantial, negative environmental and economic impacts.

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. Damage assessment reports revealed that the losses sustained were in excess of ten million dollars.

3.1.2.1 Slope Failures

Virgin Gorda is characterised by steep slopes with limited soil development as a consequence of generally dry climate conditions.

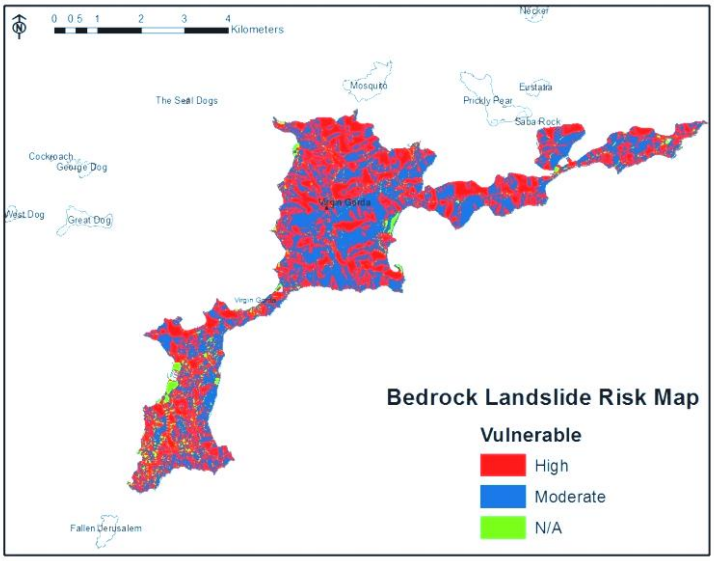


Figure 10.
Areas of Virgin Gorda most vulnerable to slope failure, showing the island to be at high risk for landslides (source: DDM, GoBVI).

Virgin Gorda and the eastern most area of Tortola expose the Virgin Islands Batholith, a vast reservoir of molten rock that formed and cooled below volcanoes 35-40 million years ago. Coarse-grained, intermediate intrusive igneous rocks of the Virgin Islands Batholith occupy almost the entire island of Virgin Gorda. Rock cut exposures of these rocks show them to be strong, slightly-to-moderately weathered, and only moderately jointed (Joyce, 2006).

The widespread occurrence of natural and man-made slope failures is largely related to extreme rainfall events. Therefore, massive slope failure events are concurrent with major floods that affect low land areas.

Rock slope failure commonly occurs during rain events because water pressure in rock joints reduces the frictional forces. The extreme rain events occurring in the BVI in the last decade have produced a significant amount of slope failures on the upper slopes of hills and rock cuts, as well as serious flooding in low-lying areas.

Figure 10 identifies the areas of Virgin Gorda that are most vulnerable to slope failure, based on geology, angle of the slope and orientation of the bedrock.

The common cause of landslides is destabilisation by the over-steepening of slopes. Over-steepened slopes are a common consequence of development on hill slopes (Joyce, 2006), as is shown in **Photos 24 and 25**, an example of a recent landslide (2009) in Virgin Gorda.

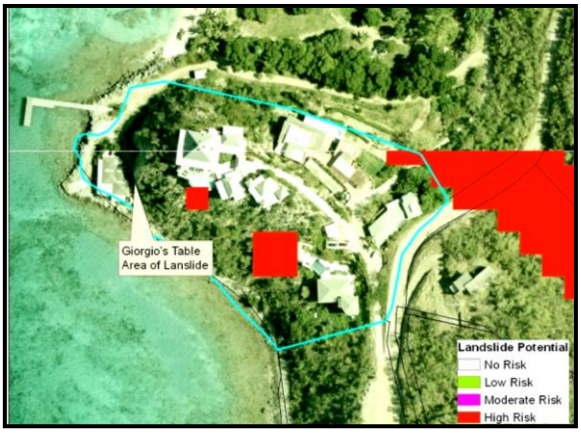


Photo 24.
2002 Aerial photo of Katitche Point (Maho Bay), Virgin Gorda, showing area of landslide (source: DDM, GoBVI).

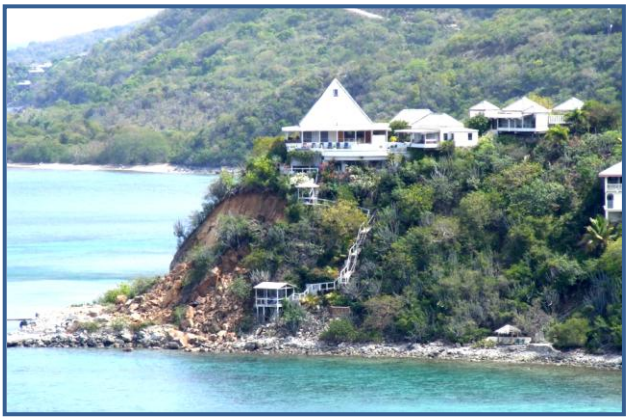


Photo 25.
Katitche Point (Maho Bay), Virgin Gorda, 6 May 2009, showing landslide (source: DDM, GoBVI).

3.1.2.2 Erosion

Due to Virgin Gorda's topography and steep slopes, land erosion is also a serious threat to the marine environment as a result of heavy rains and flash flood events. **Photo 26** shows sedimentation from a 2003 flood event at Nail Bay, where unpaved roads and poor land development practices contributed to severe sediment runoff and degradation of the coastal waters.

Studies undertaken on the neighbouring island of St. John in the US Virgin Islands have identified unpaved roads as the most important source of sediment on that island. These studies indicate unpaved roads erode at rates that may be up to 10,000 times higher than undisturbed hillslopes (Ramos-Scharrón, 2007/b). Current sediment yields from watersheds in St. John are three to nine times *higher* than what could be expected from undisturbed conditions (Ramos-Scharrón, 2007/a).

Photo 26.
Severe sedimentation from 2003 flooding at Nail Bay, Virgin Gorda.

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

3.1.3 Earthquakes

The northeastern Caribbean has the potential to experience earthquakes of magnitude 7.4 to 8.5 as has occurred during the twentieth and twenty-first centuries, on 8 October, 1974 and 29 November, 2007 (CDERA, 2003, taken from www.earthquake.usgs.gov/regional/neic).

The islands of the BVI are particularly vulnerable 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 11**). Intense earthquake activity is caused by faulting induced by the differential movements of the plates.

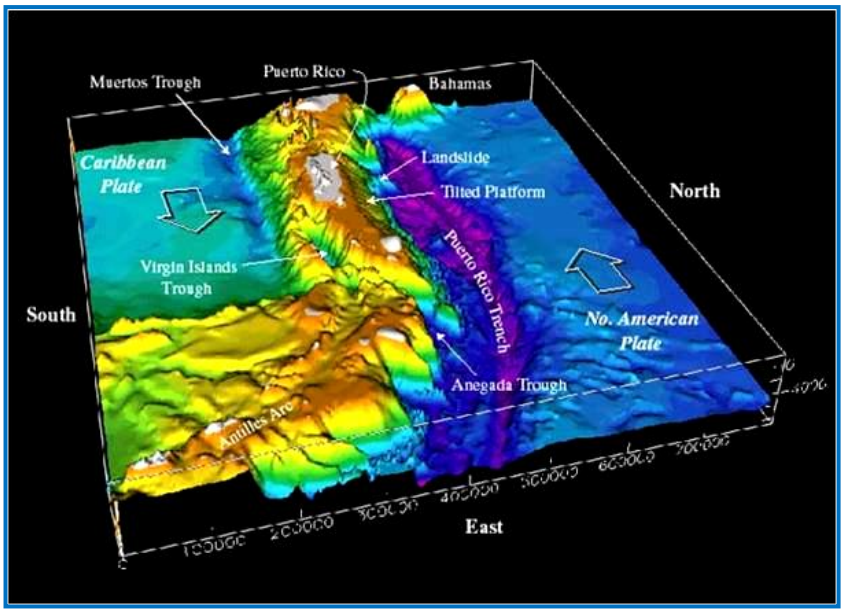


Figure 11.
Caribbean Tectonic Plate meets the North American Plate at the Puerto Rico Trench (source: US Geological Survey, Woods Hole Science Centre).

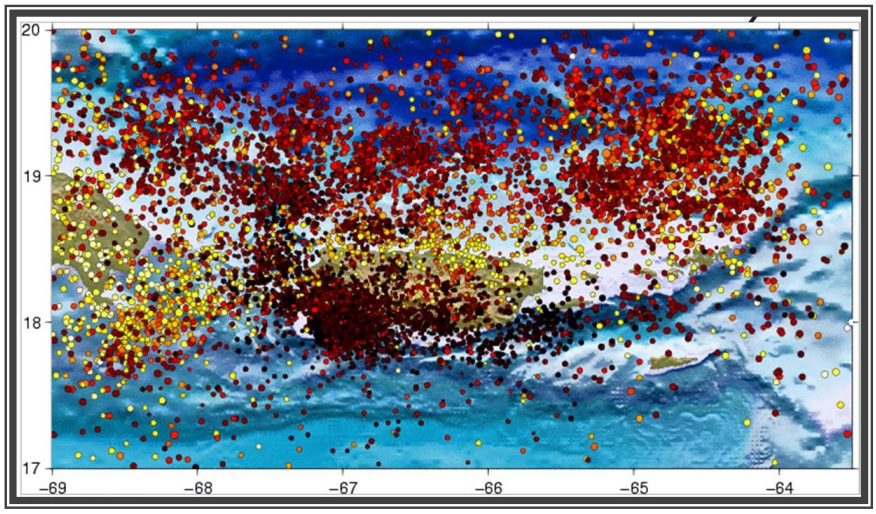


Figure 12.
Seismic activity on the northeastern boundary of the Caribbean Plate, 1995-2005 (source: Joyce, 2008).

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 12** represents the seismic activity that occurred over a 10 year period.

Tsunami hazards are highly relevant to the Virgin Islands. The November 8, 1876, Virgin Islands earthquake and the tsunami that closely followed caused considerable loss of life and damage in several places in the northeast Caribbean region (Barkan, 2010). Recent studies have been undertaken in the Virgin Islands to investigate the historical occurrence of tsunamis in the region. These investigations were undertaken by scientists with the United States Geological Survey and the National Oceanic and Atmospheric Administration. Further information on these studies can be accessed from the BVI's Department of Disaster Management.

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

> *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.*

3.1.4 Global Warming and Sea Level Rise

The British Virgin Islands, like all small islands, will be among 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).

In the Caribbean region, the projected changes of most concern include:

- rising temperatures;
- decreasing overall rainfall, accompanied by a change in rainfall patterns, so that more and heavier rain events (and therefore flood events) are likely;
- stronger, more persistent and devastating hurricanes, and
- rising sea level.

Recently, a comprehensive project was undertaken by the Department of Conservation and Fisheries to assess the potential impacts on the BVI from global warming and sea level rise. Findings of this project (entitled Adaptation to Climate Change in the Caribbean UK Overseas Territories) are identified in a Climate Change Green Paper (Burnett Penn, 2010), and a Climate Change Adaptation Policy and Strategy is expected to be placed before Cabinet in the near future (see also, Chapter 2, Section 2.1.5.9).

3.1.5 Technological or Man-made Hazards

Marine traffic, especially oil tankers and large cruise liners and cargo vessels in transit through the BVI's coastal waters, present the risk of major oil pollution from collisions, fires and explosions, and groundings. Damage from oil spills, or spills of other harmful products, is not limited to major incidents as 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 damage (DDM, 2009).

Operations such as fuel stations, garages, and auto repair shops pose the greatest risk for land-based pollution from spills, from fire and explosions, and from improper disposal of petroleum-based waste products. Many industries in the BVI use oil and other pollutants in large quantities on a daily bases. The presence of large quantities poses a hazard should there be an accident or if the products are not properly stored.

Disposal of oil and other pollutants is regulated and costly in the BVI, which has, in turn, lead to common disregard of regulations and widespread illegal dumping of such products. Many times the most likely place for such dumping is in remote and environmentally sensitive areas.

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 vertebrate and shell fish can be harmful to human health.

3.2 Natural Hazard Events and Associated Environmental Impacts

Table 14 illustrates the relationship between major ***Hazard Events*** encountered in Virgin Gorda, the ***Secondary Results*** of some of these Events, the ***Major Environmental Impacts*** that result from Hazard Events, and those ***Man-made Factors*** that exacerbate the negative consequences of each type of Hazard Event or its Secondary Result. To a large extent, the information presented in the table is derived from the long experience of the BVI's Department of Disaster Management and a consolidation of several disaster management studies undertaken in recent years.

Table 14.
Relationship of selected hazard events (and their secondary results), major environmental impacts, and man-made factors that increase those impacts.

Hazard Events	Important Secondary Results					Major Environmental Impacts								Man-Made Factors Increasing Hazard Event's Negative Impacts					
	High Winds	Coastal Flooding	Inland Flooding	Landslides	Tsunami	Loss of Species Diversity (Ecosystem Resilience)	Coastal Erosion	Sewage/Waste Contamination	Inland Sedimentation and Erosion	Reef Degradation	Loss of Land Productivity (Land Degradation)	Decreased Fisheries	Natural Habitat Destruction	Destruction of Functioning Coastal Ecosystems	Reefs Degraded from Run-off (sediment and sewage)	Accumulated Toxins (lack of proper sewage and waste treatment)	Weak Development Planning, Control, and Implementation Practices.	Loss of Natural Protective Buffers (e.g., wetlands, salt ponds)	Excessive Green House Gas (GHG) Production
Hurricane/Tropical Storm	X	X	X	X		X	X	X	X	X		X	X	X	X	X	X	X	X
Rain Events		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	
Sea Level Rise (or coastal subsidence)		X				X	X	X	X	X		X	X		X	X	X		X
Spills of Oil or Hazardous Materials		X	X			X		X		X		X	X	x	X	X	X	x	
Increased Temperatures	X					X				X	X	X	X			x			X
Increased Climate Variability	X	X	X				X		X		X		x	x	X		x	X	X

3.3 Development Trends Affecting Natural Hazard Risk

3.3.1 Reduction of Natural Environmental Defenses

Historically, tourism developments in Virgin Gorda have generally been built at a moderate pace, using relatively high-quality standards for design and construction. For the most part, major roadways in Virgin Gorda have been paved using grading and drainage methods, which—while not without issues—have nonetheless reduced the severity of impacts from recent rain events, particularly when compared with other areas of the Territory. Nevertheless, the island is not devoid of land-use practices that not only have impacted the environment negatively, but have also increased risks for Virgin Gordians from the consequences of natural hazard events. These practices have included:

- Removal or destruction of natural ecosystems, such as mangrove stands, mangrove wetlands, and salt ponds;
- Unpaved roads;
- Unstable slope cuts; and
- Inadequate setbacks from coastline and natural drainage ways (ghuts).

Mangrove wetlands provide protection from storms by reducing water flow and absorbing wave energy. As such, they provide the following eco-services:

- Storm protection and flood mitigation
- Shoreline stabilisation
- Erosion control
- Retention of nutrients and sediments.

Regarding the value of mangroves in particular, the World Bank (2010) has pointed out that:

> *The importance of mangroves was demonstrated by the Asian tsunami in 2004. Coastal areas with good mangrove forests suffered far less damage and loss of life than adjacent areas without mangroves.*

One analysis places a dollar value on mangroves at a healthy $400 per hectare *(Natural Hazards Observer*, 2012, **Figure 13**). In contrast to this stated economic worth of wetland resources, a local scientist in the BVI has asserted that more than 84 percent of the territory's original salt pond wetlands has already disappeared (Jarecki, 2004).

Figure 13.
One assessment of the value of mangroves (source: *Natural Hazards Observer*, 2012).

Coral reef ecosystems also protect shorelines by reducing storm impact and routine erosion from wave action. Continued impact to these systems from land-based sedimentation runoff increases the risk to adjacent communities, private property, and infrastructure as more of these protective natural barriers are degraded or lost.

As development continues in Virgin Gorda—spearheaded by population growth and emphasis on tourism especially in the North Sound—pressure to exploit natural resources, particularly in coastal areas, will continue. Because there is now more local awareness about the productivity and utility of wetlands, public and private sector planners and developers in the BVI often acknowledge the need to protect these defense systems provided free of charge by Mother Nature.

Nevertheless, it is still too common for development activities to move ahead without sufficient mitigation measures in place to ensure the survival of these protective ecosystems. Rather, these very systems are often the first to be sacrificed to the requirements of coastal development expansion.

But Virgin Gorda does so at its own risk, namely, the loss of naturally occurring and freely given environmental defenses to withstand the consequences of natural disasters—which will continue to occur and to which the island will always be subjected.

3.3.2 Planning and Building Regulations

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

Hazard vulnerability assessment reports are based on geological mapping and scientific models. In addition (and as important as the hazard data), the DDM requires recommendations for mitigation measures specific to each development and each hazard identified within the proposed project.

Mitigation recommendations may include the following:

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

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;
- Wind and wave hazard maps;
- Reclaimed land maps;
- Solid and surficial (drift) geology maps and engineering characterisation;
- Landslide susceptibility, liquefaction susceptibility and shaking amplification maps at high resolution;
- Quantitative risk assessment for critical BVI infrastructure, based on an evaluation of the engineered construction of 53 individual buildings to determine their vulnerability during a design hurricane and earthquake;
- Development and implementation of quantitative risk assessment methodology, with model runs for critical infrastructure; and
- Compilation of multi-hazard risk map for "model housing" in the BVI and ongoing development of specific outreach materials for dissemination of project results.

The DDM is also working with DTCP to identify development applications requiring a geotechnical study to determine adequate design criteria for projects 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 amongst key public-sector agencies overseeing land development in the Territory.

Issues, Conflicts, and Areas of Concern	Impacts of No Action/No Change	Short-term Options Long-term Recommendations
ISSUE ONE To ensure that safe and sustainable development is achieved in the British Virgin Islands, design requirements applied to development projects (both public and private), and to the construction methods to be employed, need to incorporate appropriate building standards to deal with the following natural hazards: – 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, including Virgin Gorda, 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 natural disasters. Historically, many public development projects, (roads, docks, harbour facilities, buildings) have been implemented without meeting the requirements of the Physical Planning Act (2004), with the Leverick Bay road and the South Sound greenhouses being key examples in Virgin Gorda. Poor development practices employed in the public sector have too often been the result of inadequate planning, including poor drainage, unstable slope angle, and lack of mitigation measures to offset negative impacts. The consequences of such actions add to the risk levels borne by Virgin Islanders and convey a negative and conflicting message to the general population. *(continued)*	**SHORT-TERM OPTIONS** 1. The Government of the BVI should take steps to: **(a)** Improve mitigation planning within the key government departments and agencies charged with land use planning, development control, natural resource management, and disaster management. **(b)** Incorporate setbacks for development activities in identified "high-hazard" areas. **(c)** Ensure that all aspects of proposed developments first address and then integrate topographic and natural features in the design and layout of projects. **(d)** 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, etc.). **(e)** Ensure that government-sponsored development projects are subjected to the planning requirements detailed in the Physical Planning Act (2004). **(f)** Promote a multi-hazard approach to physical planning. **(g)** Involve a multi-disciplinary team approach to physical planning, including professionals with local knowledge and a variety of technical expertise and background. **LONG-TERM RECOMMENDATIONS** 1. Over time, the Government of the BVI should implement the following: **(a)** Approve Regulations under the Physical Planning Act of 2004 (see Chapter 2, Section 2.1.4.2), including regulations for measures to protect natural barriers that reduce the impacts of natural hazards. **(b)** Complete, approve and implement the draft Wetlands Management Plan (DTCP, 2005). **(c)** Integrate hazard data into the National Physical Development Plan.

Issues, Conflicts, and Areas of Concern	Impacts of No Action/No Change	Short-term Options Long-term Recommendations
	If public projects continue to be implemented without being subject to the same planning process as the private sector, there is a high probability that the general population will also continue to follow poor development practices. Development of public projects should provide an example to the population of how to design and construct with the least possible impact to the environment and minimal risk to the population.	**LONG-TERM RECOMMENDATIONS (continued)** **(d)** Require all roads to be paved and incorporate proper drainage measures. **(e)** Establish and enforce adequate setback requirements for drainage ways (ghuts) and all coastal developments. **(f)** Increase lot-size requirements for developments on steep slopes. **(g)** Strengthen environmental monitoring, particularly for beaches, wetlands, mangroves, and watersheds. **(h)** Continue to ensure that all public development projects are subject to the same planning requirements as private development projects.

4. BIODIVERSITY RESOURCES: THE TERRESTRIAL ENVIRONMENT

This chapter on the terrestrial environment of Virgin Gorda focuses on the flora, fauna, natural habitats, ecology and landscapes of the island or, in other words, the island's biodiversity. It includes not only the island of Virgin Gorda but also the nearby islands of Mosquito, Prickly Pear, Eustatia, Saba Rock, Necker, the Dogs (Great Dog, West Dog, George Dog, East Seal Dog, North Seal Dog, George Dog and Cockroach), Fallen Jerusalem, Broken Jerusalem, and Round Rock.

Although many of the surrounding islands are included in the analysis, assessment and reporting, some remain relatively obscure, and their overall resources little understood and known. Further work beyond the scope of this *Environmental Profile*, will help to elucidate the unique conditions and characteristics of these lesser-known places. Our overall knowledge of the larger islands of Virgin Gorda, Mosquito, Necker, Prickly Pear, and Eustatia is a little better, but there also are large gaps in our understanding of these places.

It is tempting to imagine what the natural world must have been like in the Virgin Islands before the arrival of humans. The earliest Amerindian inhabitants brought with them species new to the islands. As a result, the landscape and ecology began to change; for the first time, humans were able to insert themselves into the geography of the place. They began to purposely manipulate the natural conditions, manage the landscapes, utilise the ecosystems—in order to extract specifically desired results to meet their needs.

This new order—the human period in these islands—brought new species, new ecosystems, new ecological opportunities, and a changed reality. Humans also increased the rate of extinction much more quickly than the islands had previously experienced.

When Europeans took up residency, a new period of human domination commenced. The changes and impacts they brought became increasingly dramatic over time. Today, for the most part, Virgin Gorda and its nearby neighbours only vaguely resemble their former selves. Very little of the original forests and woodlands remain, and many species have disappeared, some sadly forever.

Most of the vegetation of today is secondary and in some places quite degraded. Humans, through their actions and behaviours, continue to have a huge impact on the flora and fauna of Virgin Gorda and nearby islands and cays. For example, livestock, especially goats, have created communities of plants that are dominated by unpalatable species—crotons or thorny non-native species such as members of the Acacia family and Tan Tan (*L. leucocephala*).

Despite today's efforts to address the consequences of environmental decline, the Virgin Islands, including Virgin Gorda, continue to undergo change—to the landscape and to the environment—and much of it is to the detriment of the Territory's biodiversity and its people.

4.1 An Overview of Biodiversity Research

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.

Botanists such as Henrik (or Heinrich) Franz Alexander Baron von Eggers (1844-1903), a Danish soldier and botanist, spent many years exploring and discussing the flora and fauna of Virgin Gorda and other Virgin Islands (British and Danish). He had such a profound effect on this region that many of its plants are named for him (often in the form of *eggersiana*).

Another early scientist was Nathaniel Lord Britton (1859-1934), founder of the New York Botanical

Garden. Briton was a renowned plant expert whose influence on the study and understanding of the flora of the Virgin Islands is unquestioned.

Others followed, such as James S. Beard (1916-2011), a British-born forester who today is remembered for his remarkable definition and circumscription of the Caribbean's vegetation classification. His multi-volume work, *The Natural Vegetation of the Windward and Leeward Islands* (1949), provides one of the most striking, and perhaps most lasting, descriptions of Caribbean vegetation and flora.

Today, researchers such as Eleanor Gibney and Dr. Gary Ray of the US Virgin Islands and the late Raymond Walker of the British Virgin Islands have had a significant impact on our understanding of the plants of both the USVI and BVI.

The study of the fauna of the Virgin Islands has included a number of prominent experts. 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*, 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, entitled *Reptiles and Amphibians of the Virgin Islands*. It remains the single most comprehensive publication of its kind for the Virgin Islands.

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 natural heritage of the British Virgin Islands.

4.2 Vegetation and Flora

From afar, Virgin Gorda appears as a soft verdant mountain with thin distant flanks snaking away on either side of Gorda Peak. Valleys plunge from steep buttresses, with shadows hiding the complex dimensions of landscapes. Trees, vines, shrubs and small plants lock, interlock and rhythmically sway back and forth, clothing the island's majestic peaks. From certain angles, the island does live up to its historic description—"fat virgin"—as it appears so much larger than it actually is.

The eastern peninsula of Virgin Gorda—like an arm lazily resting astride the earth's horizon—displays colours of browns, golds, and greens, thoughtlessly enmeshed to create a vibrant dry landscape. When the rains are scarce, it almost seems dead and wilted, but looks can be deceiving. The seemingly dry scrubby appearance of much of Virgin Gorda's vegetation masks the ecological diversity that is this island.

Virgin Gorda supports rich vegetation communities comprised of native plants. Some of these can be found amongst the massive boulder fields of both Virgin Gorda and Fallen Jerusalem. Other examples include the aggregations of terrestrial *Epidendrum ciliare* communities that are established on Gorda Peak, and the desert-like scrub communities that can be observed on the east end peninsula.

And yet, despite what we know, there is much that we still need to learn. Many rare plants have yet to be located and identified. Complex ecological processes, seasonal cycles, and plant-landscape-fauna relationships that ensure species survival—all need to be better understood.

There are over 600 species of native and naturalised plants found on Virgin Gorda and nearby islands (native refers to species that occur here naturally, and naturalised means those species that arrived here through some human intervention and are now established in the wild).

The native plants of Virgin Gorda are closely related and allied to those from across Puerto Rico and the rest of the Virgin Islands archipelago. Many species are unique to the islands of the Puerto Rico Bank and to the wider West Indian biogeographic region. **Table 15** provides an overview of the plant species for Virgin Gorda and neighbouring islands, including the number of regional endemics. As plant scientists continue their work across the Virgin Islands, these numbers are likely to be revised and refined.

As land was cleared, landscapes altered, and native ecosystems disrupted, many species have declined or found it difficult or impossible to adapt. It is not known if any plant species went extinct, but given similar histories and events in nearby islands, it is more than likely that some did. Other species are now rare and are limited to small patches of scattered habitats.

Additionally, human settlement has permitted the deliberate or accidental introduction of numerous exotics. The majority of deliberate introductions have been for agriculture production. But most plant introductions are accidental in that they arrived as stowaways.

Species introduced to the Virgin Islands evolved in their native environments along side of other species that provided effective means of control. However, in their new Virgin Islands environment, many have become invasive, largely because very few native species are able to stop their spread. As a result, these introduced, so-called exotics are displacing native plants and are creating disorder and destruction within many island habitats.

There are now over 100 non-native, naturalised plant species in Virgin Gorda and nearby islands, and this number is growing. Of this 100, a handful of species are considered seriously invasive, meaning that they displace native species and disrupt natural ecological processes and functions, often driving plants and animals to extinction.

4.2.1 Vegetation Communities

The vegetation of Virgin Gorda and nearby Profile islands consists primarily of seasonal-deciduous forests, woodlands, shrublands and a few man-grove wetlands. Virgin Gorda possesses the most diverse and complex community types, while the nearby smaller islands are dominated by small patches of forests, woodlands, grasslands and shrublands.

4.2.1.1 Historical Studies of Virgin Gorda Vegetation

The vegetation of the Virgin Islands was first described by Danish soldier and botanist, Heinrich Franz Alexander Baron von Eggers in 1879 in his work *The Flora of St. Croix and the Virgin Islands*. His work focuses mainly on the then-Danish island of St. Croix. By the time he arrived in the Danish West Indies, most of the Virgin Islands had been transformed by agriculture and human settlement, and little of the original vegetation remained. He observed that livestock and small-scale farming had created extensive croton shrublands (*Croton spp.* are unpalatable to most livestock).

At the time, there were few roads on Virgin Gorda, and none of the cays supported extensive development. Residents moved from remote locations around the island or to other islands by boat. Because roads are usually a pathway for further development, this relative lack of road infrastructure meant that, despite deforestation, lands left untended quickly reverted to vegetation cover.

Eggers provided the first comprehensive list of plants of the Virgin Islands, including Virgin Gorda, though the island's list at the time was relatively short.

It is by understanding Eggers's work that we are able to deduce that at the time of his studies, much of Virgin Gorda west of Gun Creek had been cleared with only small scattered patches of forests and woodlands remaining. Areas west and northwest of Gorda Peak were in small plots of

cotton or other crops and in pasture used for grazing cattle and small ruminants.

The neighbouring islands seemed to have undergone similar changes. Mosquito Island was used for many years as pasturage for sheep and goats, and undoubtedly so was Prickly Pear and Eustatia.

In 1949, J.S. Beard published his well-known work on the vegetation of the Lesser Antilles and the British Virgin Islands, *The Natural Vegetation of the Windward and Leeward Islands*. Beard provided a summary description of Virgin Gorda and of its vegetation (he did not undertake a similar effort for the cays).

By 1949, croton shrublands dominated Virgin Gorda, and presumably some of the offshore islands, due to grazing by goats and other livestock. However, some reforestation had begun to occur, especially around Gorda Peak and the eastern peninsula.

In 1976, Elbert Little, *et al.*, of the Institute of Tropical Forestry in Puerto Rico, described the flora of Virgin Gorda in their *Flora of Virgin Gorda (British Virgin Islands)*. Little provided an overview of the island's flora and a summary of its vegetation, which in his view had not changed much from the time of Beard. Little also provided an extensive list of the native, naturalised and cultivated plants of the island. However, the team did not provide any views on the vegetation and flora of the neighbouring islands and cays.

In the intervening decades, researchers and conservationists have attempted to refine the extant descriptions of the vegetation and flora of the Virgin Islands and bring them in line with modern classification systems. The most comprehensive and extensive of these were developed by the Conservation Data Centre at the University of the Virgin Islands (CDC, 2004) and by Kennaway, *et al.* (2008). The CDC's work involved extensive data analysis and fieldwork, and the latter used aerial imagery and some fieldwork to map vegetation.

Together, these two efforts produced the most up-to-date and modern views of Virgin Islands vegetation. Using new methods of classifying plant communities and tracking human actions, vegetation has been mapped and documented (see below **Figure 14**). As this work continues, further definition, refinement and review will add more understanding to our knowledge about the flora and vegetation communities.

Based on prior and current studies, today the vegetation of Virgin Gorda and its neighbouring islands and cays is divided into six broad forms:

- Woodlands and Shrublands
- Forest
- Wetlands
- Herbaceous Community
- Sparse Vegetation
- Developed Areas

Each of these categories is further refined into more discrete alliances to Include 23 vegetation types (**Table 15**).

Most of the vegetation of the Profile islands is secondary or has undergone human-induced changes, including clearing for agriculture and construction and for fuel wood. A number of Virgin Gorda's plant communities are recent creations, modern developments resulting from past land-clearing and other human activities. The resulting vegetation types are wholly or mostly artificial in nature.

4.2.1.2. Virgin Gorda Vegetative Types

The single most extensive area of forest is centred on Gorda Peak. The vegetation is a mix of evergreen, semi-evergreen, deciduous forests and woodlands. On the eastern peninsula, and remote and undeveloped headlands, the vegetation consists of dry deciduous shrublands, woodlands, patches of grasslands and sparse vegetation.

Table 15.
Vegetation alliances and community types for Virgin Gorda and nearby islands.

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

Source: Adapted from Kennaway, *et al.* (2008). Also, see Figure 13.

Along the islands' shores are hedges of coastal woodlands, wetlands, desert-like shrublands, exposed rock pavements and grasslands. Virgin Gorda and some of the larger islands in North Sound have coastal fringing mangroves, salt ponds, salinas (or salt flats), and, in a few locations, mangrove forests and woodlands. However, these wetlands are in rapid decline due to coastal development, coastal erosion, pollution, sea level rise and storm damage.

Most of the coastal wetlands around Spanish Town, at Little Dix Bay, and other Virgin Gorda locations have been filled or significantly altered. **Photo 27** shows a typical area of fringing coastal mangrove woodland along Biras Creek.

Photo 27.
Coastal red mangrove woodland at Biras Creek, Virgin Gorda.

On the southwestern coast of Virgin Gorda (and also on Fallen Jerusalem), a unique geologic feature of rock outcrops—referred to as boulder fields—can be found, consisting of large boulders, many measuring over 10 m (33 ft) in diameter. Formed over 50 million years, these boulders are the result of intense chemical and physical weathering.

Throughout the boulder field area, piles of rocks often perch precariously on top of each other. This allows a complex desert-like vegetation community of plants of varying formations to occur. On the lower and smaller boulder fields, shrub and low woodland growth persists. On the larger boulder fields, a unique woodland and epiphytic herbaceous community persists. It is dominated by dry deciduous and a few evergreen species, including Turpentine (*B. suberosa*) and Clusia (*C. rosea*). These species often become lithophitic—growing on rocks like epiphytic plants, sending their roots down between the rocks to the ground below (**Photo 28**).

Amongst the trees and shrubs growing on the rocks are epiphytic herbs of bromeliads, cacti, and orchids, some forming extensive colonies. At this location, IRF researchers found formations of three unreported bromeliads: *(i) Hohenbergia sp.,* (ii) *Tillandsia fasciculata*, and *(iii)* a hybrid between *T. fasciculata* and *T. utriculata*.

Also found were collections of the beautiful Eyelash Orchid (*E. ciliare*). Many species of this area have not been previously reported for Virgin Gorda, and because we know so little about the area, there is still much to learn.

On **Mosquito Island**, the northern and northwestern slopes support evergreen forests dominated by Coccothrinax palms (broom palms), seasonal semi-deciduous forests and woodlands, coastal shrublands, sparse rocky areas of vegetation with numerous species of cacti including the rare *Mammilaria nivosa*.

On this island, there are a few specimens of the extremely rare West Indian endemic palm *S. causarium*. This species is now largely extinct in the wild in the British Virgin Islands and persist mainly in gardens around settlements. Mosquito Island has one of the few wild populations.

Photo 28.
Vegetation located in the northern sections of the boulder fields, Virgin Gorda, covered with bromeliads, orchids, cacti, and trees growing on rocks.

In the past, this palm would have formed extensive evergreen forests, mixing with the more common *Coccothrinax barbadensis*, which was highly prized early in the last century to make baskets, hats and other local materials. On Virgin Gorda, this species is now quite rare and absent from most of the island. **Photo 29** shows the evergreen palm forest on Mosquito Island.

On nearby **Prickly Pear Island**, free-roaming goats have overgrazed the landscape and have created what are termed "goat climax" plant communities, which are dominated by unpalatable species, the most common of which are *Croton spp*. Goats will eat all palatable plants down to stumps, and the result is the elimination of most species, a disruption in ecological processes, severely reduced biodiversity, erosion and eventually species extinction.

Prickly Pear cannot support sustainable populations of livestock, given its degraded condition. Over time, the goats have become so desperate for edible plants that they are now eating beach and wetland plants including Red Mangroves (*R. mangle*), a plant species that is relatively high in tannins used for dyes or tanning. It is not a species preferred by most livestock, but it may indicate the level of need by the goat population.

The vegetation of **Eustatia Island** consists primarily of low patches of woodland, shrubland, grassland and cacti.

Although **Necker Island** is now a resort, much of it is undeveloped. Its vegetation is somewhat similar to Eustatia, though grasslands and open shrublands are more widespread (**Photo 30**).

Photo 29.
Evergreen palm forest (commonly named broom palms) along the northwestern slopes of Mosquito Island.

Photo 30.
Vegetation on northern section of Necker Island.

The Dogs are steep rocky outcrops, and the vegetation is similar to Eustatia. For the islands on the southwestern end of Virgin Gorda including **Fallen Jerusalem**, the vegetation is somewhat similar to the shrub communities of the boulder field area of Virgin Gorda, with the absence of most of the epiphytes. **Round Rock** is steep and consists primarily of grasslands, patches of shrub growth and cacti.

Figure 14 provides a map of the vegetation communities of Virgin Gorda and neighbouring islands.

4.2.2 Plant Species

There are over 600 species of native and naturalised plants recorded for Virgin Gorda and surrounding islands spread across nearly 100 families. Of these, 265 are herbaceous in nature, 135 are shrubs, 148 are trees and 78 are vines. Over 500 species are native, and about100 species have been introduced and are now naturalised. There are a number of unique and range-restricted species (*i.e.*, species that are found on only a few or one island in the West Indies). Some are quite rare and found in few small populations.

With the loss of much of the native vegetation, the survival of many of these species is very precarious, and in some cases it is only a matter of time before they are rendered extinct.

In the past, plants declined because of clearing for agriculture and, to a lesser extent, the development of towns and villages. Today, the primary cause of the decline of native plant flora is coastal development (housing and tourism-related), urban expansion, and infrastructural development.

Some of the declining habitat areas are very important for the continued survival of rare, endemic and threatened species. These include:

- dry woodlands and shrublands on the eastern peninsula,
- seasonal woodlands on the western and northwestern slopes of Gorda Peak,
- coastal hedges, mangroves and salt ponds,
- the boulder fields, and
- the offshore cays.

Habitats and plant species of *Special Conservation Concern* are discussed in Section 4.2.3. A comprehensive list of the plants of Virgin Gorda and its associated islands is provided in a supplemental document to this Environmental Profile and is available at IRF's website at www.irf.org.

Unlike many of its neighbours in the Caribbean region, Virgin Gorda—and to some extent its nearby satellite islands—seems to have an unusually high number of herbaceous plants. Herbs represent over 42 percent of the island's plant species. In other islands, that number is usually around 29 to 35 percent. What is the reason for the seemingly disproportionate representation of these plants in the flora of Virgin Gorda?

It is not yet well understood, but, on speculation, it might be that in the past, when the climate was drier, Virgin Gorda had more extensive natural herbaceous and grassland savannas than its neighbours, especially on its eastern peninsula and offshore cays. As a consequence, most of the species today may be relicts from these now long-disappeared habitats.

Another explanation could be that because most of the herbaceous plants are grasses and sedges—species that are easily transported—many of the plants may have accidentally arrived or were deliberately brought to provide fodder for livestock.

Table 16 provides a summary of the physiognomic features of plants found on Virgin Gorda and its neighbouring islands.

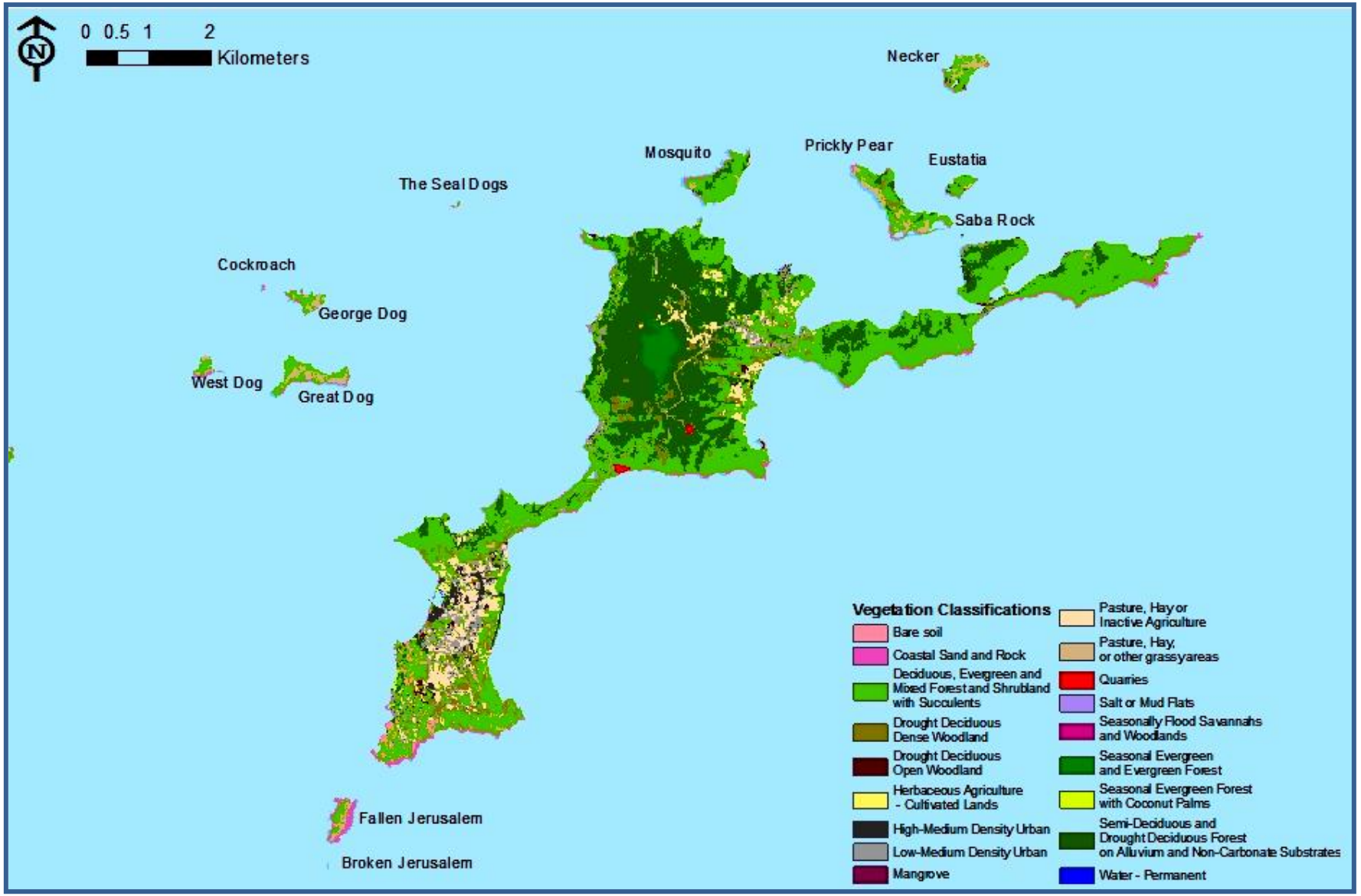


Figure 14.
General vegetation map of Virgin Gorda and nearby islands (source: Kennaway, *et al*., 2008)

Table 16.
Physiognomic categories of plants found on Virgin Gorda and neighbouring Islands.

Category	Numbers	Percentage
Herbs	265	42%
Shrubs	135	22%
Vines	78	12%
Trees	148	24%
TOTAL	**626**	**100%**
Plant Families	98	
Native	520	83%
Introduced	106	17%

4.2.3 Species and Habitats of Special Concern

4.2.3.1 Plants Species of Special Conservation Concern

There are approximately 70 species of plants of *Special Conservation Concern* on Virgin Gorda and its nearby satellite islands. Many of these species are range-restricted species, including rare and vulnerable species endemic to the West Indies and those endemic to the British Virgin Islands, the wider Virgin Islands, the Puerto Rico Bank, and the Greater Antilles. Three species are restricted to the BVI, and six species are found only in the Virgin Islands (US and British).

Many of the *Species of Special Conservation Concern* are limited to specific habitat types, and some have been reduced in population and distribution by deforestation and disturbance (**Table 17**). The species of plants listed include many that are range-restricted (West Indian endemics) and some that are found further afield. Most are native to Caribbean islands.

The IRF research team determined the conservation status of listed species by using a number of sources, including:

- the team's extensive field knowledge and experience,
- previous studies and reports,
- expert opinions, and
- local knowledge.

IRF's methodology for reaching its status determinations does not fully satisfy the requirements of the global-standard IUCN guidelines, largely because of local data limitations. Nonetheless, we have followed the general precepts of the IUCN approach, and pending additional detailed studies, we are confident these status determinations are congruent with IUCN standards.

Three of the categories used by IUCN to denote conservation status were employed in the table to express tentative ranking for each species.

Table 17.
Plant species of special concern for Virgin Gorda and neighbouring islands.

ENDANGERED | THREATENED | VULNERABLE

NO.	SPECIES	DISTRIBUTION	STATUS
1	*Agave missionum*	PR Bank Endemic	
2	*Argusia gnaphalodes*	WI Endemic	
3	Avicennia germinans	Neotropics & W. Africa	
4	*Brassavola cucullata*	Neotropics	
5	*Calyptranthes kiaerskovii*	BVI Endemic	
6	*Calyptranthes thomasiana*	VI Endemic	
7	*Catesbaea parviflora*	WI Endemic	
8	*Chromolae nasinuata*	WI Endemic	
9	*Coccoloba* cf. *Costata*	Greater Antilles Endemic	
10	*Coccothrinax barbadensis*	Caribbean Endemic	
11	*Conocarpus erectus* var. *erectus*	Neotropics; W. Africa	
12	*Consolea rubescens*	WI Endemic	
13	*Cyperus nanus*	WI Endemic	
14	*Croton fishlockii*	VI Endemic	
15	*Eugenia cordata* var. *cordata*	WI Endemic	
16	*Eugenia cordata* var. *sintenisii*	WI Endemic	
17	*Erythroxylum rotundifolium*	Greater Antilles and Mexico	
18	*Forestiera eggersiana*	WI Endemic	
19	*Furcraea tuberose*	WI Endemic	
20	*Galactia eggersii*	VI Endemic	
21	*Guaiacum officinale*	Neotropics	
22	*Guapira* sp. ✳	Virgin Islands	
23	*Hernandia* sp. ✳	Virgin Gorda	
24	*Hohenbergia* cf. *antillana* ✳	PR Bank Endemic	
25	*Hohenbergia* sp. ✳	Virgin Gorda	
26	*Ipomoea steudelii*	Greater Antilles Endemic	
27	*Ipomoea tiliacea*	Neotropics	
28	*Ipomoea triloba*	Neotropics	
29	*Jacquemontia cumanensis*	WI Endemic	
30	*Jacquemontia havanensis*	WI and N. America	
31	*Laguncularia racemosa*	Neotropics and W. Africa	

NO.	SPECIES	DISTRIBUTION	STATUS
32	*Lepidaploa sericea*	Greater Antilles Endemic	
33	*Machaonia woodburyana*	VI Endemic	
34	*Malpighia coccigerasubsp.coccigera*	WI Endemic	
35	*Malpighia infestissima*	Greater Antilles Endemic	
36	*Mammillaria nivosa*	WI Endemic	
37	*Maytenus cymosa*	PR Bank Endemic	
38	*Maytenu slaevigata*	WI Endemic	
39	*Melocactus intortussubsp. Intortus*	WI Endemic	
40	*Metastelma anegadensis*	VI Endemic	
41	*Metastelma decipiens*	WI Endemic	
42	*Mimosa ceratonia*	WI Endemic	
43	*Mitracarpus polycladus*	Greater Antilles Endemic	
44	*Mosiera xerophytica*	PR Bank Endemic	
45	*Myriopus microphyllus*	WI Endemic	
46	*Nashia cf. Inaguensis*	Greater Antilles Endemic	
47	*Neea buxifolia*	PR Bank Endemic	
48	*Opuntia dillenii*	Tropical America	
49	*Opuntia repens*	PR Bank Endemic	
50	*Ourate alitoralis*	Greater Antilles Endemic	
51	*Phoradendron racemosum*	Neotropics	?
52	*Pilosocereu sroyenii*	WI Endemic	
53	*Psychotria glabrata*	Greater Antilles Endemic	
54	*Rhizophora mangle*	Tropics	
55	*Rhoeos pathacea*	Tropical America	
56	*Ruellia coccinea*	WI Endemic	
57	*Sabal causiarum*	WI Endemic	
58	*Scaevola plumier*	Tropics	
59	*Securidaca diversifolia*	Neotropics	
60	*Solanum conocarpum*	VI Endemic	
61	*Stenocereus fimbriatus*	Greater Antilles Endemic	
62	*Suriana maritime*	Neotropics; Africa	
63	*Tetramicra elegans*	WI Endemic	
64	*Tetrazygia angustifolia*	WI Endemic	
65	*Tetrazygia elaeagnoides*	WI Endemic	
66	*Tillandsia fasciculate*	Neotropics	

NO.	SPECIES	DISTRIBUTION	STATUS
67	*Tillandsia x lineatispica*	WI Endemic	
68	*Tolumnia variegate*	GA endemic	
69	*Vachellia anegadensis*	BVI Endemic	
70	*Vigna luteola*	Neotropics	
71	*Xylosma buxifolia*	WI Endemic	
72	*Zanthoxylum thomasianum*	PR Bank Endemic	
73	*Ziziphu srignonii*	WI Endemic	
74	*Zygia latifolia* var. *Latifolia*	Neotropics	

TABLE KEY:

? **Status is tentative at the moment.**

✳ **Recently encountered by the IRF team, as yet unidentified; complete taxonomy has not yet been confirmed. These could represent widespread species, new species, or recent introductions. Further research is needed to determine their exact status.**

cf. **Abbreviation for *"confer,"* suggesting that the plant in some way resembles the typical form of a known species but may represent some other.**

var. **Abbreviation for "*variety*."**

x. **The placement of "x" between the genus and the species name denotes a species of hybrid origin. For example, *Tillandsia* x *lineatispia*.**

subsp. **Abbreviation for the term subspecies.**

4.2.3.2 Habitats of Special Conservation Concern

(1) Coastal Wetlands and Fringing Mangrove Communities

Coastal wetlands are some of the most endangered ecosystems in the British Virgin Islands, and indeed the rest of Caribbean. The limited availability of flat land, coupled with increased coastal development pressures from tourism, commercial real estate, and high-end home construction, have all placed demands on coastal habitat and encouraged their conversion from natural areas to development uses.

Since the 1960s, Virgin Gorda has lost about one-third of its coastal wetlands.* Almost as much or more of its fringing mangrove communities are now gone.

The last reported sighting of the Virgin Islands Crested Toad (*P. lemur*) occurred prior to the filling of native aquatic marshes for development of the Little Dix Bay resort in the 1960s. For decades, such losses were little noted and little significance was attached to wetland survival—perhaps because it was generally assumed wetlands haboured diseases and bred mosquitoes and other pestilence. But today, the significance of wetland habitats and the imperative to protect remaining coastal wetlands is more clearly understood and needs to be more aggressively pursued (see also Section 4.4.2 of this Chapter and Section 3.3.1 of Chapter 3).

Significant to the composition of coastal wetland flora are the sedges and reed species. **Table 18** lists native species that are essential to the formation and functions of coastal wetlands.

* This number was derived from analysis of historical maps and other sources to determine the historical extent of coastal wetlands and when and how they were lost. "*Lost*" in this instance means completely destroyed (not altered).

Table 18.
Native sedges and reeds of Virgin Gorda's wetlands.

Species	Status
Cyperus articulatus L.	Native
Cyperus compressus L.	Native
Cyperus confertus Sw.	Native
Cyperus elegans L.	Native
Cyperus involucratusRottb.	Considered rare on VG.
Cyperus laevigatus L.	Native
Cyperus ligularis L.	Rare? WI endemic.
Cyperus nanusWilld.	Rare
Cyperus odoratus L.	Common on dry slopes
Cyperus planifolius Rich.	Rare?
Cyperus polystachyosRottb. var. polystachyos	Common?
Fimbristylis cymosa R. Br.	Native
Fimbristylis dichotoma (L.) Vahl subsp. dichotoma	Native
Fimbristylis ferruginea (L.) Vahl	Native
Fimbrstylis sp.	Rare?
Rhynchospora berteroi (Spreng.) C.B. Clarke	Locally common to uncommon.
Rhynchospora ciliata (G. Meyer) Kükenthal	Locally common.
Rhynchospora contracta (Nees) J. Raynal	Considered rare on VG.
Rhynchospora rariflora (Michx.) Elliott	Considered rare on VG.
Scleria gaertneri Raddi	Common
Scleria lithosperma (L.) Sw.	Considered rare on VG.
Scleria microcarpaNees ex Kunth	Locally common

Fringing mangroves are a type of coastal wetlands that deserve special mention. They too are fast-disappearing from Virgin Gorda and its satellite islands as a result of coastal development. All four mangrove types have now become vulnerable to local extirpation (see also Chapter 5 and Section 4.4.2 of this Chapter).

(2) Native Grasslands

Native grasslands and scrubland glades have escaped the attention of experts for many hundreds of years. It was often believed that for these to be viable ecosystems of natural origin, they had to cover dozens of hectares in extent. J.S. Beard in his 1949 work on the Caribbean's flora, forests and woodlands did not describe the small patches of native grasslands that were common throughout the region. Instead, Beard focused on the natural savannas in Barbuda and on artificial grasslands created for pasture or as a result of farming.

Because native grasses and shrubs occurring in coastal habitats and some upland areas were so little understood and appreciated, many were systematically destroyed and their faculties quickly dispatched for the cultivation of crops and to provide forage for domestic livestock.

In an excerpt from *Island Peak to Coral Reef: A Field Guide to the Plants and Marine Communities*

of the Virgin Islands (Thomas and Devine, 2005, page 65), botanist Dr. Gary L. Ray, an expert on Virgin Islands flora and a resident of St. John, describes the unique native grasslands of the VI, carefully explaining:

> *… [W]hat makes the community unique is a combination of what ecologists have termed a "cryptogamic soil crust," which is a thin, cohesive coating of the top layer of soil occurring in gaps among the grasses clumps. These soil crusts are composed of lower biotic forms, such as cyanobacteria, algae, fungi, lichens, and mosses, all of which reproduce by spores or fission. The cyanobacteria fix atmospheric nitrogen, and the mycorrihizal fungi supply plants with phosphorous, thus amending and sustaining the nutrient balance of the soil. Particular species of fungi produce filaments that associate with roots of orchid species, allowing them to gain critical nutrients. The soil crust prevents wind and water erosion, which would eliminate the fine soil particles, spores, and nutrients critical to the integrity of this extraordinary ecosystem.*

Dr. Ray has speculated that this community was once quite common but is now largely destroyed, primarily by goat grazing on the small cays. On Virgin Gorda, the cryptogramic soil crust that is so characteristic of this ecosystem has mostly disappeared after hundreds of years of continued human occupation, free-roaming livestock grazing, and destructive land-use practices. At the eastern peninsula, many abandoned dry coastal areas have relicts of native grasslands and some communities continue to support native grassland species, although these continue to struggle as non-native species of grasses dominate.

Grasslands are entirely absent from the island of Prickly Pear, but small patches of these grasslands remain on Mosquito Island, and are likely present on Necker, the Dogs, and other offshore islands.

Table 19 lists the species of native grasses that are found in the native dry coastal grasslands of Virgin Gorda and neighbouring islands.

(3) Dry Coastal Scrub and Woodland

Similar to native grasslands and scrubland glades, the ecosystem health of dry coastal habitats has yielded to years of agriculture, uncontrolled livestock grazing, and deforestation. Crop farming has largely been abandoned on Virgin Gorda, and most of the neighbouring islands are now unpopulated; nevertheless, the native dry scrub communities have been slow to recover. The previous 200-300 years of land use have caused soil depletion, erosion, ecosystem dysfunction, and species loss, all of which have retarded the growth and recovery of these communities.

These systems are dominated by thorny shrubs, a few small trees, orchids, grasses, sedges and cacti. Despite this, dry scrub and woodlands on the eastern peninsula (**Photo 31**) and offshore islands are critical to the continued survival of these rare Caribbean coastal dry plant habitats.

Photo 31.
Dry coastal woodland and scrub at Deep Bay, Virgin Gorda, where many rare and threatened native species persist. The view is from Biras Hill looking toward Deep Bay Beach with the Oil Nut Bay road visible on the hillside.

(4) Dry Coastal Forests

This system is similar to that of dry coastal scrub and woodland, both in characteristics and situation, although it is dominated by dense stands of trees. **Photo 32** shows dry coastal forest on the northern slopes of Deep Bay, Virgin Gorda.

Table 19.
Native grasses of Virgin Gorda and surrounding islands.

Poaceae	Status
Andropogon bicornis L.	Native
Anthephora hermaphrodita (L.) Kuntze	Native
Bouteloua americana (L.) Scribn.	Common
Cenchrus echinatus L.	Native
Cenchrus cf. incertus M. A. Curtis	Native
Chloris barbata Sw.	Native
Chloris radiata (L.) Sw.	Native
Digitaria eggersii (Hack.) Henrard	PR Bank endemic
Digitaria insularis (L.) Mez ex Ekman	Native
Eustachys petraea (Sw.) Desv.	Very rare.
Lasiacis divaricata (L.) Hitchc.	Common
Lasiacis sorghoidea (Desv. ex Ham.) Hitchc. & Chase	Native
Oplismenus hirtellus (L.) P. Beauv. subsp. hirtellus	Native
Paspalum distichum L.	Native
Paspalum fimbriatumKunth	Native
Paspalum plicatulumMichx.	Native
Setaria setosa (Sw.) P. Beauv. var.setosa	Native
Setaria utowanaea (Scribn.) Pilg. var. utowanaea	Native
Setaria cf. Vulpiseta (Lam.) Roem. &Schult.	Rare; a Setaria on the slopes of the eastern end of the island resembles this species.
Spartina patens (Aiton) Muhlenberg	Locally common but declining.
Sporobolus indicus (L.) R. Br. var. indicus	Locally common but declining.
Sporobolus pyramidatus (Lam.) Hitchc.	Locally common but declining.
Sporobolus virginicus (L.) Kunth	On dunes and around salt ponds
Stenotaphrum secundatum (Walter) Kuntze	Rare
Urochloa adspersa (Trin.) R. D. Webster	Native
Urochloa fusca (Sw.) B .F. Hansen &Wunderlin	Locally common but declining.

(5) Seasonal Forests of Gorda Peak

This area includes the lower slopes of Gorda Peak on the southwest, northwest and northeast. This forest is secondary, but represents the most extensive seasonal forest of its type in the Virgin Islands. Much of Virgin Gorda's native plant biodiversity can be found here and is worthy of protection.

(6) Evergreen Forests

Evergreen forests are rare on Virgin Gorda and the neighbouring islands. They can be found on the northern and northwestern slopes of Mosquito Island, and along the old Rockefeller Road at Gorda Peak.

(7) Boulder Fields

The vegetation communities of the boulder fields in southwest Virgin Gorda are singled out because of their rarity and uniqueness.

The scrubland and low woodlands of the southern end of this geologic formation include a significant percentage of non-native species, but those of the impenetrable areas of the northern section are primarily indigenous and consist of a desert-like community dominated by epiphytes.

Photo 32.
Dry coastal forest at Deep Bay, Virgin Gorda.

(8) Coastal Cliffs

Coastal cliffs are the result of natural erosion and geologic formations. Sparse vegetation grows on these rocks, often dominated by low thorny shrubs, herbs and grasses and cacti. However, human actions, such as the unrestrained collecting of plants, have resulted in the loss of many species. **Photo 33** shows collections of the rare cacti *M. nivosa* and other species inhabiting one of the coastal cliff communities.

Photo 33.
Coastal cliff vegetation on Mosquito Island.

(9) Coastal Beach Dunes and Natural Beaches

Before tourism became the major economic driver of Virgin Gorda, the island's natural beaches were dominated by vegetation communities and sand formations called dunes.

By the 1970s, as development activities accelerated and as demand for sand for construction material surged, these sites became the target for hotel and resort development and for sand mining. Very few of these communities remain today. Sea level changes, coastal development and other factors have eroded beaches and destroyed most of these once widespread plant communities.

On Virgin Gorda, one of the best surviving examples is found at Savannah Bay Beach. The vegetation is dominated primarily by small herbs and low shrubs in the fore area and taller shrubs and trees in the higher older dunes. Here, one of the island's most peculiar varieties of plants can be found, the "warri" vine, a species of legume from which a seed is often harvested to make jewelry or playing pieces for the old African board game Warri.

This scandent shrub is usually covered in thousands of sharp spines, which makes the plant unattractive for horticulture and cultivation, although important as nourishment for birds and insects. However, some of the plants found at this site have few or no spines, which is unusual. This makes the Savannah Bay population quite unusual in the region (**Photo 34**).

Coastal beaches are also important habitat for shorebirds and nesting sea turtles.

Photo 34.
G. cilita pods, an unusual specimen from Savannah Bay, in that it is *without* the dense sharp spines typical of the plant.

(10) Coastal Hedges

This habitat is part of the dry seasonal plant community formation of Virgin Gorda and its nearby islands, but because of both erosion and coastal development, it is disappearing.

Coastal Hedge usually forms a low line of trees immediately behind beaches and is often dominated by Seagrape (*C. uvifera*), Button Mangrove (*C. erectus*), Seaside Mahoe (*T. populnea*), low shrubs and vines. Like beaches and other coastal formations, these areas are being replaced by the infrastructure associated with development and economic expansion.

4.2.4 Invasive Species

Invasive plants are species that are usually exotic, *i.e.*, introduced from somewhere else that cause or may cause adverse environmental, economic, social and/or health impacts.

There are several species identified as "invasive" that occur in the BVI and in particular on Virgin Gorda and nearby islands. In addition, several other species have been identified as potentially invasive. **Table 20** provides a list of both invasive and potentially invasive species found in Virgin Gorda and nearby islands.

Why a species becomes invasive depends on many factors, but high on the list is human actions and behaviours. 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 severe problem elsewhere. An example of this phenomenon is the coconut (*C. nucifer*), 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; it also uses up water resources resulting in the demise of other plants, and it reduces beach enhancement while increasing coastal erosion.

But this may be a hard sell to resort owners, for example, who see the benefits to be derived by the presence of such a highly prized and beloved species. The coconut has not yet proven to be an invasive in Virgin Gorda or its satellite islands. Nonetheless, invasive plants come in many forms and can have severe 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.

There are 17 species listed as invasive or potentially invasive for Virgin Gorda and adjacent islands (see **Table 20**).

Table 20.
Invasive and potentially invasive plants of Virgin Gorda and neighbouring Islands.

SPECIES	STATUS	GROWTH FORM	ORIGIN
MONOCOTS			
Asparagaceae			
Agave americana L.	Localised but spreading; invasive	**H**	**I**
Poaceae			
Cenchrus ciliaris L.	Naturalised; invasive	**H**	**I**
Megathyrsus maximus (Jacquin) B. K. Simon & S. W. L. Jacobs	Common; Invasive	**H**	**I**
Pteridophyta – Ferns			
Lomariopsidaceae			
Nephrolepis brownii (Desvaux) Hovenkamp& Miyamoto	Invasive	**H**	**I**
DICOTS			
Acanthaceae			
Ruellia tweediana Grisebach	Potentially very invasive.	**H**	**I**
Apocynaceae			
Cryptostegia grandiflora R. Br.	Invasive	**S**	**I**
Cryptostegia madagascariensis Bojer ex Decne	Invasive, especially in dry coastal habitats	**S**	**I**
Boraginaceae			
Cordia oblique Willd	May be invasive in some locations Fruits favoured by Columbids	**T**	**I**
Casuarinaceae			
Casuarina equisetifolia	Invasive	**T**	**I**
Fabaceae			
Leucaena leucocephala (Lam.) De Wit subsp. Leucocephala	Naturalised; invasive	**T**	**I**
Goodeniaceae			
Scaevola sericeaVahl	Natralised; invasive	**S**	**I**
Meliaceae			
Azadirachta indica A. Juss.	Invasive	**T**	**I**

SPECIES	STATUS	GROWTH FORM	ORIGIN
Moringaceae			
Moringa oleifera Lam.	Prized in local medicine	**T**	**I**
Polygonaceae			
Antigonon leptopus Hook. & Arn.	Localised in towns; invasive and potentially very destructive to native plants and habitats	**V**	**I**
Rubiaceae			
Morinda citrifolia L.	Prized for its medicinal properties; potentially invasive	**S**	**I**
Rutaceae			
Murraya paniculata (L.) Jacq.	Potentially invasive	**T**	**I**
Sapindaceae			
Melicoccus bijugatusJacq.	Natralised; invasive	**T**	**I**

Table Key: H=herb; S=shrub; T=tree; V=vine; I=introduced.

Of the 17 species, seven are of immediate concern because of the conservation challenges they pose. A discussion of the seven species follows.

(1) *Agave americana*

This Agave, or Century Plant, is native to Mexico and Central America, but was probably introduced to Virgin Gorda early in the last century to cultivate for its fiber and also as a horticultural curiosity (**Photo 35**). It has since spread to the wild. In some places, its continued use as an ornamental has also allowed it to spread into nearby forests and woodlands. It is now present as a wild species at North Sound, Bitter End, Biras Creek and Deep Bay.

It is a hardy plant, resistant to many insect pests. It is replacing the native *A. missonium*, a Puerto Rico Bank endemic species that is now decimated by the Mexican Snout Beetle (*Scyphophorus acupunctatus*). Though *A. americana* is nowhere common, it has the potential to entirely replace native species, including the native Agave. It is for this reason that local gardeners should always maintain them in their gardens and not allow the plant to escape into the wild.

Photo 35.
A. Americana, an introduced invasive species (silver-grey shrub) growing wild at Bitter End, Virgin Gorda.

(2) *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 as a curiosity, appreciated for its bright pink and sometimes white inflorescence. It was grown in many botanical gardens and on estates and was 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.

(3) *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 (stands consisting of more or less one species), crowding out natives, disrupting local hydrology and creating ecological disruption. Wherever and whenever it is found in the wild, it should immediately be removed.

(4) *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 and is often planted (**Photo 36**). It is a toxic and unpalatable to most animals; hence, it is often one of the only plants that may remain in an area after livestock overgraze. It is also somewhat salt tolerant and so can grow in mangroves, on beaches and along the coast.

It readily smothers native vegetation and eliminates indigenous plants. In many other West Indian islands, it has become a major pest. It should be eliminated from the wild when encountered.

(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) *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 educated about the risks posed by this introduced invasive.

Photo 36.
Purple Allamanda (*C. madagascariensis*) growing near mangroves at Bitter End, Virgin Gorda.

(7) *Casuarina equisetifolia*

This species, known as Australian Pine, is a recent invasive and is—as its name implies—native to Australia and South Pacific islands. This pine "look alike" is not really a pine. It is actually a deciduous tree, an angiosperm (*i.e.*, a flowering plant), and member of the Casuarinaceae family. Specimens can grow up to 35 m tall.

The Australian Pine is very salt tolerant and can out-compete most native plants contending for the same real estate. It can suppress other plants by its allelophathic characteristics, *i.e.*, the ability to produce chemicals toxic to other plants.

In beach environments, native plants have deep roots that hold dunes and drifting sands. Australian Pines on the other hand have web-like, shallow roots that extend quite a distance. The thick impenetrable roots will not only prevent other species from establishing but will also prevent nesting opportunities for sea turtles.

The Australian Pine was introduced to Anegada in the late 1960s and soon after spread to many islands in the BVI. In Virgin Gorda, the species is limited to Spanish Town and a few resorts. Its aesthetic appeal and important function as a windbreaker will probably ensure its survival. However, efforts to control its distribution should be a priority. This species should be prevented from colonising any coastal area, particularly areas of native vegetation and areas where sea turtles nest—especially Savannah and Pond Bays.

4.2.4.1 Invasive Species Control

For the British Virgin Islands, invasive species control is a challenge. The Territory does not possess the technical and financial resources to aggressively pursue and eliminate the major threats. Nor is it able to anticipate and act offensively to prevent potential threats.

There has been some success in the "plant protection" approach adopted by several departments of agriculture in the Eastern Caribbean. However, to arrest the destructive potential of these and other plants, as well as exotic animals, the following will need to be put in place:

- A carefully constructed plant control strategy for the Territory that is sensitive to the local community.
- Closer coordination between the BVI and the USVI, given the BVI territory's proximity to the US territory with its high volume of traffic.
- A designated institution for management and enforcement.
- An education and awareness-building programme on invasive species control for stakeholders and the general public.
- Training and retraining of persons whose professional or personal activities bring them into contact with invasive plant species.
- Access to information networks that target effective and successfully applied approaches and applications for invasive plant control.

4.3 Fauna

As with the native plants, the indigenous fauna of Virgin Gorda and nearby islands 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 Congo, for those places are vast and with resources that are almost overwhelming. Virgin Gorda and its adjacent islands are oceanic in nature, isolated, small, and unique in many ways. Virgin Gorda and its neighbouring islands are a crucible of evolution, as are the better-known Galapagos, for on these shores can be found one of the world's smallest reptiles and some of the most unique species on earth.

BVI residents and visitors may identify an African lion more readily than the dwarf gecko *S. parthenopion*, a lizard so small it can fit on a 25 cent piece. But this reality does not absolve us of the obligation to protect and conserve the splendid faunal biodiversity of Virgin Gorda and the other Profile islands.

4.3.1 Birds

About 60 species of resident, migrant and naturalised birds are found on Virgin Gorda and the adjacent islands and cays (**Table 21**). These species range from seabirds to warblers and finch-like birds, spread across approximately 28 families. Many of these birds are migrants, and numbers will fluctuate throughout the year as well as from year to year, depending on local and global circumstances, such as storms, weather cycles, global warming and sea level rise, droughts and rains, food availability, habitat quality and habitat destruction, breeding successes, and the continued goodwill of the human population with whom they share the natural environment.

Many of the bird species are migrants. They arrive during the late summer and fall seasons; some soon depart for distant warmer shores, while others stay until the end of winter when they travel to North America and Europe to nest.

There are a number of regional and pelagic migrants. These species differ from the fall-and-winter, North American and Eurasian migrant passerines, shorebirds and waterfowl. They move between Caribbean islands, spend part of their lives in South America, and/or are seabirds that spend part of their lives nesting on BVI cays.

The resident species of birds are perhaps the most noticeable and commonly known species. One easily recognised bird is the noisy and very rambunctious **Pearly-eyed Thrasher** (*M. fuscus*). It is a brown, thrush-like bird that is most visible around homes, hotels and in tall trees and familiar by its whistles and harsh calls. It is sometimes very inquisitive, coming into homes to inspect or snatch morsels of food. It will often approach a person quite closely as it carries out its investigations.

A close relative of the Thrasher is the **Northern Mockingbird** (*M. polyglottos*), a drab grey and white species that often cocks its tail upward as it sits on an exposed perch and sings and whistles. It is a mimic—hence its name mockingbird—and will sometimes imitate the calls of other birds, animals and even mechanical objects. It will often sing melodiously and is a welcome voice of the wild coastal areas of Virgin Gorda.

Another common species is the **Grey Kingbird** (*T. dominicensis*), a flycatcher frequently seen on utility wires and around populated areas, and distinguished by its call "*pitiree*." This species is a drab grey above, and it often "forks" for insects from its perch, and will chase larger birds and even people when it is nesting.

Table 21.
Bird species identified for Virgin Gorda (VG) and nearby/neighbouring islands (NI).

COMMON NAME	SCIENTIFIC NAME	VG	NI
Pied-billed Grebe	*Podilymbus podiceps*	X	
White-tailed Tropicbird	*Phaethon lepturus*	X	X
Red-billed Tropicbird	*Phaethon aethereus*	X	X
Brown Booby	*Sula leucogaster*	X	X
Brown Pelican	*Pelecanus occidentalis*	X	X
Magnificent Frigatebird	*Fregata magnificens*	X	X
Great Blue Heron	*Ardea Herodias*	X	X
Great Egret	*Ardea alba*	X	
Snowy Egret	*Egretta thula*	X	
Little Blue Heron	*Egretta caerulea*	X	X
Cattle Egret	*Bubulcus ibis*	X	X
Green Heron	*Butorides virescens*	X	X
Yellow-crowned Night Heron	*Nyctanassa violacea*	X	X
Scarlet Ibis (introduced – Necker)	*Eudocimus ruber*		X
Greater Flamingo	*Phoenicopterus ruber*	X	X
White-cheeked Pintail	*Anas bahamensis*	X	X
Blue-winged Teal	*Anas discors*	X	
Osprey	*Pandion haliaetus*	X	X
Red-tailed Hawk	*Buteo jamaicensis*	X	X
American Kestrel	*Falco sparverius*	X	X
Merlin	*Falco columbarius*	X	
Peregrine Falcon	*Falco peregrines*	X	X
Helmeted Guineafowl (introduced)	*Numida meleagris*	X	
Clapper Rail	*Rallus longirostris*		X
Common Moorhen	*Gallinula chloropus*	X	X
Caribbean Coot	*Fulica caribaea*	X	
Black-bellied Plover	*Pluvialis squaterola*	X	X
Wilson's Plover	*Charadrius wilsonia*	X	X
Semi-palmated Plover	*Charadrius semipalmatus*	X	X
Killdeer	*Charadrius vociferus*	X	X
American Oystercatcher	*Haematopus palliates*	X	X
Black-necked Stilt	*Himantopus mexicanus*	X	X
Greater Yellowlegs	*Tringa melanoleuca*	X	
Lesser Yellowlegs	*Tringa flavipes*	X	X
Solitary Sandpiper	*Tringa solitaria*	X	
Spotted Sandpiper	*Actitis macularia*	X	X
Ruddy Turnstone	*Arenaria interpres*	X	X
Semi-palmated Sandpiper	*Calidris pusilla*	X	X
Least Sandpiper	*Calidris mitunilla*	X	

COMMON NAME	SCIENTIFIC NAME	VG	NI
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
Rock Dove	*Columba livia*	X	
Scaly-naped Pigeon	*Columba squamosa*	X	X
Eurasion Collared Dove	*Streotopelia decaocto*	X	X
White-winged Dove	*Zenaida asiatica*	X	X
Zenaida Dove	*Zenaida aurita*	X	X
Mourning Dove (near confirmed)	*Zenaida macroura*	X	
Common Ground-Dove	*Columbina passerine*	X	X
Budgerigar	*Melopsittacus undulatus*	X	
Yellow- billed Cuckoo	*Coccyzus americanus*		X
Mangrove Cuckoo	*Coccyzus minor*	X	X
Smooth-billed Ani	*Crotophaga ani*	X	X
Green-throated Carib	*Eulampis holosericeus*	X	X
Antillean Crested Hummingbird	*O. 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
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
Yellow Warbler	*Dendroica petechia*	X	X
Magnolia Warbler	*Dendroica magnolia*	X	
Prairie Warbler	*Dendroica discolor*	X	X
Blackpoll Warbler	*Dendroica angelae*	X	X
American Redstart	*Setophaga ruticalla*	X	
Ovenbird	*Seiurus aurocapillus*	X	
Hooded Warbler	*Wilsonia Warbler*	X	

COMMON NAME	SCIENTIFIC NAME	VG	NI
Bananaquit	*Coereba flaveola*	X	X
Black-faced Grassquit	*Tiaris bicolor*	X	X
Lesser Antillean Bullfinch	*Loxigilla noctis*	X	
House Sparrow	*Passer domesticus*	X	X
Cockatiel	*Nymphicus hollandicus*	X	
Amazon Parrot	*Amazona sp.*	X	

Hummingbirds are also quite noticeable. Two species are now present on Virgin Gorda and adjacent islands: the **Antillean Crested Hummingbird** (*O. cristatus*), and the **Green Throated Carib** (*E. hololosericeus*). Sadly, there is another species, the **Antillean Mango** (*A. dominicus*), which was relatively common in the BVI, but now is thought to be extinct. This latter species is endemic to Puerto Rico and the Virgin Islands, but coastal development and competition from the Green Throated Carib, which is expanding from the Lesser Antilles, may have combined to rob the Virgin Islands of one of its most enigmatic species.

Another "lost" species is the **Virgin Islands Screech Owl** (*O. nudipes newtonii*); this subspecies was endemic to the Virgin Islands, but no one has seen it since sometime in the 1930s, though it was reported from Guana Island on the basis of owl pellets (regurgitated bits of bone and other materials). The Virgin Islands Screech Owl was once widely distributed across all of the US and British Virgin Islands, which would have included Virgin Gorda and its surrounding islands. Attempts to relocate existing populations have proved futile, but some continue to hold out hope that it may still reappear.

The image in **Figure 15** is from an illustration of this species by renowned Danish bird illustrator John Gerrard Keulemans (1842-1912).

Another subspecies, the **Puerto Rican Screech Owl**, still exists on Puerto Rico, but is quite rare. This owl, reported for Virgin Gorda and other larger islands of the VI, measures about 23 to 25 cm (9 to 10 in) in length. It was always rare, but many Virgin Islanders knew it and gave the bird its common name, "cuckoo bird," on account of its call, a plaintive and distant "*hoo-hoo-hoo-hoo*" called from a perch, usually in a large tree. It preferred the edges of forests and woodlands, and hunted for insects such as grasshoppers, rodents and small birds. It nested in the holes of trees, including palms, and it is believed that one of the reasons for

Figure 15.
Virgin Islands Screech Owl (*O. nudipesnewtonii*) from an illustration by John Gerrard Keulemans.

its disappearance was the felling of old trees and old-growth native forest on which it relied for habitat. The species was nocturnal.

For seabirds, little is known about their status in the offshore islands surrounding Virgin Gorda. The Dogs, islands northwest of Virgin Gorda, support populations of nesting seabirds during the spring and summer months, and so does Broken Jerusalem, west of Virgin Gorda, as well as Eustatia, Prickly Pear and Necker Islands in North Sound.

It is important that we better understand the nesting seabirds on the offshore islands because seabirds are experiencing sharp and dramatic declines across the globe. In the Virgin Islands, their numbers are down due to poaching of their eggs and chicks, predation by introduced mammals (including rats and the Small Indian Mongoose, *Herpestes javanicus*), predation by domestic and feral cats, disturbance and destruction of habitats by grazing goats and feral livestock, coastal development, and habitat destruction by human activities.

It is only through systematic surveys, analysis and monitoring that the status and requirements of seabirds can be better understood. Such data is required if effective long-term strategies for conserving and protecting existing populations are to be developed.

A remarkable success story is that of the **Greater Flamingo** (*P. ruber*). This pink wonder of the bird world went extinct in the Virgin Islands and the Lesser Antilles because of habitat destruction and hunting. Today, it has been reintroduced to Anegada, Guana Island and Necker Island, and is a vagrant to Prickly Pear, and Beef Island (Tortola). If local populations are to be sustainable, however, efforts to protect existing wetlands and to restore their diminished ecological functions will have to be strengthened. **Photo 37** shows a flock of Flamingos on Necker Island in 2007.

Since the 1950s, the Territory has declared a number of "bird sanctuaries" to help protect native birds, with several in the area of Virgin Gorda (see **Table 22**). Many of the bird sanctuaries were declared over 50 years ago and are now private properties, resorts and tourist destinations, including Mosquito, Necker, Eustatia and Saba Rock.

Photo 37.
Greater Flamingos (*P. ruber*) on Necker Island (2007).

Table 22.
Bird Sanctuaries of Virgin Gorda and nearby islands.

Site	Date Declared
Cockroach Island	1959
Fallen Jerusalem Island	1959
George Dog Island	1959
Great Dog Island	1959
Little Dog Island (now called West Dog)	1959
Mosquito Island	1959
Necker Island	1959
Prickly Pear Island	1959
Round Rock Island	1959
Saba Rock Island	1959
Seal Dog Islands	1959
St. Eustatia	1959

Sources: Bird Sanctuaries Order (S.R.O. 20/1959).
Bird Sanctuary (Flamingo Pond, Anegada) Order (S.R.O. 24/1977).

4.3.2 Mammals

Today, the only native mammals that are extant on Virgin Gorda and nearby islands and cays are bats. Like snakes, bats generally evoke panic, revulsion and even fear when discussed or observed by islanders. When the IRF team conducts night bat surveys in the BVI, persons encountered during these expeditions invariably complain that they have bats in their roofs and ask that they be removed. Some refer to these small insectivorous (insect eating) animals as "rat bats" on account of their small dark furry appearance. They are also known as "roof bats."

There are four species known from Virgin Gorda, and three of these are also known from nearby Mosquito Island. We know nothing about the bats on the other smaller islands near Virgin Gorda.

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, avoid danger, and locate their friends and family.

They also are not rats, mice or rodents, and none of the species here drink blood or are vampires! Rabies has not been reported for the Virgin Islands.

The species of bats for Virgin Gorda follow.

(1) The Cave Bat (*Brachyphylla cavernarum*)

This bat roosts primarily in rock caves, especially along the coast. It eats fruits, nectar and some invertebrates. It can be found in caves on Virgin Gorda, but it is quite rare here. It may visit the nearby smaller islands when food becomes available.

In October 2011, this species was recorded for the first time on Virgin Gorda by the IRF research team.

(2) The Fishing Bat (*Noctilio leporinus*)

This bat is known to many, though most people are not quite sure what it is, some thinking that it is a strange bird. This species catches fish and other marine and aquatic life for food and is quite a master fisherman. It uses its long powerful feet with sharp claws to scoop up fish from just below the

water surface and then carries its kill off to a perch to consume. It has sharp long teeth for crunching up the bones and scales of its prey.

It fishes along the coasts, especially in calm bays, marinas and beaches and will also fish on salt and freshwater ponds and along ghuts. It also eats shrimp and crayfish. It is a rare species in the Virgin Islands, but is likely to occur across most of the profile islands. It roosts in small caves and in hollow trees.

So far, this species has not been captured on Virgin Gorda, but it has been reported through eyewitness accounts.

(3) The Jamaican Fruit Bat (*Artibeus jamaicensis*)

This Fruit Bat is the most common and widespread species across the Virgin Islands. It roosts in caves, old buildings and ruins, hollow trees, old cisterns and wells, ceilings, and sometimes in trees and palms. Like the Cave Bat, it eats fruits, nectar and some invertebrates, but will also chew leaves and extract the juices.

Many people may only encounter this species by its "calling card," namely, excrement splattered against walls during the night. This usually occurs near large Fig Trees. Often times, it may also leave half-eaten almonds under trees and on the floor of buildings.

In old churches, it sometimes may spook worshipers by flying during the day. This usually occurs when the bats are frightened by noise from the congregation.

(4) Velvety Free-tailed Bat (*Molossus molossus*)

This is the Roof Bat species that most people encounter. It is most common around human settlements since it roosts under galvanised roofs and building shingles and in the cracks and cavities of older structures. But before the arrival of Europeans, this species roosted in rock cavities, and it still does in many places such as on Mosquito Island.

The Roof Bat feeds on invertebrates, primarily flying insects, which it catches by chasing after them or snatching them from the leaves of trees.

Despite the relative rarity of bats in the Virgin Islands, the species are very important, not only because they are native, but also because they play a significant role in the local ecology, *e.g.*, by helping to reduce invertebrate populations, including flies, mosquitoes and moths.

They also help to spread plant seeds, especially in forests. Additionally, they 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 them 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 US Virgin Islands.

4.3.2.1 Extinct Mammalian Species

In the past, the Virgin Islands had far more mammal species than today. We know this from archaeological studies, paleontological work and historical eyewitness accounts. Among the most remarkable was the **Puerto Rican Shrew** (*Nespohontes edithae*), a small mammal that fed on invertebrates and small vertebrates. It is believed that this species became extinct throughout its range across Puerto Rico and the Virgin Islands soon after the first Europeans arrived. It is not definitely known from Virgin Gorda (it is reported in archaeological middens from nearby St. Thomas and St. John), but it is likely that it was present here as it would have been for the Virgin Islands. It was hunted and eaten by Amerindians for many years.

Another species that has disappeared is the **Agouti** (*Dasyprocta* sp.), likely brought to the Virgin Islands thousands of years ago by Amerindians from South America. The species soon disappeared when the forests were cleared and when it was hunted into extinction.

The third "disappeared" species was the **Puerto Rican Hutia** (*Isolobodon portoricensis*), a relatively large rodent, similar in general appearance to the Agouti, but endemic to Puerto Rico and Hispaniola. The Amerindians often transported this species from island to island, raising them for food. The hutia, like many of its close relatives in the Greater Antilles, is now extinct in the Virgin Islands.

The Amerindians would likely have brought other species of mammals with them, including **Dogs** (*Canis familiaris*), which were 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 also found the remains of perforated dog teeth, which were worn as necklaces and other adornments.

4.3.2.2 Invasive Mammalian Species

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 farmed for its meat. There is no evidence to suggest that it ever lived in the wild.

Since the appearance of Europeans, other mammals have arrived as stowaways, including the **Brown Rat** (*Rattus norvegicus*), the **Black Rat** (*Rattus rattus*) and the **House Mouse** (*Mus musculus*). These are all very invasive and cause an untold amount of damage. They destroy structures, transmit diseases, decimate native wildlife—including birds and reptiles—and destroy crops and plants. They are present on just about every island in the Caribbean region, although Black Rat is by far the more common of the two rat species and the House Mouse seems to prefer areas in and around human settlements.

Over the last two centuries, humans have also introduced, farmed, cultivated and let wild many breeds and species of animals. These include cattle, pigs, donkeys, horses, sheep and goats. These are all domesticated animals, but when left free, they can wreak havoc on the landscape. The landscapes of Virgin Gorda, Mosquito, Eustatia and Prickly Pear all bear the characteristic scars of overgrazing by non-native livestock.

To safeguard and protect the future ecological health and sustainability of the Virgin Islands, it is critical that feral and free-roaming animals be brought under control and carefully managed.

4.3.3 Amphibians

Virgin Gorda at night belongs to the frogs as an operatic chorus plays out across the island. With the fading of daylight hours, the first whistles and piping calls begin, at times in hesitant fits and starts, but by nightfall, a chorus echoes from every corner of the island, an unending serenade until once again the first light of the returning sun appears. **Table 23** provides a summary of the six species of frogs (including toads, which are more terrestrial in nature and have rougher skins, often said to be "warty").

For most residents of Virgin Gorda, the calls of the island's frogs are a signature of the night. Take away the frogs and it will soon become apparent just how much they are a defining feature of islanders' sense of place.

Yet—except for perhaps the Cuban Tree Frog (*Osteopilus septentrionalis*)—most residents are unaware of how many different species there are, with six species of frogs and toads recorded for Virgin Gorda. Most are small and a drab brownish colour, and thus many Virgin Gordians have a hard time differentiating the several species.

There are no amphibians on most of the offshore cays, except for Mosquito Island, which now has the Cuban Tree Frog.

Table 23.
Frogs and toads of Virgin Gorda and neighbouring islands.

SPECIES	COMMON NAME	DISTRIBUTION	STATUS
Eleutherodactylus antillensis	Puerto Rican Red-eyed Frog	Puerto Rico and most of the Virgin Islands except Anegada	Common and widely distributed. The most common tree frog in the BVI.
Eleutherodactylus cochranae	Puerto Rican Whistling Frog	Puerto Rico and most of the Virgin Islands except Anegada	Common and widely distributed.
Eleutherodactylus schwartzi	Virgin Islands Khaki Frog	Virgin Gorda, Tortola, Jost Van Dyke, St. Thomas and St. John	Rare. Endemic to the Virgin Islands. This species is listed by IUCN's Red List as Endangered.
Leptodactylus albilabris	Puerto Rican Ditch Frog; White-lipped Frog	Puerto Rico and the Virgin Islands	Rare. Not previously recorded for Virgin Gorda, but recent sighting of large tadpoles and their subsequent metamorphosis confirms that it is present there.
Osteopilus septentrionalis	Cuban Tree Frog	Virgin Gorda, Mosquito Island, BVI, Wider Caribbean and Florida	Introduced invasive. Widespread, especially around homes and freshwater habitats, including ponds and cisterns.
Peltophryne lemur	Puerto Rican Toad; Puerto Rican Crested Toad	Virgin Gorda, St. John (?), Puerto Rico	Believed to be locally extinct.

Of the six species, the invasive **Cuban Tree Frog** is perhaps the most known because it is a notorious pest. The Cuban was introduced to the Virgin Islands possibly in the mid-to-late 1990s, most likely in shipments from south Florida. It is a native of Cuba and the Cayman Islands, but has spread widely in the Caribbean and other warm regions of the Americas.

It is relatively large, averaging about 10 cm (4 in) in length, and its colour varies from a drab grey to a rich marbled brown and grey. Its calls are just as varied, from a low croak to a puppy-like bark or whine. It will often come indoors seeking the comfort of humid damp places, and seems especially fond of bathrooms, kitchens and bedrooms. It is more frequently seen at nights.

This species requires freshwater to lay its eggs and raise its tadpoles, and will often congregate in large numbers in cisterns, ponds and fountains. This is how most residents have come to know the Cuban Tree Frog first hand. Single-handedly, this species has given amphibians a bad name in the Virgin Islands.

And yet, despite their reputation as a nuisance, frogs are important to sustaining healthy ecosystems. Farmers and householders especially benefit from frogs since they eat many types of invertebrates, including roaches, spiders, mosquitoes and flies.

Perhaps the rarest species of frog found on Virgin Gorda today is the **Puerto Rican Ditch Frog** (*Leptodactylus albilabris*). Although it is fairly common and widespread in suitable habitats on most of the larger Islands in the Territory, it is remarkably rare on Virgin Gorda. It has been suggested that it was possibly present on the island early in the last century, but no specimens were secured and for many years afterward, there was no mention of the species on Virgin Gorda.

As the name suggest, this species prefers ditches and drains—habitats which are often moist and wet. It has only been observed at one location, as tadpoles in a watering trough on the slopes of Gorda Peak. No adults have been seen and no calls have been heard. During dry periods, when conditions are unfavourable, this species may go silent or even hide underground until the rains arrive. It seems limited by the lack of suitable habitats. **Photo 38** shows tadpoles in the water trough on Virgin Gorda.

Photo 38.
Puerto Rican Ditch Frog (*L. albilabris*) tadpoles in water trough at Gorda Peak.

Another rare species is the **Virgin Islands Khaki Frog** (*Eleutherodactylus schwartzi*), endemic to the Virgin Islands but now quite rare in most places. Like other Eleutherodactylus species, it is small but coloured a beautiful golden brown. It prefers shady damp places in forests and woodlands, and in the day when it is hot, it retreats to hide under rocks, leaf litter, at the base of bromeliads leaves, near ponds and ditches, and in logs.

One very interesting species now presumed extinct in the Virgin Islands is the **Puerto Rican Toad**, a species once found on Virgin Gorda and Puerto Rico, and reportedly on nearby St. John. The Toad was first discovered and described in Puerto Rico in 1868, and was reportedly never common. Very soon after its discovery it disappeared, and by early in the twentieth century some feared that it had gone extinct. It was rediscovered in 1967 when small populations were found in the north and south of Puerto Rico (the northern and southern populations are considered to be genetically distinct from each other, and this may have been true for populations in the Virgin Islands as well). On Puerto Rico, the species continues to hang on to existence by a thin thread of luck and human goodwill.

On Virgin Gorda, the species was first discovered about 1914 at Spanish Town, when a specimen was brought to the attention of naturalist William Barbour. As in Puerto Rico, the species soon disappeared, but in 1921, Stuart Danforth is said to have secured an additional seven specimens, which he took to Puerto Rico. He reported that he collected these animals from mangroves in Spanish Town. He said he found them hiding below the dried bark of Red Mangrove branches. These mangroves were found at a large salt pond (at the time, it was Virgin Gorda's largest mangrove wetland), which is now the Virgin Gorda Yacht Harbour Marina.

There is no doubt that the species was always rare. When it was first brought to the attention of Barbour, he inquired amongst the local population and no one had reported seeing the animal before.

The late Rowan Roy of Tortola often told the tale of having seen this little toad in the coastal freshwater wetlands at Little Dix Bay. That Toad population disappeared when its habitat was filled in to build the resort in the mid-1960s.

There have been no known reports of the species on Virgin Gorda since then. It is not know why it has gone extinct, though some suspect loss of suitable habitat. The species seems to prefer dry low coastal forests and woodlands—a harsh and difficult habitat for the survival of most species. It was able to survive the dry periods by estivating (spending dry periods underground) and then emerging during heavy rains. It would have bred during these brief wet periods when freshwater pools in the ghuts and at nearby ponds were available. It would "hide" away underground for long periods and reemerge when conditions were suitable. This could explain why it was so rarely observed and the great length of time passing when it was not seen.

The Toad is variable in appearance; with females being larger than the males (this is relatively common in frogs). The female measures around 10 cm (4 in) in length, while the male is about 8 cm (3 in).

Females are said to be a dull brownish colour and males an olive green and gold. However, this description is primarily based on the Puerto Rican populations. Both male and female have "pebbled" and textured skins, which give the appearance of being "warty," though the females are reportedly more so. The females also have a high boney crest above their eyes, which are reportedly a golden yellow.

Photo 39.
Mating pair of Puerto Rican Crested Toads at Guanica State Forest in southwestern Puerto Rico. Males are smaller than females (photo courtesy of Fr. Alejandro Sanchez, Puerto Rico).

Despite its disappearance nearly 50 years ago, some continue to hope that a small population of this enigmatic and unique Virgin Islands species survives somewhere on the island, and that one day the Virgin Islands Toad will surprise us all with its reappearance. **Photo 39** shows Puerto Rican Crested Toads taken in Guanica State Forest in southwestern Puerto Rico.

4.3.4 Reptiles

The reptiles of the Virgin Islands fall roughly into two categories—terrestrial reptiles and marine reptiles. Terrestrial species are found primarily on land, and marine reptiles are confined to the seas.

4.3.4.1 Terrestrial Reptiles

To date, there are 18 reptile species reported for Virgin Gorda and nearby islands. **Table 24** provides a summary of each species, including their conservation status.

The most visible and best known of these reptiles are the ***Anolis* lizards**, which are seen so frequently on exterior walls, trees, bushes and rocks, some entering dwellings and even appearing around the dining areas of hotels and resorts. There are three anole species on Virgin Gorda, including a species not often observed or seen by most residents, *Anolis pulchellus* or **Bush Anole** (**Photo 40**). It is a small species whose habitat includes branches of low shrubs, grasses and near to the ground. It measures around 12 to 13 cm (about 5 in) in length (including tail) and is the smallest of the three species. It is usually quite common, but because of the location of its habits, it is not known to most people.

Of the other two species, ***A. cristatellus wileyae*** and ***A. stratulus***, the former is the largest and has a ridge of skin on the tail that looks like a small sail. It can also raise the skin on its back, neck and crown to appear more formidable and larger. All three species are relatively common in the BVI, and are endemic to the Puerto Rico Bank.

On the ground, a number of species are at home. These include the **Ground Lizard** (*A. exsul*). This species is relatively common throughout most of the BVI, especially in lowland areas, including urban areas. Males are larger and more brightly coloured than females.

Photo 40.
Bush Anole (*A. pulchellus*) near Gorda Peak, Virgin Gorda.

Another ground-living species is the **Skink**. At least one species is present in the BVI, possibly *Spondylurus semitaeniatus*. A recent study of the members of the Caribbean Skinks (family Mabuyidae) by Hedges and Conn (2012) has shown there are a number of previously unidentified species in the Virgin Islands and that the BVI has at least three. The species on Virgin Gorda and surrounding islands has been renamed *Spondylurus semitaeniatus* (formerly *Mabuya sloanii*) and is a species endemic to the Virgin Islands.

It is found in dry habitats, especially where there are rocks, boulders, low shrubs, Agave, cacti and native grasslands. It often basks in the early morning sun or in mid-afternoons when it lies exposed with its eyes closed and legs held close to its sides. It may reach about 15 cm (6 in) in length.

It is limited to open woodland and grasslands, but primarily absent from dense and heavy forests and woodlands where exposure to sunlight and warming temperatures is more limited. **Photo 41** shows a specimen hiding in *Hohenbergia* bromeliads on Mosquito Island.

Photo 41.
S. semitaeniatus Skink on Mosquito Island.

Skinks are found on the eastern peninsula of Virgin Gorda, but the exact species remains to be determined. Observations on drier parts of the island have indicated the presence of a small skink, possibly *S. semitaeniatus*, but only further field work will shed light on the exact taxonomy and conservation status of this population.

The Iguanas are the largest land reptiles of the Virgin Islands, and two species are present: the Rock Iguana (*C. pinguis*) and the Green Iguana (*I. iguana*), a species thought to be introduced to the Virgin Islands, though further studies are needed to determine the exact origins of the Green Iguana.

The **Rock Iguana** is endemic to the British Virgin Islands, and it is believed that it was once far more widespread and common. It was likely found in the US Virgin Islands prior to the arrival of Europeans. It is highly endangered and now found only on Anegada where the population continues to struggle. It has also been reintroduced to Necker, Mosquito and Guana Islands.

The **Green Iguana** is limited in distribution but is spreading. It is found on Virgin Gorda where it is believed to have been introduced sometime during the last century.

There are two other ground reptiles present in the Profile islands: the **Eye-spot Sphero** (S. *macrolepis macrolepis*) and the **Virgin Islands Dwarf Gecko** (S. *parthenopion*). Both these species are geckos, and are restricted to the leaf litter of forests, woodlands and herbaceous growth.

The former is the most common species, achieving some of the highest densities of any vertebrate in the world. It is found throughout most of the Virgin Islands. The latter, *S. parthenopion,* holds an elite position in the animal kingdom, since it is considered one of the smallest species of vertebrates in the world, measuring 1.3 to 2.0 cm (0.5 to 0.8 in) in length, a record it shares with another Spherodactylus dwarf gecko of Hispaniola.

S. parthenopion was first recorded from the area of Savannah Bay on Virgin Gorda, and a small population survives on Mosquito Island. One specimen was observed on the north slopes west of Leverick Bay. It has also been reported from Tortola. **Photo 42** shows one of these magnificent reptiles from Mosquito Island.

There are two other species of geckos recorded for the Profile islands: the **House Gecko** (*H. mabouia*)

and the **Thick-tailed Gecko** (*T. rapicauda*). Both species are primarily nocturnal and feed on invertebrates.

The first species is widespread in parts of Africa, the Caribbean, and Central and South America. It is thought to have arrived as a stowaway on slave ships.

Photo 42
S. parthenopion, one of the world's smallest vertebrates. It is endemic to Virgin Gorda and Mosquito Island.

known from neighbouring islands. It is much smaller than the previous species, measuring up to 46 cm (1.5 ft) in length; most that are encountered are less than 25 cm (10 inches). It also feeds on reptiles, possibly amphibians, and invertebrates. It is vulnerable to rats and to human harassment.

The second species is found in Central America and parts of South America and in the West Indies as far north as the Virgin Islands. So far, in the Profile islands, it is known only from Necker Island, although it is believed to be more widely distributed. It primarily inhabits forests and woodlands, although it will occur in buildings and ruins, and amongst boulders and rocks.

Some research suggests that the Thick-tailed Gecko represents a species complex because several closely related species are involved and the population on Necker Islands is relatively unique. Further research is needed to clarify the taxonomy of this unique Virgin Gorda reptile.

There are four species of snakes found on the Profile islands; all are restricted to the islands of the Puerto Rico Bank. The largest (by length) is the **Anegada Racer Snake** (*Borikenophis portoricensis anegadae*) achieving lengths up to 76.2 cm (2.5 ft), though most are usually smaller. It is a subspecies endemic to the Virgin Islands and is common on Mosquito and Necker. It is far less common on Virgin Gorda, and its status on other BVI islands is unknown. It feeds on other reptiles, birds and large insects. The species is vulnerable to rats, human harassment and development.

The **Virgin Islands Racerlet** (*Magliophis exiguous exiguus*) is rare on Virgin Gorda and unknown from neighbouring islands. It is much smaller than the previous species, measuring up to 46 cm (1.5 ft) in length; most that are encountered are less than 25 cm (10 inches). It also feeds on reptiles, possibly amphibians, and invertebrates. It is vulnerable to rats and to human harassment.

The third species the **Virgin Islands Tree Boa**, (*Epicrates granti*), has been reported for Virgin Gorda but its presence has not been confirmed. It is a robust species, a constrictor (*i.e.*, it wraps itself around prey and kills it by suffocation or by increasing pressure on the body causing the heart to stop). It is primarily nocturnal in habit, and, for this reason, it is very rarely observed. It feeds on birds, eggs, rodents, reptiles, amphibians and large invertebrates.

This subspecies is endemic to both the US and British Virgin Islands. However, some researchers report that there are morphological and ecological differences between the US and the BVI populations. If this is the case, then those populations in the BVI are critically endangered.

Further work is needed to establish the presence of this species on Virgin Gorda, and to determine the exact taxonomic status and relationship of the BVI populations to those on Puerto Rico, Mona, and other islands.

Photo 43.
The endemic and rare Blindsnake (*Typhlops naugus*) found at Savannah Bay, Virgin Gorda.

The final species, the **Virgin Gorda Blindsnake** (*T. naugus*), is a species endemic to the Virgin Islands (**Photo 43**). So far, it is known from Virgin Gorda and Necker Island. It is likely present on all major islands in the North Sound.

Because it is primarily a fossorial species (that is, a species adapted for digging in

soil), it is rarely seen or encountered. Related species are called "blindworms" or "coffin borers" in other Virgin Islands because similar species are often encountered when digging deep holes where it is mistaken for an earthworm. The Virgin Gorda species is relatively robust compared to its relatives in the BVI; it is a dark brownish pink in overall colour. It spends daylight hours under rocks, in leaf litter, under dead tree trunks and debris, and emerges at night to hunt invertebrates.

Table 24.
Summary of the terrestrial reptiles of Virgin Gorda and neighbouring islands.

SPECIES	COMMON NAME	DISTRIBUTION	STATUS AND ISSUES
TORTOISES			
Chelonoidis carbonaria	Red-footed Tortoise	Virgin Gorda, Necker Island, BVI, Lesser Antilles, and South America	Exceedingly rare and extirpated from most of the VI. Most specimens are actually pets or captures from the wild kept in pens. Locally called "Land Turtle."
LIZARDS			
Ameiva exsul	Virgin Islands Ground Lizard	Throughout the Virgin Islands (British and US) and in Puerto Rico	Relatively common throughout the Virgin Islands, including especially around towns and the drier lowland and coastal habitats.
Amphisbaena fenestrata	Virgin Islands Amphisbaena	British and US Virgin Islands	Very rare. Endemic to the VI.
Anolis cristatellus wileyae	Virgin Islands Crested Anole	Culebra, Vieques, and the British and US Virgin Islands	Common. This sub-species is endemic to the Virgin Islands.
Anolis pulchellus	Puerto Rican Bush Anole	Virgin Islands and Puerto Rico	Common and widespread but not often observed or seen. It prefers grassy and shrubby habitats.
Anolis stratulus	Puerto Rican Spotted Anole	Puerto Rico and the Virgin Islands	Common and widespread.
Cyclura pinguis	Anegada Iguana	Necker, Anegada and Guana Island	Originally widespread throughout the VI, now restricted to Anegada and reintroduced to Necker and Guana. Listed as Critically Endangered by IUCN.
Hemidactylus mabouia	House Gecko	Throughout the Virgin Islands and the rest of the Neotropics	Common around homes but also found in forests and woodlands
Iguana iguana	Green Iguana	Virgin Gorda, the VI, Puerto Rico, Lesser Antilles and South America	An introduced invasive.
Spondylurus semitaeniatus	Greater Antillean Skink	Virgin Gorda, Mosquito Island, Necker Island, Fallen Jerusalem, Round Rock, Tortola, Ginger Island, Great Camanoe, Guana Island, Little Thatch Island, Salt Island, and the USVI.	Locally common to rare. This species prefers drier, hilly and rock-strewn habitats.
Spondylurus sp.	Skink	Virgin Gorda, east end	A small skink is known from the eastern end of Virgin Gorda. It may be *S. semitaeniatus*, but specimens seen are much smaller with bright blue tail.
Sphaerodactylus macrolepis macrolepis	Puerto Rican Eye-spot Sphaero	Throughout the Virgin Islands	Common and widespread.

SPECIES	COMMON NAME	DISTRIBUTION	STATUS AND ISSUES
Sphaerodactylus parthenopion	Virgin Islands Dwarf Sphaero	Virgin Gorda, Mosquito Island and perhaps Tortola	Very rare. Known only from a handful of specimens and a small population. The locations of any existing Virgin Gorda populations remain elusive.
Thecadactylus rapicauda	Thick-tailed Gecko; Turnip-tail Gecko	So far, on Necker and Mosquito (BVI); on St. Croix (USVI); also Lesser Antilles and CA/SA	Reportedly common on Necker, but likely to be present on all islands and cays of North Sound.
SNAKES			
Epicrates granti	Virgin Islands Tree Boa	Virgin Gorda (?)	This subspecies is endemic to the VI and is endangered.
Borikenophis portoricensis anegadae	Anegada Racer	British Virgin Islands	Rare on Virgin Gorda, but locally common and widespread on Mosquito Island.
Magliophis exiguous exiguous	Virgin Islands Racerlet	Virgin Gorda, rest of the VI, and Puerto Rico	Rare.
Typhlops naugus	Virgin Gorda Blindsnake	Virgin Gorda and Necker Island	Very rare. Endemic to Virgin Gorda and Necker Island. Likely present on all islands and cays of North Sound.

4.3.4.2 Marine Reptiles

There are four marine sea turtles (**Table 25**) in the BVI. Shown in **bold** are those listed in the U.S. Virgin Islands as *Species of Special Concern* and species on the IUCN Red List for the BVI.

Status designations in **Table 25** are the following:

- US Federally Threatened (T),
- Endangered (E) for listing in 2006,
- IUCN Critically Endangered (CR),
- Endangered (EN).

Table 25.
Summary of marine reptiles of Virgin Gorda and neighbouring islands.

Species	Common Name	Distribution	Status
Chelonia mydas	**Green Turtle**	**Worldwide**	**T / EN**
Caretta caretta	Logger Head Turtle	Worldwide	T / EN?
Dermochelys coriacea	Leatherback Turtle	Worldwide	E / CR?
Eretmochelys imbricata	**Hawksbill Turtle**	**Worldwide**	**E / CR?**

4.3.5 Aquatic Fish

There are no recorded native freshwater species of fish known from the BVI today, but, in the past, it is likely that a few species lived in Virgin Gorda's streams, pools, ghuts and wetlands.

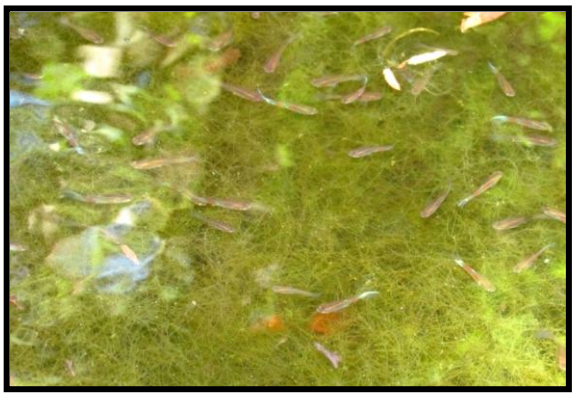


Photo 44.
Guppies (*P. reticulata*) in a pool at Spanish Town.

The fish and other freshwater aquatic fauna would have disappeared when native landscapes were cleared, resulting in a disruption of ecosystems, the decline or disappearance of species, and the loss of habitats. The removal of native forests, especially old trees, disrupted local hydrology; as soils were cultivated, they were exhausted of their nutrients and organic matter, and became more desiccated, friable and susceptible to erosion. Their ability to retain water and to replenish springs, streams and wetlands throughout the year was reduced, with consequential ecological impacts.

It is likely that natural springs existed on the slopes of Gorda Peak and in the lowlands. Freshwater ponds and pools also occurred, scattered around the island. At the boulder fields, natural depressions allow some invertebrates to survive.

Where streams meet the ocean is an environment that allows some fish and possibly shrimp and crayfish to move between the two systems as they do in other islands such as St. Thomas and St. John.

During the past, it is plausible that species of **Gobids** (members of the Gobidae) swam up the ghuts and lived out most of their lives there (Gobids are fish that spend much of their lives in freshwater habitats but then return to the sea to breed. It is also possible that the **Mountain Mullet** (*Agonostomus monticola*) was present. This species is found on some of the Virgin Islands with running streams and permanent ghut pools.

Today, the only freshwater fish species known in the wild is the **Guppy** (*Poecilia reticulata*), a species native to North, Central and South America, but which is widely known in the aquarium trade. It has been introduced widely throughout the tropics. On Virgin Gorda, populations are often established in small pools, especially near the boulder fields, to help control mosquitoes and to add colour to the landscape.

Though it may help to control mosquito populations, this species has the potential to reduce the populations of native invertebrates and disrupt fragile freshwater habitats. **Photo 44** shows Guppies at a small pool near the boulder fields in Spanish Town.

4.3.6 Invertebrates

Invertebrates are animals without backbones, and include insects such as butterflies and spiders. Many live on land, some in the sea, some in streams and ponds, some below ground, and some even inside homes and on other creatures.

So far, for Virgin Gorda and nearby islands, research has shown that there are at least 133 species of invertebrates, in 21 orders, representing about 70 families. But this is just the tip of the iceberg. It is likely that these numbers represent only a small fraction of the actual diversity of invertebrates for the Profile islands.

Invertebrates are perhaps the most immediately noticeable and recognisable of the islands' fauna. They are around us, on us, beneath us and just about everywhere. Visitors to these shores will quickly notice the dragon flies, the bright and colourful butterflies, the moths and even the pesky mosquito and bothersome flies. In our homes, roaches drive us to desperation to find solutions to rid our lives of their frequent presence.

On some islands such as Mosquito, day-flying wasps (a member of the family Sesiidae although one would swear it is a member of the bee family and not that of the butterfly) can be seen crawling amongst the flowers of shrubs and trees. During the day, and especially the evenings, the droning calls of the Cicadas are almost ghostly. They truly are one of nature's best ventriloquists.

Outside of bacteria, viruses, fungi and lichens, invertebrates represent the largest group of living things on the Profile islands. Their significance to the ecology of the Caribbean is often overlooked or downplayed, due, for the most part, to our lack of understanding, appreciation and to some extent our fear of many of these creatures. But when one looks closely at their diversity, ecological roles, beauty, complexity, and influence on larger vertebrates such as birds and reptiles, then it becomes obvious how important it is that we more fully identify the species, understand their roles, and protect them and their habitats.

Photo 45.
The Tiger Moth (*C. credula*) on Mosquito Island.

Along with plants, bacteria, virus and fungi, invertebrates form one of the most fundamental components of the ecological system. Many of the resident species of birds are insectivores, or consume invertebrates as a significant part of their diets. The preponderance of Buthid scorpions on nearby Mosquito Island, for example, may attest to the variety and abundance of prey available to these voracious predators.

Invertebrates may hold the key to medicinal applications and uses. Many of the chemical compounds that species use to defend against attack, to attract mates, to kill or maim prey, to create armor, and to advertise their presence could hold promise for a range of uses and new industries. Yet, we know so little about the species—their identities, their habitats, their biology, their populations, and their conservation status.

Many invertebrate species may represent new forms to science or new records for the BVI, all of the Virgin Islands or the Caribbean region as a whole. It is therefore important to establish a local framework for identifying and monitoring invertebrates over the long term.

So far, we do not yet have the data to tell us the conservation status and the distributions of many of the invertebrate species. Only further fieldwork and study will allow us to properly understand the local species and to then develop effective conservation and management programmes.

Invertebrates can provide memorable natural experiences for islanders—from the centipedes (what some residents call "santapy") and scorpions that provoke fear and revulsion, to spectacular butterflies with their beautiful bring colours—the invertebrates of Virgin Gorda are diverse and a splendid feature of the island's biodiversity. **Photo 45** shows one of the rarest of the island's Tiger Moths, *Composia credula*, which is often found in forests and woodlands on the underside of leaves or dancing on slow wing beats through the understory.

At night, one of the most formidable hunters of the Profile islands—the scorpion—prowls the leaf litter and rock outcrops in search of prey. Though

scorpions are more common on the drier offshore islands, the species are widespread across the Virgin Islands. **Photo 46** shows a ***Centruroides* Scorpion** on Mosquito Island.

There are no dangerous scorpions in the Virgin Islands, despite local folklore. However, the stings of the larger species can be painful, if not fatal.

Photo 46.
A. centruroides Scorpion on Mosquito Island.

4.3.7 Species and Habitats of Special Concern

There are at least 24 species of amphibians, mammals, birds and reptiles that are of *Special Conservation Concern* for the Profile islands. **Table 26** provides a summary of these species.

Table 26.
Fauna of *Special Conservation Concern* for Virgin Gorda and neighbouring islands.

Species	Conservation Status	Issues/Concerns
Amphibians		
Puerto Rican Red-eyed Frog (*Eleutherodactylus schwartzi)*	Endemic to the Virgin Islands; vulnerable	This species is rarely observed. All indications are that its population is declining.
Puerto Rican Ditch Frog *(Leptodactylus albilabris)*	Very rare on Virgin Gorda; vulnerable	This is a rare species facing possible extinction on Virgin Gorda.
Puerto Rican Toad *(Peltophryne lémur)*	Extinct?	Further research and field work are needed to determine the historical circumstances of the discovery and eventual disappearance of this species, including a study of its habitats. This will go a long way to help explain its rarity.
Mammals		
Antillean Fruit-eating (or Cave) Bat *(Brachyphylla cavernarum)*	Quite rare	Known only from one location on the island of Virgin Gorda, though other caves are reported for the island. The population there was estimated to be perhaps 100 bats. They move between the two caves at the site. This species is primarily a cave rooster, and because it is gregarious in habit, it prefers relatively large flocks. There are not many caves on the island so the population is naturally limited. Also, it requires natural habitat to sustain healthy populations, and with increasing coastal development, critical habitats are being fragmented and lost.

Species	Conservation Status	Issues/Concerns
Greater Bulldog (or Fisherman) Bat *(Noctilio leporinus)*	Very rare	This species often occurs in small populations throughout its range. Given this, it is vulnerable to disturbance, coastal pollution, fish declines and to the destruction of coastal habitats.
Birds		
White-tailed Tropicbird *(Phaethon lepturus)*	Uncommon to rare in coastal cliffs	This seabird nests in steep coastal cliffs. Populations across the Caribbean and the globe have declined, likely due to predation by introduced rats, habitat destruction, human disturbances, and declines in their preferred marine prey.
American Flamingo *(Phoenicopterus ruber)*	Rare and vulnerable	This species went extinct in the Virgin Islands but was reintroduced to Anegada in the 1990s and has since been introduced to Guana Island and Necker. It is vagrant to the wetlands and coast areas of Prickly Pear.
White-cheeked Pintail *(Anas bahamensis)*	Uncommon to rare; vulnerable	Because of wetland destruction, pollution, and human disturbance, this species is mostly on the decline in the Caribbean. On Virgin Gorda, it may nest occasionally, but is limited by the availability of suitable habitats.
Virgin Islands Screech Owl *(Otus nudipes newtonii)*	Possibly extinct	Though there have been occasional reports of this species from various BVI islands in the past, most experts conclude that it is likely extinct. Nevertheless, because of its size, its nocturnal habits and its relative rarity, there is a slim chance it may continue to survive in the forests of Virgin Gorda and on Mosquito Island.
Antillean Mango *(Anthracothrax dominicus)*	Possibly extinct	The situation for this species is similar to the above, but it was primarily a lowland bird and even frequented home gardens. It has been suggested that it was the expansion of and competition from the Green-throated Carib (*E. holosericeus*) that pushed it to extinction in the BVI. There are occasional reports of this or a similar species from the Virgin Islands, but none confirmed. The species is still present on Puerto Rico.
Puerto Rican Flycatcher *(Myiarchus antillarum)*	Very rare and locally endangered	This species seems to prefer open forests and woodlands, but especially areas of relatively stable and natural forests. The scarcity of suitable coastal habitats, the introduction of non-native species, perhaps the decline of invertebrate prey, disturbance and pollution are possible causes for this decline.
Terrestrial Reptiles		
Red-footed Tortoise *(Chelonoidis carbonaria)*	Rare; likely technically extinct in the wild	This species has declined considerably, and may now be present mostly in private menageries; only a few individuals may be present in the wild, and this does not represent a viable breeding pool. It is a species that may have been moved around by Amerindians, and so their native range remains in question.
Virgin Island Amphisbaena *(Amphisbaena fenestrata)*	Rare and vulnerable	This species of legless lizard is fossorial in habit, and, as a result, it often goes unseen and unobserved. Nevertheless, because we know so little about its populations, and because so little native habitat remains, it is relatively rare and vulnerable.
Anegada Iguana *(Cyclura pinguis)*	Rare; endangered	The ground–living Rock Iguana was once widespread across the Virgin islands, but by the 1960s, a relict population survived on Anegada. Today, some have been reintroduced to Necker, Guana and Mosquito Islands (private resort islands), and there is a concerted effort to restore the population on Anegada to sustainable levels.
Virgin Islands Dwarf Sphaero *(Sphaerodactylus parthenopion)*	Very rare; vulnerable	This small reptile requires native woodlands and forests with stable leaf litters and small rocks where it may hide during the day. It directly competes with its larger relative, *S. macrolepis*, which may also predate on it. It is vulnerable to habitat loss, fragmentation, degradation and invasives such as rats.
Turnip-tail Gecko *(Thecadactylus rapicauda)*	Rare	The population on Necker is quite healthy in numbers, but represents one of the few known places it is found in the BVI. Some consider its presence an introduction, but it has been reported for that island since at least the 1800s. One was spotted on Mosquito in January 2012, possibly a stowaway from nearby Necker.

Species	Conservation Status	Issues/Concerns
Virgin Islands Tree Boa *(Epicrates granti)*	Very rare; vulnerable	The Virgin Islands Boa is a remarkable snake that has declined across its range because of habitat loss, human interference and persecution, and the introduction of non-native predators. It has not been confirmed for the Profile islands, but there are early reports that it is present on Virgin Gorda.
Anegada Racer *(Borikenophis portoricensis anegadae)*	Locally rare and vulnerable	This species is widespread across the Virgin Islands, and is the snake most likely to be encountered by humans. However, like the Boa, it too is susceptible to persecution and habitat decline. Also, despite its size and voracious appetite, it is very vulnerable to predation and attacks by introduced rats.
Virgin Islands Racerlet *(Magliophis exiguous exiguous)*	Locally rare and vulnerable	This species is quite rare in the Profile islands. The reasons for this remain unknown, but it is likely similar to the above species, *i.e.*, susceptible to predation by rats, especially as juveniles.
Virgin Gorda Blindsnake *(Typhlops naugus)*	Uncommon and vulnerable	This snake is endemic to Virgin Gorda and its nearby islands. It is fossorial in habits, so it is not often observed. However, it is an easy prey for rats, and is vulnerable to habitat loss, especially deforestation.
Marine Reptiles		
Green Turtle *(Chelonia mydas)*	Endangered	This species has been traditionally netted. Catches are declining due to over-exploitation. It primarily feeds on seagrass. Loss of seagrass is probably a contributing factor to its decline.
Logger Head Turtle *(Caretta caretta)*	Vulnerable	Not known to nest in the BVI, but presumably forages in BVI waters. The species is considerably rarer than either Green or Hawksbill Turtles.
Leatherback Turtle *(Dermochelys coriacea)*	Endangered	Largest of all turtles, it primarily feeds on jellyfish and other soft-bodied prey. Historically beaches such as Big and Little Trunk Bays and Valley Trunk Bay on Virgin Gorda once supported nesting sites.
Hawksbilled Turtle *(Eretmochelys imbricate)*	Endangered	The most common nesting turtle in the BVI, although known sites are in decline due to coastal development. Important foraging areas include Eustatia Sound (Virgin Gorda) and Ginger Island.

4.3.8 Invasive Species

(1) Agave Snout Weevil (*Scyphophorus acupunctatus*)

This Weevil was introduced sometime in the 1990s. It is native to Mexico, but was likely accidentally imported with potted plants, perhaps from Florida, the centre of horticulture trade in the region.

It attacks and destroys the native and endemic *Agave missionum*, populations of which have dramatically declined across the Virgin Islands. The insect attacks the heart of the unopened leaves by burrowing deep inside. The grubs eat the succulent tissue, while at the same time, toxins build up, which allows fungi and bacteria to attack the plant, cutting off vital circulation. The result is the collapse of the central rosette of the plant, followed by its eventual death.

Agave missionum is an important native species because its flowers provide support for birds and insects; additionally, reptiles and amphibians find refuge amongst its dead and dying leaves.

After adult plants flower, the drying mass provides homes to snakes, lizards, frogs, invertebrates and helps to supply essential organic matter to the soil.

Over the last 10 to 15 years, *A. missionum* populations had been reduced to a few scattered individuals in the BVI. Though numbers once again seem to be on the increase, the process is slow, and any major disaster or habitat destruction could once again reduce population numbers.

(2) House Mouse (*M. musculus*)

This species arrived with the first Europeans as a stowaway on ships. It is now widespread and present on most islands. It is more common around human settlements, but also occurs in the wild.

The Mouse will attack native wildlife, including ground-nesting birds, their eggs and chicks. It will also prey on reptiles and amphibians. Being omnivorous, it will also consume native plants, their flowers and seeds. On the offshore islands, the Mouse presents a major threat to native flora, fauna and ecosystems.

(3) Black Rat (*R. rattus*)

The Black Rat's history on these islands is similar to the House Mouse. Their habits are somewhat similar, though the rat also climbs trees and is a much larger creature. It is a dangerous invasive, and on the offshore islands, it needs to be controlled.

(4) Brown Rat (*B. norvegicus*)

The Brown Rat is sometimes called the Roof Rat because of its arboreal or climbing habits. It sometimes reaches a size somewhat larger than the Black Rat, is a bit more aggressive, but, otherwise, they are both similar in behaviour, although it tends to favour more urbanised areas. The Brown Rat arrived in the Virgin Islands as a stowaway on ships when Europeans first arrived.

(5) Small Indian Mongoose (*Herpestes javanicus*)

The Mongoose is *NOT* present on any of the Profile islands, but is found on nearby Tortola and Jost Van Dyke. Because of the proximity of these two populations to Virgin Gorda, and because of its deliberate introduction to Jost during the late 1970s and early 1980s, it is possible that it could be introduced on Virgin Gorda. On JVD, a generalised fear of snakes induced residents to bring the Mongoose from Tortola and release them on the island, with disastrous consequences for local fauna.

Without effective public education and a Territorial policy of control and legal restrictions to prevent its transport from island to island, the Mongoose could easily be introduced to Virgin Gorda.

(6) Cuban Tree Frog (*O. septentrionalis*)

Although the Cuban Tree Frog presents an economic and ecological threat to Profile islands (*e.g.*, by invading cisterns and outcompeting other native frogs), it is difficult to manage given the size of its populations and its widespread presence on all of the Virgin Islands. Additional field study will help to determine its impacts, as well as ways to control and manage it.

(7) Feral and Free-roaming Livestock

Domesticated livestock breeds are present on Virgin Gorda and on Prickly Pear. Though in some instances, only one type may be present in a given area, overall, feral and free-roaming livestock present several challenges for the two islands.

These animals have been a part of the local landscape since late in the 1800s. During lean times, residents could rely on the meat and the sale of stock to survive. Even as the BVI progressed to today's service-oriented economy, aspects of this farming tradition persist, and the adverse impacts of these introduced non-native herbivores over the decades have resulted in habitat degradation and loss, deforestation, erosion, and ecological system dysfunction.

On Prickly Pear Island, a goat-climax vegetation community has been created as a result of years of overgrazing by goats. The dominant plants now covering most of the island are Croton species—unpalatable to goats and other livestock because of their sap—and so they persist. The result is a degraded landscape. On Virgin Gorda, similar plant communities are present, especially on hills around Spanish Town, Milton and Cow Hills.

Even after feral and free-roaming livestock have been removed from a particular area, the damage they have caused may persist for years. Evidence of this can be seen on many of the Profile islands, for example, Mosquito Island. On Virgin Gorda, the long-term effects of feral livestock can be seen on the easternmost peninsula, North Sound and South Sound.

4.4 Coastal Wetlands

Over thousands of years, coastal wetlands came into being as a result of wave action, storms, beach development and the growth of coastal vegetation. These aquatic ecosystems are an integral part of the coastal landscape and the ecological fabric of Virgin Gorda and the nearby islands. They provide critical habitats for many species of native flora and fauna, as well as important environmental services.

Why are coastal wetlands so critical?

1. They are natural sediment traps, holding the runoff from upland areas, retaining silt and other materials, and preventing them from reaching sensitive coastal marine habitats such as coral reefs and seagrass beds.
2. Coastal wetlands, especially fringing mangroves, serve as critical coastal barriers that protect inland areas from storms and high tides.
3. Ponds and marshes also protect the coastline from erosion and help protect natural beaches.
4. They provide habitats for native flora and fauna. The endemic Toad (*P. lemur*) once found refuge within coastal marshes. The destruction of many of these wetlands may have driven the species to extinction.

   Many other native species, such as land crabs and other invertebrates, depend on wetlands for survival. So too do waterfowl such as ducks, coots and rails, as well as shorebirds which cannot survive without wetlands.
5. Many plants also depend on wetlands, including species of grasses, sedges and reeds, and the four mangrove species of the Profile islands survive only in wetlands.
6. Wetlands are an integral part of the natural landscape. They are aesthetically pleasing, adding texture, dimension and diversity, and creating a unique one-of-a-kind island experience. When one of its wetlands disappears, so does a unique aspect of what is the reality of Virgin Gorda.

Although the coastal wetlands are relatively small, they are—as indicated in the enumeration above—critically important. Despite this, many of Virgin Gorda's wetlands have been filled in or altered, and many have disappeared entirely. Starting in the 1960s, many of the island's mangroves, salt ponds and coastal marshes have been lost to development. The largest of Virgin Gorda's ponds, at Spanish Town, was dredged to create the Virgin Gorda Yacht Harbour at St. Thomas Bay. In fact, since 1960, approximately one-third of the island's coastal ponds have been lost, including the natural ponds at Spanish Town, Little Dix Bay, Biras Creek and Oil Nut Bay, all of which have disappeared or been dramatically altered.

Most prominent fringing mangrove systems on Virgin Gorda are found along the shores of Deep Bay (**Figure 17**) where mangrove die-off is noticeable. Ongoing development and encroachment along these fragile coastal ecosystems have increased in recent years—for example, the building of a barge ramp and concrete dock and the expanded use of the unpaved road—and these will only increase the pressures on these system, in addition to the adverse effects of recent increases in hurricanes and storm surges.

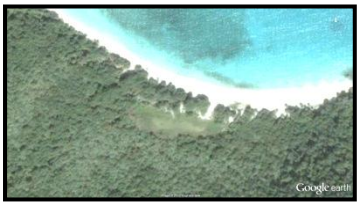
There are currently 14 salt ponds within the Virgin Gorda Profile area: five on Virgin Gorda, four on Prickly Pear Island, two on Mosquito Island, two on Necker Island, and one on Great Dog Island. **Table 27** provides a brief description of their characteristics and current conditions. Their geographical locations are displayed on **Figure 16**.

There are also several coastal fringing mangrove communities throughout the Profile islands. The most significant ones are found on Virgin Gorda, more specifically at Gun Creek, Biras Creek (north side), Deep Bay north and south side, Long Bay, and South Creek (**Figure 17**).

Table 27.
The salt ponds of Virgin Gorda and neighbouring islands.

No.	Name	Location	Type/Classification	Issues/Impacts
1	**POND BAY POND, VIRGIN GORDA**	Adjacent to Savannah Bay and Pond Bay, along the isthmus connecting the central land mass of Virgin Gorda to the southern peninsula of the island	 **Photo 47.** **Pond Bay Pond looking northwest.**  **Photo 48.** **Pond Bay Pond looking northeast.** This is the largest unaltered salt pond on VG, and is fringed by White, Black and Buttonwood Mangroves. The pond is flooded most of the year and receives much of its freshwater from hillside runoff. The barrier beach berm is quite wide, and therefore inundation from heavy storm surges seldom occurs.	To date, there has been relatively little impact on the salt pond. However, residential development on an adjacent hillside to the northeast is on the increase (Photo 21, top left corner). This activity is encroaching on the pond's vegetation buffer. Continued land clearing may lead to increased erosion and sedimentation leading to the deterioration of water quality. Although maximum water depth is estimated at around 1 m (3 ft), it is normally below 0.5 m (1.5 ft) during most of the year. The presence of water and even fluctuating water levels provides great foraging opportunity for waterfowl, shorebirds, and egrets.
2	**FISHERS COVE POND, VIRGIN GORDA**	Southwest of Spanish Town, Virgin Gorda	 **Photo 49.** **Fishers Cove Pond, looking north.** This is a very small pond situated inland from the shoreline (Fishers Cove). Buttonwood and White Mangroves are the dominant mangrove species occupying the outside perimeter. Patches of Red Mangroves are also present within the inundated zone. The pond is mostly fed by storm water runoff from the Spanish Town urban area to the north and east and natural runoff and seepage from the boulder fields to the south.	This ecosystem is slowly decreasing in size as encroachment from development continues. Dumping of domestic waste and construction waste material is evident from the roadside. Since there are so few ponds within this area of Virgin Gorda, this salt pond becomes a magnet for much of the local and migratory avifauna. The pond provides critical foraging opportunity for waterfowl as well as protective shelter.

No.	Name	Location	Type/Classification	Issues/Impacts
3	**BIRAS CREEK POND, VIRGIN GORDA**	Located within the eastern peninsula of Virgin Gorda, between Biras Creek and Deep Bay	 **Photo 50.** **View of Biras Creek Pond from the north.** This pond has been severely altered and dredged in the past. However, coastal species of flora are slowly on the increase along the perimeter which will help to attract more wildlife. Red mangrove seedlings were noted along the edges of the pond. This natural regeneration trend is positive.	The pond is vulnerable to constant pressure from surrounding activities (*e.g.*, a horse ranch) and from road and off-road ATV traffic associated with both the Oil Nut Bay and Biras Creek Resorts. All nearby roads are unpaved and very susceptible to sediment runoff.
4	**MOUNTAIN POINT POND, VIRGIN GORDA**	Northwest tip of Virgin Gorda, along Saddle Bay	 **Photo 51.** **Aerial view of Mountain Point Pond.** This pristine pond and its surroundings have yet to be investigated due to its remoteness. A few species of mangroves are likely to inhabit this ecosystem. Beach vegetation is visibly stunted by strong offshore winds. The exposed, high-energy beach is composed of coral cobbles and rubble.	Mountain Point Pond and its surrounding area are relatively untouched by human activity.
5	**OIL NUT BAY POND, VIRGIN GORDA**	Eastern peninsula, Virgin Gorda	 **Photo 52.** **Eastern half of Oil Nut Bay Pond, looking north to Eustatia Sound.** As part of the Oil Nut Bay Development Project, the pond has undergone dramatic changes, and now is more of a retention pond than a naturally functioning pond.	Oil Nut Bay Pond has completely been altered and *no longer functions as a salt pond*. It is absent of any significant wetland flora (aquatic and terrestrial). Although an occasional waterfowl might stop by, current site conditions are unfavourable to foraging or nesting. The lack of any vegetation buffer around the pond is likely to cause an increase in pond sedimentation.

No.	Name	Location	Type/Classification	Issues/Impacts
6 & 7	**VIXEN POINT POND and PRICKLY BAY POND, PRICKLY PEAR ISLAND**	Southwest tip of Prickly Pear Island	 **Photo 53.** **Aerial views of Vixen Pond (R) and Prickly Bay Pond.** Both ponds are shallow and frequently dry due to the extreme xerophitic conditions on the island. During heavy rains, the two ponds are likely to connect due to their proximity to one another.	On Prickly Pear Island, a goat-climax vegetation community has been created as a result of overgrazing by goats for many years. The surrounding flora is dominated by croton species and ground vegetation cover is sparse, thereby exposing soils and increasing sediment runoff into the ponds. As a result, both ponds are rapidly filling up. Prickly Bay Pond seems to be the shallower and more turbid of the two based on imagery.
8	**EAST END POND, PRICKLY PEAR ISLAND**	East end, Prickly Pear Island	 **Photo 54.** **Aerial View of East End Pond.** The largest pond on Prickly Pear is likely to have a few species of mangroves (Buttonwood and White Mangroves). Imagery show possible Red Mangroves colonising the land side shallow waters of the barrier beach.	The pond's ecosystem is vulnerable to overgrazing and sediment runoff due to nearby goat activity.
9	**NORTH EAST POND, PRICKLY PEAR ISLAND**	Northeast shoreline, Prickly Pear Island	 **Photo 55.** **Aerial view of North East Pond.** This is the smallest pond on Prickly Pear Island. It is mostly covered with shrub vegetation. It is dry for most of the year and temporarily wet after heavy rains.	The pond shows no signs of being negatively impacted; however, the threat of nearby goat activity may alter its condition. The pond is reaching the natural end stage of its development cycle, and eventually it will be completely filled and totally covered with thick shrub vegetation with no presence of open water. However, intense tropical storms could reverse the process.
10	**MANCHIONEEL BAY POND, MOSQUITO ISLAND**	Southwest, Mosquito Island	 **Photo 56.** **A view of the pond, foreground (dry stage), and barrier rubble beach from Lookout Point.** *continued*	This pond is slowly and naturally filling in with sediments washed from the hillsides. This will gradually encourage tree growth around the edges. Ultimately, if the trend continues, shrub-like vegetation will cover the entire pond.

No.	Name	Location	Type/Classification	Issues/Impacts
			The pond is usually dry for most of the year and becomes flooded after torrential rains combined will hillside runoff. The central portion is dominated by marsh forb (*Batis maritima)*. No mangroves are found. An impressive barrier berm over 5 m (16 ft) in height marks the shoreline side of the pond. The majority of it is comprised of rock rubble and minor coral rubble.	
11	**SOUTH BAY POND, MOSQUITO ISLAND**	Northeast, Mosquito Island	 **Photo 57.** **A view of the pond looking north.** This pond is located on the flats between the upland and the former Drake's Anchorage Resort. It is mostly dry except during heavy rains and periods of hillside runoff. The perimeter of the pond is dominated by White and Buttonwood Mangrove trees.	In the past, part of the pond was used as dump site. The pond now serves as a sediment retention basin as part of a development project currently taking place on the island. There are plans to restore the pond's ecology and to include a channel that connects to the sea. This will render the pond a "lagoon type." The outcome is likely to attract more wildlife and enhance the growth of wetland vegetation.
12	**NORTH POND, NECKER ISLAND**	Northwest side, Necker Island	 **Photo 58.** **A view of the pond with a flock of Flamingos along its edge.** Once a small natural pond, it is now a large managed pond that contains an introduced flock of about 200 flamingos and a small flock of scarlet Ibis.	This pond is managed to maintain water quality. The flock of birds are fed and provided with necessary care. Birds will move between the Necker Island ponds and often leave the island, but usually return. The shoreline consists of a grassy shore and some mangroves. The pond's habitat attracts many native species including the White-cheeked Pintail, moorhens, gulls, terns, and shorebirds. The system appears sustainable as long as water quality standards for wildlife remain healthy.
13	**SOUTH POND, NECKER ISLAND**	South of Devil Hill, Necker Island	 **Photo 59.** **Looking north toward Devil Hill.** **Small flock of Flamingos in the foreground.** South Pond is also a managed salt pond. It is surrounded by a variety of wetland plant species including Red Mangroves.	This pond has an aeration source and some flushing to improve water quality. The Flamingo and Scarlet Ibis have been introduced and are managed by regular feeding. The pond also attracts an array of waterfowl species including pintails, moorhens, herons, shorebirds and gulls. Water quality could be an issue if the system exceeds its carrying capacity.

No.	Name	Location	Type/Classification	Issues/Impacts
14	**GREAT DOG POND, GREAT DOG ISLAND**	South shoreline, Great Dog Island	This is a rather small coastal pond situated along the southern shoreline. It has not been investigated by the IRF Profile Project team, and little is known about it through the literature.	No impact or issues can be denoted from available aerial imagery.

4.5 Biodiversity Issues and Development

Conservation presents a considerable, ongoing challenge for today's modern Virgin Islands. How can Virgin Islanders as a community continue to develop and grow, while at the same time ensuring the future health of their natural world? But as much as it is a challenge, it is also an opportunity—for innovation, for advancement, for research and science, for learning, and for welcoming fresh views.

The actions of the people of the Profile islands—whether BVIslanders, their political leaders, land developers, residents, visitors—are causing the decline and loss of species, habits and their ecosystem services. The accumulation of change in the natural world is increasingly observable to scientists, stakeholders, resource users, resource managers, and to those who remember Virgin Gorda as it was in their childhoods.

The long and—yes—tedious process of balancing conservation and protection with development and economic growth is an ongoing one. What is mostly overlooked is an intangible something that should be interwoven into any narrative that speaks of Virgin Gorda and its future. And that is a need for an enhanced understanding of the ***sense of the place***, or, as the English poet, Alexander Pope, once wrote, for *the* ***"genius of the place"***—for the ethos of landscape that captures the beauty and uniqueness of the island and celebrates a connection to the land and to the sea and to a natural poetry that is the essence of Virgin Gorda.

In our concern for livelihoods and jobs, for wealth and stability, for economic gains and expanded horizons, let us not forget ***the genius of the place*** that is Virgin Gorda.

4.5.1 Biodiversity and Road Construction

The construction of the island's roads has emerged as an issue that clearly demonstrates what occurs when development needs meet environmental concerns. It is an every-day activity of earth movement that emphasises how easily we forget the specialness of biodiversity when placed alongside the imperatives of the development process.

Road construction is a necessary feature of the BVI's modern development. Unfortunately, as roads have been developed, they have too often scarred the landscape with deep cuts gouged into hillsides, as has dramatically occurred on the island of Virgin Gorda. What are often left behind by road-building activities are massive scars, eroding slopes and disrupted drainage.

Road construction can also adversely impact the target area's flora and fauna, so severely that habitats are often diminished or destroyed while species decline or disappear.

During fieldwork on Virgin Gorda, IRF researchers heard rumours of a small cave with bats situated somewhere near North Sound. When the team made arrangements to visit the cave in February of 2012, it was disappointing to learn that it had been destroyed as a result of road construction in

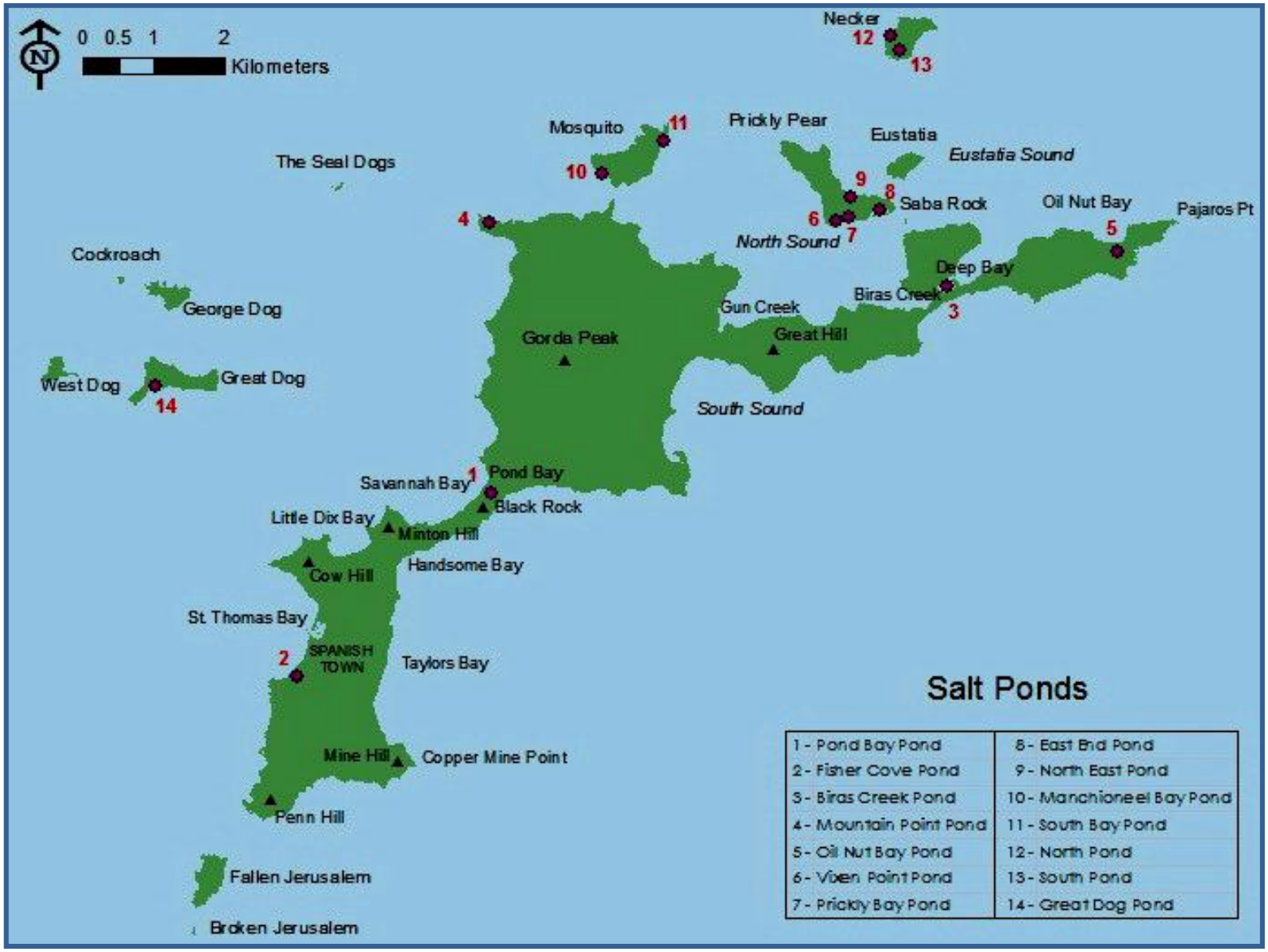


Figure 16.
The salt ponds of Virgin Gorda and neighbouring islands.

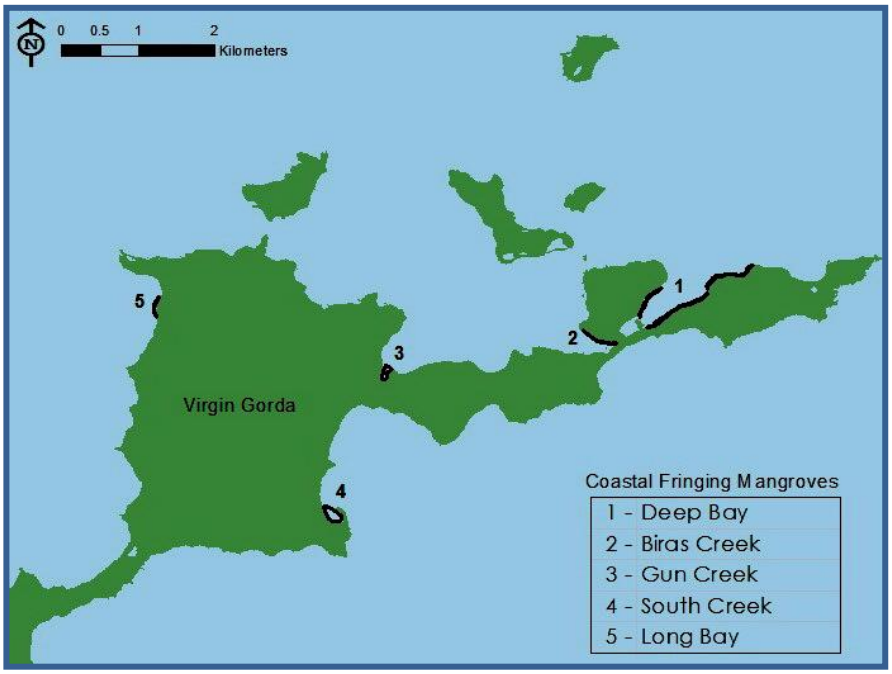


Figure 17.
The remaining few fringing mangroves of Virgin Gorda.

the area. Since natural caves are a rare occurrence in the Virgin Islands, and since—for bats—these caves are critical habitat, this news was both frustrating and heartfelt by the IRF investigators.

But it is the impacts of road construction on biodiversity that is most worrisome. Above Leverick Bay and in nearby valleys, there are beautiful native forests and scrubland with many rare, threatened and regional endemic plants. Road construction in this area has been indiscriminate, and as a result, much of the area's unique flora has been put at risk.

Here, one of the island's most threatened plants, the St. Thomas Prickly Ash (*Zanthoxylum thomasianum*), is found in small numbers. One plant, a scraggly dying tree, was found hanging by a few roots down the side of a deep escarpment gouged into the hillside by bulldozers. **Photo 60** shows the unfortunate Prickly Ash at Leverick Bay.

Road construction impacts can be lessened by careful planning and engineering, including biodiversity field surveys, to ensure that road development has a minimal effect on the area's natural life and environmental features.

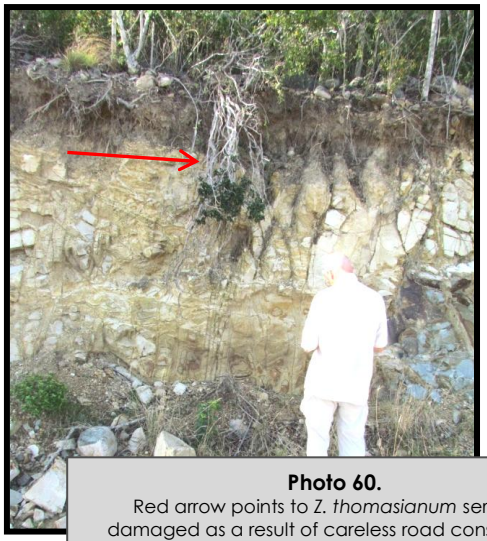


Photo 60.
Red arrow points to *Z. thomasianum* seriously damaged as a result of careless road construction practices at Leverick Bay, Virgin Gorda.

An excellent example of road construction utilising best management practices can be found at nearby Mosquito Island where a new road cut is barely visible from offshore. Virgin Gorda and the BVI can learn valuable lessons from the environmental management strategies employed by the Mosquito Island development team.

Issues, Conflicts, and Areas of Concern	Impacts of No Action/No Change	Short-term Options Long-term Recommendations
ISSUE ONE **Loss of Native Vegetation** Due to past and present land-use practices, along with current infrastructure development, the remaining tracts of Virgin Gorda's native forest, woodlands, shrublands, grasslands, and wetlands are at risk. Many such areas are fragmented or degraded and their functions disrupted. Many have already been lost, and further decreases are likely in the near term given proposed development plans for the Profile islands.	Ongoing loss and deterioration of native vegetation will further reduce biodiversity, possibly to levels so severe that recovery of certain species and habitats may be impossible. These losses, when coupled with the gradually diminishing esthetic appeal of the island's landscape and coastal environment, may ultimately lead to a reduction in tourist arrivals.	**SHORT-TERM OPTIONS** 1. The physical planning and conservation departments of Government need to Identify the sites most at risk from loss of native vegetation, especially habitats located on the eastern peninsula, at Leverick Bay, the north side of Gorda Peak, Blunder Bay, Saddle Bay, Long Bay, South Sound Bluff, Valley Hill, Great Hill including Grassy Point, and the boulder fields (especially the northern section). 2. Concurrently, the critical plant and animal species and habitats of the areas identified above should be described, and mapped. GIS maps of these habitats and species should be integrated with the Territory's development planning and development control information base at DTCP. **LONG-TERM RECOMMENDATIONS** 1. As part of a long-term intervention and monitoring strategy to save and protect critical species, the Department of Conservation and Fisheries should coordinate with the Department of Town and Country Planning to use and implement provisions of the Physical Planning Act (2004) that can protect critical ecological resources, including plant species. 2. A conservation strategy for critical habitats situated outside designated parks and protected areas should be developed by the Government's planning and conservation agencies. A draft management plan for the Territory's wetlands exists (DTCP, 2005), but has never been completed, approved or implemented. 3. The Department of Conservation and Fisheries needs to be more aggressive in developing species recovery plans for critical native plants, including periodic reviews of plan implementation every 5 to 10 years.
ISSUE TWO **Invasive Species: Feral and Free-roaming Livestock** Free-roaming livestock on Prickly Pear and Virgin Gorda have contributed to land deterioration through soil loss and erosion. They have also caused considerable biodiversity reduction, particularly vegetation land cover. *(Continued)*	If kept unchecked, the continued presence of goats—on Prickly Pear in particular—will further impact the environment, with increased loss of biodiversity, reduction and degradation of habitats, increased soil erosion, and deterioration of wetlands. *(continued)*	**SHORT-TERM OPTIONS** 1. Since Prickly Pear Island is a national park, NPT needs to identify and rank areas where free-roaming livestock are a problem on the island (perhaps also including heavily degraded areas on Virgin Gorda). 2. The next step is for NPT to develop a management and recovery strategy by, first, determining the ownership status of the Prickly Pear's goat population, *i.e.*, the goats that can be identified as property of specific owners and the population that is free-ranging. Individual goat owners will need to be encouraged to maintain their animals within their own property and not within the boundaries of a national park.

Issues, Conflicts, and Areas of Concern	Impacts of No Action/No Change	Short-term Options Long-term Recommendations
Invasive Species: Other Invasive Issues – The presence of rats in wildlife habitats poses a threat to plant biodiversity and to nesting seabirds. – The introduction of exotic pets for recreational purposes and personal menageries carries risk for native wildlife and other native species. .	The desire by many to import exotic pets and wild animals in order to satisfy a growing demand for zoological entertainments poses potential harm to native flora and fauna and also presents safety issues for locals and visitors.	**LONG-TERM RECOMMENDATIONS** **1.** The National Parks Trust should develop a plan for the removal of free-ranging goats from Prickly Pear Island and then provide a strategy for the restoration of areas heavily impacted by livestock. Removal of the goats and ensuring that they not return will be a significant environmental challenge for the NPT. However, to continue to take no action is to leave a very visible national park site in a degraded natural state. **2.** Perhaps in cooperation with Virgin Gorda community groups (see Chapter 2, Section 2.2), the NPT and the DCF could develop an education programme to support efforts to control the impacts of grazing livestock, including those in protected areas. Such an awareness-building programme might focus on: – Increasing public awareness about the short- and long-term impacts of invasive species on the BVI's environment, emphasizing the consequences of inaction. – Identifying options and alternatives to remedy each invasive issue—whether free-grazing livestock, rats, exotic pets—assessing the pros and cons of each. – Seeking Government assistance and/or external expertise when community resources are not adequate to meet desired outcomes. – Providing information on the importation of exotic pets and wild animals. **3.** A rat eradication-and control-programme, such as carried out successfully from 2002 to the present at Sandy Cay, and a rat control programme such as is currently in effect at Mosquito Island, should be considered for other islands in the North Sound of Virgin Gorda. (See: Varnham, 2003, *Eradication of Black Rats (*Rattus rattus*) from Sandy Cay, British Virgin Islands*).

Issues, Conflicts, and Areas of Concern	Impacts of No Action/No Change	Short-term Options Long-term Recommendations
ISSUE THREE **Loss of Wetlands and Their Functions** There are 14 wetlands within the Profile islands. About one-third of this area has been significantly altered by man-made development. Some of the remaining ponds are under threat from development, from the dumping of refuse and waste, from sediment runoff (caused in part by an increase in unpaved road surfaces), and from loss of protective habitats and buffers along their perimeter. Fringing mangroves are also under threat primarily due to coastal development.	Unless the Government takes a more aggressive approach to protecting, managing, and conserving these vital ecosystems, further deterioration and loss will take place. On Virgin Gorda, fringing mangroves at Biras Creek, Gun Creek and Deep Bay could disappear in the near future.	**SHORT-TERM OPTIONS** 1. Salt ponds and fringing mangroves that are being used as waste deposit sites need to be cleaned up and waste and refuse should be removed, perhaps as part of a targeted "island clean-up" campaign. Priority areas suffering from refuse dumping on Virgin Gorda are Fishers Cove, Gun Creek, and Biras Creek. 2. Because they serve as valuable avian habitats and provide storm wave buffering protection, the filling of ponds should ***always*** be avoided. **LONG-TERM RECOMMENDATIONS** 1. Because the Territory lacks a comprehensive coastal zone management law to protect and manage its wetland resources and coastal areas, it is important for the BVI Government to have in place a wetlands policy, *approved by Cabinet*, that: – *Integrates* planning for wetlands across government departments and agencies, – Provides a workable definition for what constitutes a wetland system, – Implements a long-term monitoring regime, – Includes a coastal disaster mitigation component, – Absolutely protects habitats whose system integrity has been identified as critical to the Territory, – Ensures perpetual maintenance of high levels of biodiversity consistent with traditional natural conditions. The extant draft wetlands policy and management plan (DTCP, 2005) should be revived immediately, completed as soon as possible, expeditiously placed before Cabinet for approval, and fully implemented without delay.

Issues, Conflicts, and Areas of Concern	Impacts of No Action/No Change	Short-term Options Long-term Recommendations
ISSUE FOUR **Loss of Drainage Ghuts** Drainage ghut corridors are some of the most diverse biodiversity habitats on Virgin Gorda. ***They are biodiversity "hot spots"*** and provide natural pathways for wildlife movement, as well as foraging opportunities. Ghut systems (including tributaries) are also important sources of fresh water for wildlife. Ongoing tourism and residential development, with their inevitable road and infrastructure construction, are gradually altering natural drainage patterns on Virgin Gorda, and, at the same time, they are disrupting the biodiversity of the island.	If this trend continues, it will contribute to the adverse impacts that man-made development activities are exerting on the natural environment, and the sustainability of insular biodiversity of Virgin Gorda and the other Profile islands will be at further risk.	**SHORT-TERM OPTIONS** 1. The Department of Conservation and Fisheries should consider undertaking an inventory of drainage ghut systems on Virgin Gorda and its offshore islands. A ranking system could be established based on the biodiversity significance of and external threats to specific ghut systems. Priority drainage systems could be considered for protection and/or restoration. 2. The data collected by DCF researchers should be available to the development control unit of the Department of Town and Country Planning to alert planners to areas prioritised for wildlife protection. Prior to the commencement of land-clearing projects, points of movement and habitat for faunal species in drainage ghuts need to be identified to facilitate passage of faunal species both during and after construction. **LONG-TERM RECOMMENDATIONS** 1. Very little research has been carried out in the British Virgin Islands on drainage ghuts and their importance for biodiversity. A long-term strategy for the management and conservation of drainage ghuts for Virgin Gorda and its nearby islands should be prepared by the Department of Conservation and Fisheries—and, by extension, for the entire British Virgin Islands.
ISSUE FIVE **Impacts of Road Construction** Too often, best management practices have not been employed in Virgin Gorda in the design of roads—as witnessed by the Leverick Bay Road and the Oil Nut Bay Road—with adverse consequences for the natural terrestrial environment. An added impact is erosion and sediment runoff, which contribute to deterioration of marine life and loss of valuable coastal habitat (see Chapter 7, Section 7.2.3.2).	If the BVI Government does not put in place a uniformly applied and consistently monitored policy and guidelines for the design and construction of roads, the reduction of biodiversity will continue with each new project not properly designed and monitored. An obvious example in Virgin Gorda is the road above and west of Leverick Bay, where road development has severely impacted native forest and scrubland and continues to threaten survival of endemic flora.	**SHORT-TERM OPTIONS** 1. The Government agency (or agencies) responsible for the Leverick Bay Road needs to review and assess the impacts of the road design and road construction practices at Leverick Bay and road cuts along the western slopes of Gorda Peak. Recovery options for stabilising erosion along road cuts and along steep slopes associated with the road corridor need to be proposed. Critical habitats along the road corridor need to be identified and surveyed, and mitigation measures need to be put in place, including habitat restoration. **LONG-TERM RECOMMENDATIONS** 1. The BVI Government needs to prepare a construction design manual adapted to Virgin Gorda conditions and applicable to the entire Territory. Road design guidelines and construction practices must be part of the Territory-wide EIA process for all projects, including Government-sponsored projects.

Issues, Conflicts, and Areas of Concern	Impacts of No Action/No Change	Short-term Options Long-term Recommendations
ISSUE SIX **Lack of Biodiversity Information** Insufficient biodiversity data—coupled with incomplete understanding of native biodiversity—limits the ability of BVI Government departments charged with resource management tasks to design fully effective management programmes for the natural resources of Virgin Gorda—and, by extension, for the BVI.	The lack of sufficient baseline data on biodiversity (including species types, distributions, population data, ecology, biology and threats) severely reduces the ability of resource managers to make informed decisions, including the ability to anticipate potentially negative events.	**SHORT-TERM OPTIONS** 1. The NPT and the DCF should continue collaborative relationships with internal and external research institutions to assist with BVI research undertakings. In Virgin Gorda, biodiversity surveys are needed of priority habitats areas, including: the eastern peninsula, Leverick Bay, north side of Gorda Peak, Blunder Bay, Saddle Bay, Long Bay, South Sound Bluff, Valley Hill, Great Hill, and the boulder fields. **LONG-TERM RECOMMENDATIONS** 1. Supporting legislation to protect endangered species and habitats is available in the draft *Environmental Management and Conservation of Biodiversity Bill* prepared by the BVI Law Reform Commission (see also Section 2.1.4.5 of Chapter 2). Enactment of the legislation will support efforts of BVI conservation agencies to collect data and develop programmes for endangered species and habitats.
ISSUE SEVEN **Land Clearing for Property Development** On Virgin Gorda, the traditional approach for preparing a parcel of land for development is to use a bulldozer and/or fire to entirely clear the land of its vegetation cover, thereby exposing the underlying soil and rocks and displacing the area's fauna.	The clearing of a small parcel of land by a single landholder may not have a larger impact on the wider ecology of Virgin Gorda. However, such practices over many parcels will have a cumulative effect and, over time, carry the risk of more widespread ecological dysfunction and loss of biodiversity.	**SHORT-TERM OPTIONS** 1. The Department of Town and Country Planning, perhaps in cooperation with the Department of Public Works, should create an "earth movement handbook" that focuses on small landholders who require information on best management practices for land-clearing including the need to retain vegetation. (Many islanders maintain that trees cause disease, attract pests, and even encourage crime. This is a myth that needs to be discouraged.) A useful model for such a handbook is found in the US Virgin Islands in *Virgin Islands Environmental Protection Handbook* (VI Cooperative Extension Service, 2002), which serves as a guide for pre-construction planning strategies and best management practices to be utilised during construction. **LONG-TERM RECOMMENDATIONS** 1. As a long-term strategy, the British Virgin Islands should develop a national policy and accompanying guidelines for land-clearing activities by small landholders.

5. COASTAL AND MARINE RESOURCES

As a relatively remote archipelago in the northeast Caribbean, the Virgin Islands are as much about the sea as the land. The lives of the inhabitants have always been closely tied to the sea. The first humans to visit the shores of Virgin Gorda arrived by dugout canoe, island hopping from South America. That was centuries before the famous voyages of Christopher Columbus.

Archaeological evidence suggests these first arrivals depended on the sea for food as well as transport. The reefs surrounding Virgin Gorda were teeming with fish and edible invertebrates. Sea turtles were likely abundant on many sand beaches during the nesting season. The estuaries, mangrove lagoons and extensive North Sound were surely filled with marine animals that were easy to hunt and could sustain the early settlements. In particular, Manatee and the Caribbean Monk Seal were probably staples in the diets of the first arrivals.

In the late fifteenth century, the first Europeans found a similar bounty of resources. There is little doubt that the abundance of marine life surrounding the islands contributed to the successful colonisation and settlement of Virgin Gorda. Unfortunately, it did not take long before the extensive use turned to abuse. Harvesting turned to plundering, and the resources were considered inexhaustible and exploitable without restriction or limitation.

As population numbers expanded, the environment began to suffer. Perhaps the first significant impact on the marine environment resulted from fishing pressure. Fishing efforts initially concentrated on those resources easiest to exploit. Large animals found on the shore or in nearby shallow waters were hunted at will. Populations of species such as Manatee, Monk Seals, and marine turtles were soon decimated. Today, the Monk Seal is extinct, the Manatee has been extirpated from the Virgin Islands as a resident species, and sea turtle populations are a tiny fraction of their former numbers. Even the great whales that previously migrated through the islands, and probably lingered in many sheltered bays, now pass well offshore and are rarely seen.

Over the years, fishing pressure has steadily increased and now fishermen must extend their search further and further from shore. As a result, virtually every species of economic importance is in decline.

In recent decades, expanded coastal developments, especially for tourism, has substantially increased the pressure on coastal and marine environments. Construction along the coast, as well as inland, has resulted in soil erosion, which is then discharged into the sea. Reclamation projects in fragile wetland and estuarine habitats have added pressure on vulnerable ecosystems. Untreated sewage and other forms of pollution further aggravate the threat to marine species and habitats.

The most unfortunate reality facing the marine environment of Virgin Gorda may well be the classic "*out of sight, out of mind*" axiom. Since most people do not see the impacts on the marine environment, there is too little concern and too little insistence that something be done to reverse the decline. It is therefore vital that information about the condition of the marine environment is assembled and widely disseminated. Understanding the causes of the problems facing coastal and marine ecosystems is the first step in finding effective solutions to restoring these essential environments.

Photo 61.
Students at St. Mary's School, Virgin Gorda, learn about the marine environment from guest teacher, Clive Petrovic (not pictured).

5.1 Overview of the Resource Base

Nearshore, shallow-water marine environments are closely linked to estuarine and shoreline habitats. The ecological processes taking place in the marine habitats around Virgin Gorda depend on coastal—and even inland—ecosystems. Furthermore, it is well understood that there is an energy flow between terrestrial and marine ecosystems. Nutrients naturally eroding from the land contribute to the rich biodiversity offshore. Likewise, underwater physical features and nearshore topography influence marine habitat structure and the flora and fauna found there.

To understand the many issues facing the coastal and marine environments surrounding Virgin Gorda requires background knowledge about the physical environment and natural resource base. More specifically, it is important to document the physical and biological features in order to place them within a present-day context.

5.1.1 Physical Features

Virgin Gorda is one of numerous hills on the Puerto Rico Bank, an extensive underwater plateau that has been both exposed and submerged in recent geological times. The current shape and distribution of the land masses on the bank result from the sea level as it presently exists.

The underwater topography is no less variable. Only minor changes in sea level will determine the shape of bays, estuaries and coastal habitats. Furthermore, this same variation will influence currents, tidal effects, and other physical factors that determine the distribution and abundance of marine flora and fauna.

It is the topography of Virgin Gorda and the underwater portions of the plateau that resulted in the windswept cliffs and coral reefs of the southeastern coast of the island. Similarly, it is sea level and underwater topography that produced the sheltered North Sound with its extensive sea grass meadows and sand bottom. The same can be said of the beaches and offshore habitats along Virgin Gorda's northwestern coast.

Marine ecosystems depend on specific physical conditions to survive. Mangroves and seagrasses require sheltered environments free from high-energy wave action. They are adapted to conditions where temperature, salinity and various parameters of water chemistry can fluctuate.

Coral reefs are just the opposite. They require stable temperatures and water chemistry, but they can tolerate considerable wave action. In fact, reefs thrive in high-energy wave areas.

Virgin Gorda contains a variety of physical features, and it sustains a wide diversity of coastal and underwater habitats. All of the island's marine habitats depend on warm, shallow, clean, clear water.

In general, there are three basic physical environments surrounding Virgin Gorda.

(1) The north and west coast contains extensive beaches that are most affected by winter ground seas. There are many sand beaches and offshore reefs dominated by soft corals (**Photo 62**).

(2) The south coast tends to be impacted by open Caribbean Sea conditions throughout the year. Continuous wave action erodes the coastline producing impressive cliffs and rocky shores. The harsh conditions create an underwater topography of eroded boulders and bedrock. Hard corals thrive in this exposed environment (**Photo 63**).

(3) The extensive sheltered waters of North Sound and its surrounding islands produce calm conditions more suited to seagrasses and algal flats. The bottom is primarily sand and soft sediments that experience little disturbance, except in a few areas (**Photo 64**).

Within these general areas, there are variations in topography and physical conditions. For example,

there are rich and diverse seagrass and algal beds in South Sound, behind the reef. The Colquhoun Reef is a high-energy reef zone that shelters part of North Sound. The offshore islands of the Dogs and several small cays south of Virgin Gorda all contain habitat diversity related to their shape and exposure to the sea.

The presence of rock or sand as a substrate on the seabed will influence the type of marine community that can survive. This is particularly true in exposed areas. Since sand tends to shift with the waves and currents, it represents an ephemeral habitat for plants and animals. Where wave action is not excessively severe, seagrasses or benthic algae, especially species of calcareous green algae, will grow and help stabilise the substrate. Under harsh conditions, grasses and most algae will be sparse or non-existent. Animals will either be mobile, like fish, or burrow into the interstitial spaces, like worms and some crabs.

In areas where the substrate is firm and reasonably stable, a different flora and fauna can survive. Such sites generally support coral reefs that may be hard corals, soft corals, or a mix of habitats. A hard stable substrate is necessary for many sessile organisms that encrust rock surfaces. Sponges, gorgonians, corals, worms and many others are found in such places.

Since many of the animals associated with such nearshore habitats are passive filter feeders, they also depend on currents to bring food and carry away wastes. Therefore, the current patterns and flows around the islands will affect distributions and abundance. Currents, in turn, are affected by a combination of the general east-to-west flow of the oceanic water mass and the variations produced by tides, waves, wind, underwater topography and island shape.

Thus, it should be expected that within the three general physical environments noted above for Virgin Gorda, there will be considerable variation. It is this same variation in physical environments that produces such different results from anthropogenic impacts.

Photo 62.
The northwest-facing beach at Little Dix Bay on Virgin Gorda's western coast. The environment is illustrative of physical environment #1 in the text.

Photo 63.
Granite boulders along the southeastern shore near The Baths, indicative of physical environment #2 in the text.

Photo 64.
Eustatia Reef shelters North Sound ocean waves (illustrative of physical environment #3). Extensive seagrass habitat behind reef.

5.1.2 Fisheries Resources

The fisheries resources of Virgin Gorda and its nearby islands have been impacted for a long time by both human-induced and naturally occurring events.

The difference is that natural events tend to be sporadic, even though they are often severe. For example, tropical storms and hurricanes can be devastating to coastal and shallow water communities. Habitats can experience significant destruction and loss. However, such natural events tend to be periodic and will vary in space and time. Thus, following a destructive episode, there will inevitably be a long recovery period. Unlike natural events, anthropogenic impacts tend to be sustained and long term and do not present the environment with a recovery period. Fishery resources provide a perfect example of this phenomenon. Natural events may be damaging to a population of economically valuable species. But, afterwards, they have an opportunity to recover. Human impacts are quite different; human pressure is often intense and sustained.

5.1.2.1 Attributes of the Commercial Fishery

Unfortunately, there is little information and few data available regarding the commercial fishery on Virgin Gorda. The fishery is only minimally regulated and enforcement of laws is challenging and not often successful. Commercial catches are often sold directly to restaurants, resorts, or individuals. Thus, it is difficult to properly assess the fishery and accurately determine the impacts on the resource. Most of the information available is anecdotal with historical inferences based on indirect evidence.

The fishery resources of Virgin Gorda—and of the British Virgin Islands in general—are limited primarily to fish and a few species of invertebrates. Open ocean pelagic species are rather limited, and these fisheries are less affected by activities in the shallow waters around Virgin Gorda and nearby islands. However, it should be noted that there are a few local fishermen who do fish the offshore waters and thus contribute to the food supply and the economy.

The fishery of Virgin Gorda is best described as artisanal. Fishing gear is generally low tech, and fishing efforts tend to be nearshore (on the bank) and restricted to daylight hours. Perhaps a better description would be to designate it as a hunter/gatherer approach to harvesting marine resources.

The most common fishing method is the use of fish traps. Rectangular wire mesh traps are deployed in selected areas. Often they are baited to improve effectiveness. Fishermen tend to have favourite spots and fish in a variety of locations and habitats. In recent years, traps are being placed further from shore in deeper water. This is a result of depletion of nearshore resources and the increase in trap loss due to boat traffic.

Trap loss is a serious concern because they continue to function as "ghost traps" and can impact local fish communities (**Photo 65**). The problem is made worse by the lack of escape gaps or biodegradable panels and the attachment of sacrificial anodes to reduce corrosion of the metal. Thus, lost traps can continue to remove fish from the ecosystem for months, or longer. The magnitude of the problem for Virgin Gorda is unknown, but worthy of further study and possible mitigation efforts.

Other fishing techniques include seines, hook and line fishing from a small boat, and hand collection by walking or snorkeling. The most common method of manual harvest is for the fisher to walk in shallow water towing a boat and simply gather,

Photo 65.
Lost "ghost trap" still able to catch fish.

or spear, anything edible or of economic value. Manual harvesting is also employed along rocky headlands for the West Indian Top Snail.

There are some fishermen based in Virgin Gorda who venture offshore to fish for pelagics. Some are engaged in sports fishing as a recreational activity for visitors. Of course, some locals also enjoy sports fishing in deeper offshore waters. However, these activities produce minimal direct impacts on the coastal resources of the island. The economic impacts are more substantial.

Limited sports fishing does occur in the nearshore waters of Virgin Gorda. This is primarily recreational, such as fly fishing the flats or spin casting from shore or a boat. The impact of these activities on coastal marine resources is presumed to be minimal.

There is some discrimination in the resources gathered. Marine plants are rarely collected. A few individuals will gather species of *Gracilaria,* commonly called sea moss, but there is no recognised fishery for plants.

There is also no commercial fishery for ornamental marine life, such as the collection of live corals, live rock, or other plants and animals specifically for their ornamental value and export. Tropical fish and invertebrates collected in other countries for the aquarium trade are not targeted here. However, the commercial trap fishery does target fish species and sizes for food that would be directed to the pet trade elsewhere.

The species targeted by the local fishery is determined by available gear and technology. The cultural history of islanders also plays a big role in the species targeted. For example, sea eggs (the urchin *Tripneustes*)—which are so highly prized on other islands—are rarely collected in the BVI. The same is true of the large land crabs common in the mangroves and coastal wetlands.

The current fishery is also influenced by historical fishing patterns. Certainly in pre-Columbian times and when the first Europeans arrived, the fishery included Monk Seals and Manatee. Since both are extinct, or extirpated, the fishery was forced to adjust.

The same is probably true for the sea turtle fishery. At one time, turtles, and their eggs, were harvested in huge numbers. Today, the turtle fishery is greatly reduced and eggs are probably collected very rarely, and illegally. Some, such as the Trunk (or Leatherback) Turtle, are endangered and given complete protection. International attitudes and pressure against harvesting marine turtles will probably, over time, eliminate the local turtle fishery.

5.1.2.2 Primary Species Collected

The commercial fishery around Virgin Gorda is largely restricted to a dwindling number of fish species and even fewer invertebrates. The primary invertebrates targeted by fishermen include:

- Queen Conch
- Spiny Lobster
- West Indian Top Snail (locally called Whelk)

Squid, octopus, urchins, cucumbers, and other invertebrates are only incidentally taken and almost never targeted commercially. The three main invertebrates are collected in different ways.

(1) Queen Conch. The Queen Conch fishery is harvested by hand, usually diving or wading in shallow water. Use of SCUBA to fish conch is illegal and rarely practiced by local fishermen. The dilemma for the fishery is that the conch life cycle is such that adults tend to migrate to deeper waters, beyond the easy access of surface snorkelers. While that does offer some protection to the older breeding animals, it exposes most of the juveniles to the fishery.

In fact, numerous field observations of local fisheries with boatloads of conch reveal the catch to be almost totally juveniles that have not yet reproduced. With increasing human pressure and the decreasing quality of shallow water habitats, it does not bode well for the sustainability of the fishery. Field observations in shallow areas around Virgin Gorda and surrounding islands reveal a depleted conch population. Habitats that should support dense populations of adults and juveniles contain few or none (**Photo 66**).

Photo 66.
Queen Conchs in seagrass bed.

It is difficult to accurately estimate landings of conch on Virgin Gorda. Lacking reliable catch data, anecdotal information must be used to estimate how much conch is harvested annually. The landings can probably be estimated in the thousands of pounds, based on information from visual observations and reports of conch in fishing boats, presence of piles of discarded shells at numerous locations, and conversations with fishermen. The local catch is probably not much more than ten thousand pounds annually.

A more accurate estimate could be obtained through more extensive and systematic interviews with fishermen, estimates of purchases of local conch by restaurants, and similar sources.

The impact of the commercial fishery on local conch populations cannot be quantified, but is presumed to be significant. Clearly, conch populations would benefit from a well-managed and well-regulated fishery.

(2) Spiny Lobster. Virgin Gorda's Spiny Lobster fishery is based on captures by traps. There is some free diving to spear lobster (which is illegal in the BVI), but there is insufficient information to suggest whether such techniques are common. The trap fishery targets both fish and lobster.

There appears to have been a gradual reduction in the use of fish traps near Virgin Gorda in recent years. This is probably due to several factors, including overfishing and reduced catches that have affected the profitability of nearshore fishing. Additionally, the growth of recreational boating and commercial vessel operations increases the likelihood that trap lines will be cut. If such losses exceed the value of the catches, then fishermen will be forced to move to new locations or switch to other forms of livelihood. In the process, an underlying conflict has become more evident between the recreational yachting community and other users of the marine environment, such as the local fishing community.

Since there is still a trap fishery in the coastal waters of Virgin Gorda, the assumption is that either fishing effort continues for cultural motives rather than profit, or that the increasing value of smaller catches compensates for lost traps or reduced quantity. The Spiny Lobster may support such a fishery, *i.e.*, while catches may be small, the high market price still makes it profitable.

As with conch, it is difficult to assess the value of the Virgin Gorda lobster fishery. Most local fishermen sell their catches to restaurants or private individuals and are hesitant to provide details of their landings. In addition, many will fish well beyond the coast of Virgin Gorda, where it cannot be determined which resource is being harvested. Once again field observations, anecdotal information and historical inference must provide the best estimates of the fishery.

It appears certain that the lobster population near Virgin Gorda has been commercially depleted for many years. There are many anecdotal reports of lobster abundance around the island, with many recreational divers suggesting lobsters remain relatively common on many dive sites, but the animals are small and nowhere near the density the habitat could, or did, support.

A combination of overfishing, coastal habitat degradation and lack of effective regulations and enforcement has decimated the lobster stock around Virgin Gorda. Nevertheless, the high value of lobster continues to encourage individuals to search the nearshore shallows with spears and snares, or bare hands. Catches are reported to include females with eggs and non-reproducing juveniles well below sustainable harvest size. The

impacts of such selective removal on the marine ecosystems can only be estimated but likely to be considerable.

(3) West Indian Top Snails. The harvest of West Indian Top Snails, or whelk, has been unsustainable for a long time. These snails live in the intertidal zone on rocky headlands. They are collected by hand in even the most remote locations. Harvesting whelk has become a tradition and is often practiced by families or small groups of individuals. Typically, individuals work the rocky shores at low tide and gather the whelks that are exposed and visible.

Nearly everyone who has gathered whelk for many years reports that more effort is required and that the average size of harvested snails is smaller. While landing figures are not available, it appears his fishery is unsustainable as practiced. A management plan with protected reserves and enforced regulations is needed to ensure the future of this valuable species.

(4) Vertebrate Fish Species. As with the invertebrates, the fish stocks around Virgin Gorda have been depleted by a variety of factors, including loss of habitat and trap fishing. Divers report that large reef fish, including the iconic reef predator, the Nassau Grouper, are rarely seen. Large specimens of virtually every species are nearly gone from the surrounding reefs.

Traps are not selective and most reef species that can pass through the opening will be caught. Grouper, snapper, grunt, parrotfish, angelfish, surgeons, and many other fish are targeted. Figures on landings are not available but are probably many thousands of pounds annually.

Since the traps remove predators and herbivores equally, the impact on the reef ecosystem is expected to be significant. Fish play an important role in maintaining ecological balances on reefs. Removing key components like reef fish from the reef system will likely result in major changes to species composition and to the abundance of many plants and animals.

In effect, the entire coral reef ecosystem will be changed, with subsequent, negative consequences. Worse still, the changes will occur underwater where they are not seen, understood, or appreciated.

5.1.3 Critical Habitats

Given the small size of Virgin Gorda, it is not surprising that most of the coastal and nearshore marine habitats (**Figure 18**) are threatened. The combination of overfishing, an increasing population, and economic development have had consequences for the environment.

The ecological connections between coastal and marine habitats are well understood. Disturbance to one habitat or species will produce impacts elsewhere in the ecosystem. For example, the loss of mangroves will deprive many marine animals of a sanctuary where they can feed and grow in a sheltered environment. The result will be reduced abundance of reef species that are commercially fished, such as lobster and vertebrate fish.

5.1.3.1 Beaches

Sand beaches are common on Virgin Gorda. They are very popular with tourists and are among the most important natural attractions of the Territory. Most of the island's numerous sand beaches are on the north and west coasts.

However, beaches are also the coastal habitat most vulnerable to rapid change. Storms and winter ground seas can quickly erode a beach or increase the volume of sand deposited on shore. Such changes can occur in a matter of hours. Many occur repeatedly as part of an annual cycle. Obviously, when the sand comes and goes on a beach, it will also come and go underwater.

Virgin Gorda has enormous underwater reservoirs of sand that are part of the island's "sand budget." These stockpiles provide important habitats. While there may be seagrass beds in regions that are more stable, even bare sand areas are teeming with life such as algal flats, which are common. Worms and many burrowing animals are able to

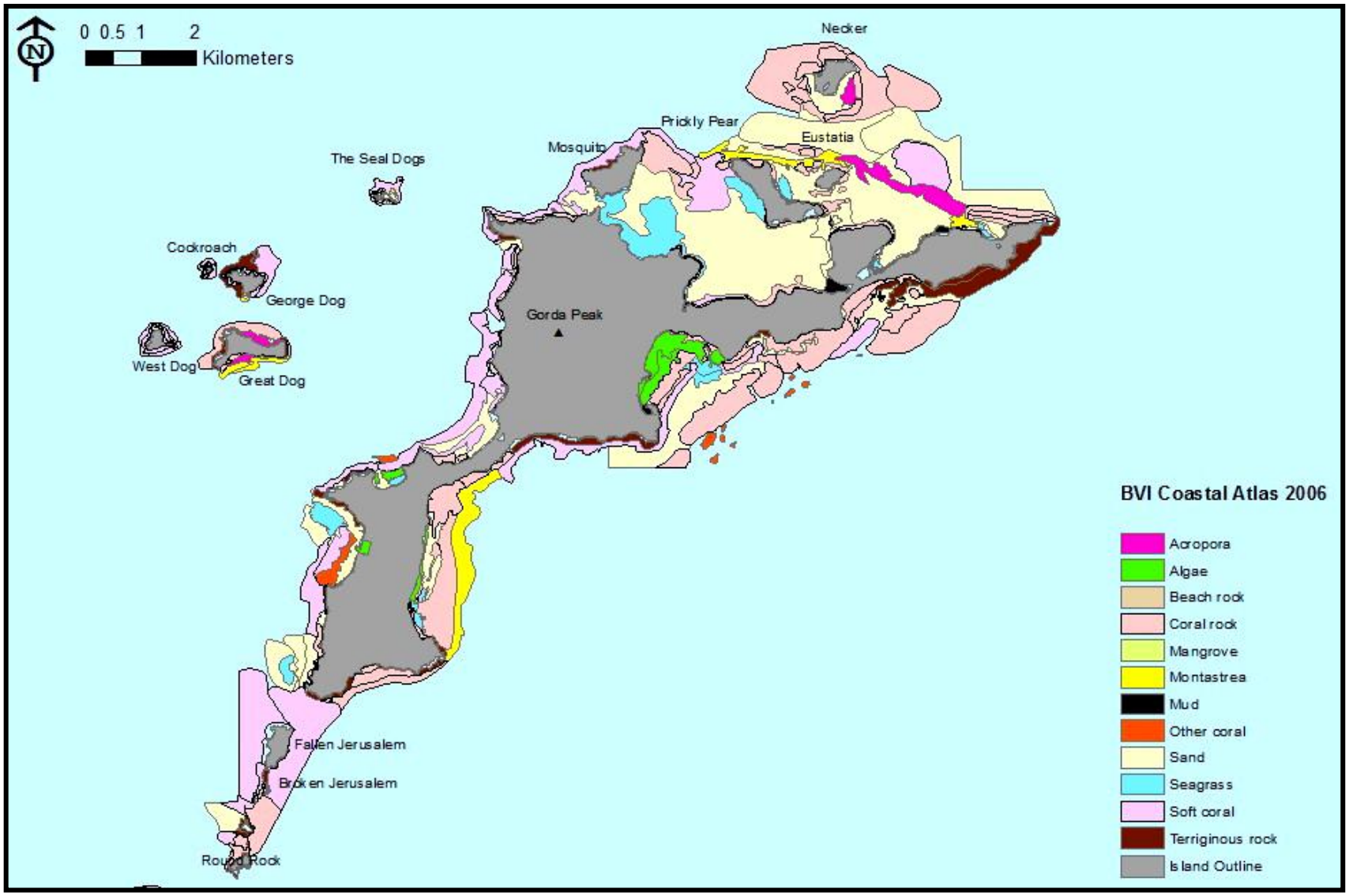


Figure 18.
The coastal and nearshore marine environment of Virgin Gorda and its adjacent smaller islands (adapted from: NPT, CFD, and University of Warwick, 2006).

survive in these ever-changing habitats which, in turn, attract larger mobile animals such as conch, lobster and fish. The sand areas become important feeding habitats for many reef species.

Often, there are bedrock outcrops in sandy areas. Such outcrops can be large and covered by encrusting sponges, corals, and a variety of reef creatures. An entire reef ecosystem can develop in an area surrounded by bare sand habitat.

Of course, these extensive underwater sand plains will vary according to depth, location, and physical conditions. Sand habitats in the sheltered North Sound will be quite different than a similar habitat off Savannah Bay, where winter wave action can be intense.

Since the beach is an ephemeral habitat and dependent on an offshore sand budget that is vulnerable to unpredictable oceanographic conditions, any disturbance on land can have negative consequences. In particular, sand mining on shore for the construction industry can quickly destabilise a beach ecosystem, resulting in erosion and beach loss.

The economy of Virgin Gorda depends heavily on tourism, and it is almost a cliché to reiterate that visitors are attracted by the magical tropical mix of sun, sea, and sand. Resorts that cater to this type of tourism must provide the beach experience people envision, but, unfortunately, the reality is that beaches are extremely variable. The ideal vision of a clean, wide, white sand beach is not always the reality.

Sometimes winter ground seas will remove nearly all the sand from a beach and move it offshore. From an environmental perspective, this is not an issue. In time, conditions will change and sand will be re-deposited naturally, with the beach restored to its former beauty. Of course, tourists do not generally appreciate these natural cycles and will be disappointed if the beach at their world-class resort suddenly vanishes—especially when this natural occurrence seems to take place frequently in the winter tourist season. This happens occasionally at the Little Dix Bay Resort on Virgin Gorda's west coast (**Photo 67**).

A new resort development may determine that not enough of the natural beach sand desired by visitors is available, as its beach may be narrow or rocky or otherwise fall short of the "image" desired. Rather than accepting the natural beach, perhaps by incorporating the natural ecosystem into design strategies, there is a tendency to alter and modify the beach to create the perceived ideal.

Often the result is an engineered design to reconfigure a natural shoreline. In some cases, it may include removing the natural accumulation of debris or replacing existing native shoreline plants with exotic non-native plantings. It may also include a substantial beach nourishment project that adds more sand to the site in order to expand the shoreline.

Depending on location and physical characteristics, such a modification may be successful, or it could have unforeseen problems. Altering the natural sand budget in any bay or open shore is always subject to substantial negative consequences. Oceanographic processes may wash the "excess" sand into the sea. If the quantities are sufficiently large, it could smother the shallow-water seagrass beds or coral reefs, both of which offer natural protection to shorelines from wave action. If

Photo 67.
Seasonal beach erosion at Little Dix Bay due to winter ground seas. The water line should be about 6 m (20 ft) from the beach shelters.

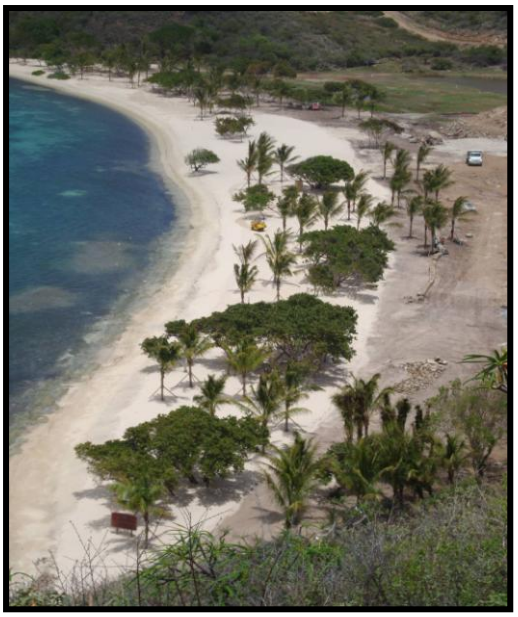


Photo 68.
The beach at Oil Nut Bay, which has been expanded by beach "nourishment." Most of the shoreline vegetation has been replaced with exotics, non-native vegetation which, because exotic species will not substitute for the natural vegetation required by native wildlife, may result in the loss of turtle nesting opportunities on this beach.

these habitats are disturbed, or lost, the beach could become vulnerable to severe erosion. Additionally, the fauna that depend on those ecosystems could be displaced or lost.

Such an attempt at beach expansion was implemented at Oil Nut Bay in 2009 when several thousand metric tons of white glistening sand were imported from the island of Barbuda. While the Oil Nut Bay beach has indeed been expanded and cleaned of debris and natural vegetation (**Photo 68**), the long-term consequences on the offshore environments are not known.

Careful assessment and study should always precede any attempt to alter a natural beach, especially given the highly variable and unstable characteristics of most beaches. Such an approach is not only beneficial to the environment, it could also save the developer considerable time and expense if, later, problems emerge.

5.1.3.2 Coastal Mangroves

Mangroves are among the most important coastal ecosystems. Many reef animals depend on shallow-water mangroves for part of their life cycle. Therefore, any disturbance to mangroves will have negative consequences for offshore habitats.

Nearly all of Virgin Gorda's coastal mangroves are found in the North Sound (see Chapter 4, Section 4.4). Historically, most of the sheltered coastline in the Sound contained mangroves. The generally steep slope behind the shore restricted the mangrove forest to a narrow zone along the water's edge. The mangroves are nearly all Red Mangrove, the species dominant along shorelines. There are few areas where the landward topography provides sufficient space for the typical zonation pattern involving other mangrove species.

The Red Mangrove fringe in North Sound is closely linked to the marine ecosystems in the area. The underwater prop roots that are characteristic of Red Mangroves provide substrate for the attachment of algae and many species of encrusting organisms. This shallow-water three-dimensional structure is an ideal nursery for many reef animals. The prop roots provide food and shelter for juvenile reef fish, lobster, and numerous shrimp, crabs and other fauna.

There is little doubt that the mangroves in North Sound contributed to a flourishing marine ecosystem that supported substantial biodiversity and abundance. The early humans who settled in the Sound benefitted from the bounty of marine life. Unfortunately, there is little direct evidence to estimate the area's historical biodiversity or its impact on Virgin Gorda in general.

With the advent of tourism development, North Sound began to change. The sheltered coastline favoured by mangroves also became desirable for human habitations. Over time, mangroves were removed for human access. Today, much of the historical mangrove shoreline is gone.

Perhaps the best remaining mangrove forest is to be found in Deep Bay extending to Oil Nut Bay, the largest continuous wetland area on Virgin Gorda (see **Figure 17** in Chapter 4). This isolated portion of North Sound has been spared most human impacts, and so the mangroves remain largely intact. However, development along Deep Bay, such as the construction of a barge ramp and

Photo 69.
Significant Red Mangrove die-off along the south shore of Deep Bay is likely due to the impact of coastal developments, combined with the adverse effects of severe storms and storm surges.

concrete dock and the expansion of the road, has likely contributed to a loss of fringing mangrove cover (**Photo 69**). In addition, recent hurricanes may have also exacerbated and contributed to mangrove loss, as indicated in the monitoring reports of ONB's environmental consultant.

Given the recognised role mangroves play in maintaining healthy coastal and marine environments, special effort should be made to prevent further loss or damage to this ecosystem. Perhaps restoration projects could be initiated to replant mangroves where they formerly grew.

In addition, good water quality must be maintained in North Sound if its mangroves are to survive and thrive (see also Chapter 7, Section 7.2). Waste water discharge should be curtailed, both from shore and boats. Pollution abatement, especially oil and fuel, should be an important priority. Finally, all development and human activities should consider the importance of maintaining a healthy mangrove ecosystem and plan accordingly.

5.1.3.3 Seagrasses

Seagrass ecosystems are underwater meadows. They are grassland-type habitats that fulfill many of the same functions underwater as they do on land. Seagrasses are flowering plants, and they produce flowers and seeds, but all under water. This is in contrast to the most abundant of marine plants—the algae.

As flowering plants, seagrasses possess fibrous roots and are connected by stem-like structures called rhizomes. Where seagrasses are dense, they help hold the substrate in place to prevent erosion, just like grasses on land. They are green plants so they carry out photosynthesis and are the beginning of the underwater food chain.

Seagrasses tend to grow in sandy areas where substrate disturbance is low to moderate. Shallow, relatively calm sand flats with good water flow seem ideal for this habitat. The most common species is Turtle Grass, and it often grows in very dense beds. Where the grass beds are sparse, many species of algae may be found.

North Sound has extensive areas of suitable substrate where grasses are abundant (**Figure 18**). One of the best is the shallow zone behind Colquhoun Reef and near Mosquito Island. Other shallow and sheltered areas, often near mangroves, also contain seagrasses.

The seagrass habitat is widespread along the entire coastline of Virgin Gorda where they tend to grow in areas of sand patches and with some shelter from open sea conditions. Occasionally, seagrass beds may be found in isolated patches behind coral reefs. Often grasses will grow in slightly deeper water below the impact of large waves. However, deeper seagrass habitats are usually sparse with extensive algal flats.

The seagrass community is an important marine environment that is linked to other habitats, both coastal and marine. The life cycle of many reef animals—especially those of economic importance to humans—depend on a variety of habitats, and seagrasses are among the most important of these. As critical habitats, they should be considered a priority for protection.

Large seagrass beds, particularly Turtle Grass, are important feeding and nursery ground for many reef animals (**Photo 70**). Reef fish and lobster make nocturnal forays into seagrass habitats in search of food. The dense grass beds make ideal hiding places for shrimp, crabs, worms and many juvenile

Photo 70.
An Eagle Ray in a grass bed.

reef animals. Seagrass beds are also the favoured feeding grounds for the Green Turtle.

Repeated sedimentation resulting from land-based erosion can smother valuable grass beds. Over time, the repeated covering of grasses from sediments will deprive these green plants of sunlight and the ability to carry out photosynthesis. Entire seagrass communities can be lost in the process.

In addition, grass beds are vulnerable to mechanical damage by fish traps and boat anchors. The growth of recreational boating and yachting in Virgin Gorda has resulted in significant damage to some grass beds. Boat anchors and chains can dislodge grasses and expose the habitat to underwater erosion. Deep holes and gullies are common where yachts frequently anchor. Placement of additional moorings and the designation of "no anchor" zones would help to alleviate these problems.

5.1.3.4 Coral Reefs

(1) What is a Coral Reef?

Coral reefs immediately come to mind whenever we think of tropical marine habitats. Coral reefs are certainly one of the greatest attractions for visitors to tropical vacation spots. Virgin Gorda is a popular destination for SCUBA divers, and nearly everyone who ventures out on the water wants to don mask and flippers to have a look at what the reefs have to offer. Visitors want to experience the thrill of drifting over boulders covered in colourful sponges, corals, and varied marine life. They want to see lobster and crabs hiding in crevices and schools of colourful fish swimming with them over the reefs. It is the pleasure of swimming in warm crystal-clear water and enjoying a wonderful variety of marine life that makes the experience so memorable.

Due to their biodiversity, these rich and colourful ecosystems are often called the rainforests of the sea. However, just as there are many diverse types of forests, there are many diverse types of reefs. Depending on the location, different kinds of reefs will be inhabited by different kinds of animals.

Corals are actually invertebrate animals that live in large colonies. They belong to the phylum Cnidaria that include jellyfish and sea anemones. Any large coral, such as the Elkhorn Coral or Brain Coral, is really a colony of many individual polyps. There may be many thousands in the colony, and they are all interconnected.

Each polyp has small tentacles studded with stinging cells that capture plankton that drift by in the currents. In addition to capturing food with tentacles, coral contain symbiotic algae within the tissues of the colony. These algae are called zooxanthellae, and they are essential to the health of the coral. Since the algae require sunlight for photosynthesis, sediments that blanket the reefs can be fatal.

In addition, these algae are sensitive to warm temperatures. In recent years several periods of elevated sea surface temperatures, linked to global climate change, have caused stress to the corals surrounding the island. The resulting stress can cause the corals to expel their symbiotic algae. This produces a phenomenon called coral bleaching. The algae give the corals their characteristic colour, so when they are expelled, the colony turns white, as if it was bleached. If the colony is not able to regain the algae, it will die. Even if it does recover its algal symbionts, the stress makes the colony more vulnerable to a host of diseases. In recent years many reefs have experienced significant losses due to a combination of bleaching and disease.

(2) The Coral Reefs of Virgin Gorda

In very general terms, it can be said that reefs are dominated by either hard or soft corals, and reef growth is determined by a variety of physical features of the environment. For example, most corals do best where the water is warm and clear and especially where there are currents and waves. Corals tolerate wave surge very well.

Thus, the windward portions of Virgin Gorda, such as the entire south and east coast, contain extensive reefs of hard coral. Some of these reefs are referred to as Montastrea Reefs or Acropora Reefs. The names refer to the species of corals that are dominant or most conspicuous in the habitat.

In places where the reefs are a bit more sheltered, or perhaps deeper, the soft corals become more common. These soft corals include sea fans and many species of gorgonians.

Corals are found throughout all underwater habitats surrounding Virgin Gorda and adjacent islands. They are even found in seagrass beds and near mangroves, especially where there are bedrock outcrops to serve as a substrate for attachment.

Photo 71.
Finger Coral reef at Deep Bay.

Some of the most extensive reefs are found just beyond the surf zone along the south-facing shore from South Sound to Pajaros Point. Here large boulders eroded from the island cliffs provide a base of attachment for coral, sponges and other encrusting organisms. The boulders also create a three-dimensional environment where colonies can grow on the exposed upper surface facing the sun and waves, or under the rocks in shady crevices that are much more sheltered.

In addition to the sessile (permanently attached) forms, many mobile invertebrates and fish take advantage of this variety of physical space and faunal composition. The result is great biodiversity in a relatively small area. This helps to create a rich and productive ecosystem that ultimately benefits fishermen and that divers love to explore.

The northern boundary of North Sound consists of a long, nearly unbroken barrier reef between the islands. From Mosquito Island to Prickly Pear Island lies the Colquhoun Reef. It is diverse and contains many species of hard and soft corals as well as associated fauna. This reef and its wide rubble zone break waves from the north and create a calmer environment for seagrass communities east of Mosquito Island.

The slightly deeper water surrounding Mosquito Rock has large eroded boulders, which are covered with soft corals and numerous species of hard corals, sponges and encrusting reef creatures such as tunicates, worms, barnacles and many more. Naturally, such complex structural habitats provide shelter for reef invertebrates and fish. From Eustatia Island to Pajaros Point the Eustatia Reef protects Oil Nut Bay, Deep Bay and extensive shallow reef flats from open-sea waves.

In the back-reef zone between Oil Nut Bay and Deep Bay, there is a shallow shelf extending offshore as part of the alluvium from the land. Along the edge of the shelf is a delicate shallow reef of Finger Coral dominated by the genus *Porites* (**Photo 71**). An environmental report prepared by Petrovic in 2001 described the reef in glowing terms as one of the best intact reefs in the region. Such an undamaged shallow reef of delicate coral species is very rare in the Virgin Islands and probably the best example of such a reef near Virgin Gorda.

Unfortunately, because the reef is shallow and unmarked, there has been considerable mechanical damage by vessels in recent years. Much of the damage probably resulted from the increased boat traffic associated with nearby developments. Given the fragile nature and rarity of such reefs, it should be clearly marked and identified immediately to reduce further damage. Without some form of protection, the entire reef could be reduced to rubble within a few years.

Much of the western shore of Virgin Gorda contains a mix of hard coral and soft coral reefs. In shallow water nearshore areas, soft corals are abundant on the hard pavement. These are especially common on the rocky outcrops seaward of the boulders at The Baths. In the vicinity, there are extensive areas of shifting sand with boulders and bedrock outcrops. These are usually covered in soft corals.

Since there is considerable underwater diversity in Virgin Gorda's topography all along the coast, there will also be variation in reef types. Beyond the general identification of reefs as hard or soft coral, there are numerous sites where reefs contain rare corals such as Pillar Coral and the Acropora species. One such area is the coastline from Long Bay south to Savannah Bay. In shallow-water zones, there are many patches of Elkhorn and Staghorn Corals.

The reefs off Nail Bay contain many Acropora corals. In the mid-1990s, a development on steep land at Nail Bay resulted in runoff that caused extensive sedimentation on the shallow reefs and massive mortality of rare corals (Rogers, 1999; Ramos, 1999; Rogers and Miller, 2001). However, once the road cuts and bare areas were paved and vegetated and sedimentation was reduced, many new coral colonies began to grow, often on the skeletons of previously killed colonies. Within a few more decades, or perhaps a century, the reef may recover completely, assuming no further negative impacts occur.

The health of coral reefs and their ability to regenerate following damage depends on the type and severity of impact and naturally the length of time of an occurrence. Other anthropogenic impacts have stressed coral reefs, including sediments, sewage, oil and chemicals, and more.

Additionally, mechanical damage to corals from vessel anchors, chains and groundings are increasing every year. These impacts are especially severe on well-developed reefs that attract tourists. Visitors, without experience or adequate knowledge, cause unintentional impacts, not only with their boats and anchors, but by snorkeling over shallow reefs where they bump, bang, stand on, and otherwise break corals and inflict further damage. Fish traps dropped on reefs also break corals and damage habitat.

A healthy reef ecosystem must maintain a delicate balance of its various components at different trophic levels. When important components of this balance are removed, the entire reef ecosystem can be altered. Since reefs are slow growing, it can take a long time to fully evaluate changes within the system. Thus, it is essential that reefs are routinely monitored and changes documented and assessed.

One such effort carried out near Virgin Gorda is Reef Check, a long-term reef monitoring effort that employs "citizen science" to annually visit a selected and marked reef to measure and document reef health and condition. The site for Virgin Gorda is near the Bronco Billy dive site in the Dog Islands. This kind of continuous monitoring and assessment followed by enlightened management are necessary to allow continued sustainable use of the marine environment, now and in the future.

5.1.3.5 Invasives

The impact of non-native flora and fauna on fragile island ecosystems is well documented and of great concern. Small tropical islands worldwide seem especially vulnerable. The invaders have been responsible for the demise of numerous endemic plants and animals. Discussion of invasives is primarily terrestrial in focus, and there is usually little mention of non-native marine organisms.

One recent marine invader that may significantly impact the marine ecosystems around Virgin Gorda is the Indo-Pacific Lionfish. Popular as an

aquarium fish, this species initially escaped from, or was released in, Florida and the Bahamas. Within a couple of decades, Lionfish spread throughout the Caribbean. First reported in the Virgin Islands just a few years ago, it is now spreading rapidly, and there have been recent reports of Lionfish along the northwestern coast and offshore islands of Virgin Gorda (for example, IRF, 2012a).

This is a voracious predator that can consume both fish and invertebrates. As the population is expected to grow substantially in the future, the impact on reef fish populations may be great. Control efforts by local divers may provide some temporary relief to targeted reefs and other marine habitats. However, it is unlikely they will be controlled and eradication seems impossible.

5.1.4 Water Quality

In general, the water quality around Virgin Gorda is good because of the presence of major ocean current flows. Water passing by Virgin Gorda comes from the open Atlantic, and there are no nearby up-current sources of pollution to diminish water quality. Virgin Gorda benefits from the old adage "the solution to pollution is dilution," meaning that a massive dilution of a small amount of biodegradable pollution works well. This approach has served Virgin Gorda for centuries, but modern times, a different economic base, and new technologies have begun to change coastal and nearshore environments with new concerns about the quality of coastal waters.

Perhaps most significant has been the impact of sedimentation on coastal environments, the result of land development on shore. Since Virgin Gorda is a small island, any development on land can affect the coast. Without improved erosion control, much sediment will end up in the sea, with repeated sediment events having the potential to degrade water quality and smother nearshore reefs and seagrass beds. Increased mortality in these habitats has far-reaching consequences for all marine environments.

Water quality has also been affected by the growth of marine tourism in Virgin Gorda. Marinas and related facilities are a necessity, with two primary locations for such infrastructure having emerged at the Virgin Gorda Yacht Harbour in Spanish Town and the North Sound. Marinas require calm protected water to shelter boats and provide safe operations. However, these waters are also areas where circulation is low and where the dominant habitats are estuaries, primarily mangroves and salt ponds.

Construction for marina facilities usually requires dredging and reclamation of these natural habitats, and thus degradation of water quality begins during the earliest phases of development. If sufficient controls are not later put in place to protect the environment, liquid and solid waste will be discharged directly into marina waters and surrounding habitats. The result is impaired water quality well beyond the footprint of the development.

Reduction of land-based sources of pollution, improved collection and treatment of liquid waste, and proper solid waste disposal will greatly improve the water quality around Virgin Gorda, in particular, in the enclosed waters of North Sound. The idea of waste management through reduction, reuse and recycling would significantly benefit the coastal water quality of Virgin Gorda. (See also Chapter 7, Section 7.2.2.)

Marine debris is another issue impacting Virgin Gorda. Even on remote shorelines like Pajaros Point, there are accumulations of man-made debris. Debris can be found in most underwater habitats, including plastic and glass bottles on most coral reefs. Even more damaging are old fishing nets and monofilament line that wrap around coral. Unfortunately, much of the debris does not originate in Virgin Gorda or the Virgin Islands. Marine debris is a world-wide problem that requires international efforts to find comprehensive solutions. Locally, beach and shoreline cleanups will help reduce visible local impacts. Any debris that is removed from the environment is a positive step. Perhaps most important is education to increase awareness and appreciation of coastal and marine environments.

5.2 The Coastal and Marine Environment of Virgin Gorda

5.2.1 Historic Use of the Coastal and Marine Environment

When the first humans arrived in the Virgin Islands, there is little doubt that they were sustained by resources from the sea and along the coast. After fresh water, the most important resource for early settlers was food, and they found an abundance of edible seafood in the untouched waters of Virgin Gorda.

Fishing and harvesting marine life probably took little effort, especially in the North Sound vicinity. Fish, conch, manatee and many animals were abundant in the Sound's pristine waters. Archaeological evidence from other islands suggests early inhabitants harvested a variety of marine creatures. Piles of conch shells and middens dating to pre-Columbian times provide ample evidence of the early link between man and the sea.

Coastal areas too produced valuable resources that were easy to harvest. The annual reproductive cycles of sea turtles on Virgin Gorda's beaches of created a smorgasbord of easy pickings. Adult turtles along with their eggs were plentiful and provided an important protein source for centuries.

Mangroves also yielded a bounty. The shallow water estuaries must have been teeming with life. In addition, mangroves were harvested for fire wood and the production of charcoal.

The early dependence on the resources of the coast and sea lasted until recent times. Fishing was a widespread and essential activity. Boat building and related services were also important. Many coastal communities had facilities for hauling boats for repair and for construction of new vessels. Trees and other natural products were harvested to sustain these activities.

Fishermen continue to harvest fish and shellfish from the shallow waters of Virgin Gorda, despite the fact that most all species that can be fished have been overfished. Despite centuries of harvesting and increasing pollution, the waters of the North Sound are still productive, albeit with smaller and scarcer and younger animals that would have been ignored a generation ago. Even today, a few individuals cut mangroves for charcoal production, although this activity is greatly reduced with the advent of modern lifestyles and the comforts of civilization. But, in general, harvesting natural products from the environment declined during the latter half of the twentieth century, as Virgin Gorda's economy evolved from an agrarian lifestyle supported by artisanal fishing to one dependent on tourism.

As tourism flourished, recreational uses of the marine environment replaced extractive uses. Beaches became important as places for tourists to relax and play instead of a place to harvest turtles and build boats. Sailing vessels plying the coastal waters began to carry fee-paying passengers rather than fishermen. Sheltered mangrove estuaries and salt ponds became ideal places to build marinas and resorts.

In time, some individuals learned that big fish were worth more alive as attractions for visiting snorkelers than dead one time in a pot. The transformation of the historical uses of the sea mirrored other transformations in the culture and society.

Change occurs not without resistance and some conflict. Individuals who spent a lifetime interconnected with the sea are often disturbed by alterations in these well-established patterns. Some long for the "good old days," real or imagined, when the sea was plentifully filled with fish stocks and making a living was as simple as casting a net or baiting a trap.

In barely half a century, Virgin Gorda has evolved from an island dependent on farming and fishing to one dependent on marine and coastal recreation. Coastal lands—once of marginal value for limited fishing, harvesting turtles, or cutting mangroves for charcoal—are now highly prized for resort development or the construction of marinas and tourism infrastructure. This has changed not only how resources are used but also local attitudes about beaches, shorelines, mangroves, and all marine resources.

5.2.2 Current Coastal Development Trends

The transformation of Virgin Gorda's economy, culture and society in the last five decades—and the environmental consequences of these changes in land use—have been significant and long-term. In some cases the changes are not sustainable and will result in the deteriorating quality of natural habitats and the permanent loss of some components of the natural resource base.

Most of the negative impacts are related to human actions, and they include:

- sedimentation from erosion on land,
- untreated waste water flowing into nearshore habitats, and
- various forms of chemical pollution.

Additionally, much of the growth in tourism has produced both direct and indirect impacts on the environment as a result of recreational yachting.

As noted in Sections 5.1.3.3 and 5.1.3.4 above, boat anchors and chains (especially of larger, heavier boats) can destroy entire coral reefs, while inexperienced boaters occasionally run aground on reefs, further destroying habitats. Snorkelers who lack training and experience grab corals as they swim, or stand on and break delicate reef structures. Given the lack of legislation and shore side pump-out facilities, boaters often discharge their waste water near to the shore, even in anchorages and marinas. The result is a gradual deterioration of water quality that can be locally severe (see also Chapter 7, Section 7.2.2).

This trend toward coastal development to support tourism creates a variety of separate, but related, environmental issues, all resulting from the physical transformation of the coastline.

Modern coastal development on Virgin Gorda has taken two forms. One is the construction of hotels and resorts near sandy beaches. Virgin Gorda contains spectacular and picturesque beaches. Many are picture postcard perfect and exactly what tourists desire. Thus, they are favoured locations for tourism development.

The process of creating a playground for visitors can seriously harm the environment if proper planning does not precede development and best management practices are not undertaken during construction and operation. For example, sand mining for the construction industry can destabilise beaches and dune systems, resulting in coastal erosion and the loss of the very asset that attracts visitors. Further, hotels often want to manicure their beaches to keep them free of vegetation and the organic material deposited by waves, but such actions may interfere with natural processes on the beach, such as sea turtle nesting.

A second type of coastal development on Virgin Gorda relates to the creation of infrastructure (*e.g.*, marinas and boatyards) for yachts and recreational vessels. Boats require sheltered anchorages and locations to dock, and such sites are almost always in protected bays bordered by mangroves. North Sound is a perfect example of mangrove destruction to make way for infrastructure.

Coastal salt ponds or low-lying areas along the coast have been dredged to create artificial harbours for boats. The Virgin Gorda Yacht Harbour and adjacent boatyard are perfect examples of this type of development.

In all cases, the construction of facilities for vessels requires the alteration of the existing coastline and its natural habitats. Usually such development entails reclamation projects that permanently change the environment. Marinas now exist in places that once contained mangrove or salt pond ecosystems.

The reality of this type of development is that the natural topography limits possible locations for such facilities. Since marine tourism represents the primary portion of the economy of Virgin Gorda, many look to grow this industry, but the limitations of geography mean that future growth will likely come at an ever-increasing cost to the environment. Furthermore, it is not only the physical loss of natural habitats that is at issue. Other impacts may follow.

For example, marinas and related developments often pollute the environment directly, sometimes unintentionally. Sewage treatment may be minimal or ineffective. Waste water, raw or partially treated, is often discharged into coastal waters. Without pump-out stations in marinas, yachts are forced to use holding tanks or discharge directly into the sea. In the naturally sheltered areas required for marinas, such discharge does not disperse quickly and can quickly degrade water quality. Evidence for this can be seen at the Virgin Gorda Yacht Harbour and in parts of the North Sound.

Additionally, fuel spills are common in marinas. Accidental discharge of oil, chemicals and toxic materials often end up in the sea. Detergents used to wash yachts and various types of chemicals required by the industry are not always properly disposed.

Tourists may be unaware of the delicate ecological balance that keeps coastal and marine environments healthy. Their yachts anchor in coral, they may disturb turtle nesting sites, their plastic water bottles may wash up on distant beaches, and their desire for fresh local seafood further depletes natural populations. These impacts may not be intentional, but are simply a consequence of the type of development that has occurred on Virgin Gorda in recent years.

Overharvesting of marine resources has long been recognised by the Department of Conservation and Fisheries, which has implemented a variety of policies including fisheries regulations that place limits on type of species, sizes and locations where certain marine animals can be taken.

The Fisheries Act (1997) authorises the establishment of marine protection zones, and pursuant to the Act, fisheries protected areas were declared in 2003 (see Chapter 2, Section 2.1.4.1). In Virgin Gorda, two fisheries protected areas were designated: one at South Sound and a second at Taylor Bay (see **Figure 25** in Chapter 8). If the protected areas are successfully managed, many overexploited populations could begin to recover. These protected areas are an important management and conservation tool to ensure the sustainable future of the fisheries of Virgin Gorda.

The growth of tourism has created new risks for Virgin Gorda's coastal and marine environments. While these new impacts may be less extractive, they can, over time, produce far more damaging consequences for the environment.

In this, Virgin Gorda is similar to many islands in the region. The trend has been away from traditional extractive uses of marine resources, even as expanding populations and increased tourism have placed new stresses on coastal and marine environments. These will likely continue in the future and could intensify without Government leadership, enlightened decision making in both the public and private sectors, and enhanced education about and awareness of the interconnectedness of all human actions on the environment.

NOTE: A comprehensive list of marine plants, marine invertebrates, and fish species for Virgin Gorda and its associated islands is provided in a supplemental document to this Environmental Profile and is available at IRF's website at www.irf.org.

Issues, Conflicts, and Areas of Concern	Impacts of No Action/No Change	Short-term Options Long-term Recommendations
ISSUE ONE **Habitat Loss: Coastal Development Along Sand Beaches** Development in the coastal areas of Virgin Gorda, especially for tourism infrastructure and tourism amenities and activities, has potential for habitat loss along the island's sand beaches.	Continued development near beaches, especially for tourism, will alter ecological processes and has the potential to negatively impact native species, such as the loss of sea turtle nesting beaches. Native vegetation will be lost with "beach nourishment" projects, sand mining and other beach-altering changes. Coastal erosion could occur, and beach morphology may change.	**SHORT-TERM OPTIONS** 1. Prohibit all sand mining on beaches and in dune environments. 2. Beach nourishment and other projects altering beach morphology should only be permitted following detailed studies and implementation of best management practices to minimise impacts on: – coastal vegetation, – turtle nesting, – coastal oceanographic processes, – other beach features that could be negatively changed. The vulnerability of a beach to coastal erosion should be considered before approval is given for alterations. 3. Natural beach vegetation should be preserved. Exotics should be restricted to areas ***behind*** beach ecosystem. 4. All activities on beaches, especially tourism-related, should consider the potential impact of such activities on sea turtle nesting. **LONG-TERM RECOMMENDATIONS** 1. Under the provisions of the Physical Planning Act (2004), the Department of Town and Country Planning has the authority to protect resources of environmental, historic, and cultural value. As such, the department could develop a management plan for the Territory's beaches (as a resource of value), in much the same way that the department collaborated with other government agencies to create a draft Wetlands Management Plan. Beach habitat has been damaged in the past by beach vendors who remove vegetation to set up areas for commerce. It is particularly important that the natural dune system at Savannah Bay not be disturbed by such activities. The employment of the EPA provision of the Physical Planning Act (see Recommendation 2 below) is one way to protect such valuable natural resources. 2. Beaches of special importance for turtle nesting should be identified by the Department of Conservation and Fisheries and designated as "environmental protection areas" (EPAs) under the Physical Planning Act. During the processing of development applications, activities in such designated areas should be limited or prohibited.

Issues, Conflicts, and Areas of Concern	Impacts of No Action/No Change	Short-term Options Long-term Recommendations
ISSUE TWO **Habitat Loss: Salt Ponds** Many of Virgin Gorda's salt ponds have been altered by development activities, resulting in the loss of the ecosystem services provided by the ponds. Many ponds are under threat from increased sedimentation and the dumping of refuse and waste in the ponds.	Continued development in salt ponds and associated wetlands will destroy important habitat for wildlife. Use of salt ponds as dump sites for debris, oil, chemicals, and other refuse may contaminate nearby coastal and nearshore habitats and potentially create human health hazards. Loss of salt ponds will prevent the natural settlement and removal of land-based sediments and increase sediment runoff to coastal environments.	**SHORT-TERM OPTIONS** 1. Development activities near salt ponds should always proceed with care to prevent discharge of sediments or other materials into ponds. Because they serve as valuable avian habitats and provide storm wave buffering protection, the filling of ponds should always be avoided. 2. Use of salt ponds and wetlands as dump sites should be prohibited. Priority areas suffering from refuse dumping on Virgin Gorda are Fishers Cove, Gun Creek, and Biras Creek. **LONG-TERM RECOMMENDATIONS** 1. Remaining salt ponds and wetlands should be identified and prioritised according to the ecosystem services they render within the scope of the draft wetlands policy and management plan prepared by Government (DTCP, 2005) but not approved or implemented. Those ponds with a high ranking should be identified for immediate protection and preservation. 2. Where possible, consideration should be given to the restoration of degraded ponds and wetland habitats.
ISSUE THREE **Habitat Loss: Coastal Development in Mangroves** The essential ecosystem functions of mangrove habitats have been impaired on Virgin Gorda through waste dumping and pollution, dredging and other coastal development, and increased coastal erosion. Fisheries resources have been lost through habitat degradation. With the degradation and loss of mangroves, the shelter they provide for vessels during storms and hurricanes has also been lessened.	Development and pollution in and near mangroves will: – Reduce marine productivity, particularly for economically important fish species. – Reduce essential habitat for marine species and birds. – Reduce shoreline protection and increase coastal erosion. – Reduce nearshore water quality (mangroves provide a natural filtration function). – Reduce storm shelter for boats during storms.	**SHORT-TERM OPTIONS** 1. Mangrove habitats that have been used as waste deposit sites, especially for oil, fuel, and chemicals, need to be cleaned up, and waste and refuse removed, perhaps as part of a targeted coastal clean-up initiative by Government and environmental NGOs. 2. Further dumping of wastes in mangroves must be halted, and this is best accomplished as part of a broader coastal management initiative by Government. The BVI needs to put in place a wetlands policy and management plan (see Chapter 4, Issue 3 of that chapter's Issues Table) As a first step, the draft wetlands policy and management plan (DTCP, 2005) needs to be completed, approved by Government, and implemented without delay. *(continued)*

Issues, Conflicts, and Areas of Concern	Impacts of No Action/No Change	Short-term Options Long-term Recommendations
		LONG-TERM RECOMMENDATIONS 1. Remaining mangroves should be identified and prioritised according to the ecosystem services they render within the framework of a territorial wetlands policy and management plan. Those mangroves ranked as most productive should be identified for protection and preservation. 2. The designation of fisheries protected areas should be clarified so that mangroves, which function as a related ecological unit, are included within the boundaries of the protected area. 3. Where possible, degraded mangrove habitats should be restored and mangrove seedlings replanted. 4. The Department of Town and Country Planning should require that erosion and sediment control BMPs are addressed in ***all*** EIAs for coastal developments (both public and private sector projects) to reduce sediments from entering mangrove wetlands.
ISSUE FOUR **Overfishing** Overharvesting of important marine species has occurred in Virgin Gorda as it has elsewhere in the Caribbean. Damage to fish populations has also been the result of lost "ghost" traps. Disruption of reef ecosystem balance by selective removal of essential species has also occurred.	If current fishing patterns continue: – Targeted fish and invertebrates will be reduced in numbers and some may be extirpated. – Ecological balances in reef systems and other marine habitats may be disrupted by the population reduction of keystone species. – The economic liveli-hood of fishermen will be negatively affected. – Lost fishing gear will continue to kill fish and will further impair natural populations, without economic benefit to fishermen.	**SHORT-TERM OPTIONS** 1. Limits on species, sizes and seasons should be clearly communicated and strictly enforced by the Department of Conservation and Fisheries. 2. All traps should have escape gaps for non-target species and biodegradable panels to reduce the life of those that are lost. 3. Restaurants, resorts, stores and purchasers of seafood should be educated and accountable for following fishery regulations. **LONG-TERM RECOMMENDATIONS** 1. Marine fishery reserves as a management tool work best when the fishing community understands the options and planning for such sites. The concept of "user management" is established within the Fisheries Act (1997) and can be employed to involve resource users in decisions about the reserves. Fisheries protected areas should be assessed and adjusted as necessary by DCF to ensure sustainable harvest of all species. 2. Landing data on the Virgin Gorda fisheries should be more systematically collected and assessed to help guide the sustainable harvest of commercially valuable species.

Issues, Conflicts, and Areas of Concern	Impacts of No Action/No Change	Short-term Options Long-term Recommendations
ISSUE FIVE **Diminishing Water Quality** Decreasing coastal water quality in Virgin Gorda results from the lack of sufficient best management practices (BMPs) for land-based development activities, inadequately treated sewage, and discharge of pollutants into wetlands and nearshore habitats.	Without changes in the Territory's pollution control standards and regulations—including long-term monitoring of coastal areas—pollutants and untreated sewage will continue to degrade coastal water quality. Uncontrolled development on land will result in more erosion of sediment into nearshore marine environments. Sediments and pollutants in estuaries and nearshore habitats will increase disease rates and mortality in coral and other marine life. A reduction in productivity will result, especially in sheltered bays and estuaries. Continued reduction in water quality will reduce the habitat health and diversity that attracts tourists to Virgin Gorda's marine environments. Localised risks to human health, such as the bioaccumulation of toxic chemicals in consumed seafood, could also result.	**SHORT-TERM OPTIONS** 1. Erosion and sediment control guidelines need to be developed and approved for the British Virgin Islands and could draw upon the expert guidance (adapted to BVI conditions) offered in documents already available for the USVI (UVI, 2002, a/b) and for the insular Caribbean (Anderson, 1994). 2. Yachts using the waters of the BVI should be required to have and 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 designated "no discharge" areas. 3. Guidance needs to be provided for individual home owners and small business establishments for the proper installation and maintenance of septic systems for sewage disposal. **LONG-TERM RECOMMENDATIONS** [See also Issues Table for Chapter 7, Issues 5, 6, and 7.] 1. DTCP should require that erosion mitigation and sediment control practices are addressed in all EIAs for major development projects. Additionally, BMPs for the control of erosion and sediment runoff for all major development projects need to be applied and monitored. 2. As noted elsewhere in this Profile, environmental pollution legislation needs major revision and modernization in the BVI. Enforceable standards for water quality, pollution control, and waste management are required.
ISSUE SIX **Pollution Risks from Marinas and Boatyards** Given the expansion of marinas and boatyards at North Sound and Spanish Town, pollution resulting from the construction and operation of these facilities is not being adequately addressed.	Coastal habitat will continue to deteriorate, especially in and down current from such facilities; untreated sewage will degrade nearby habitats; toxic chemicals from boatyards can enter marine food chains with resulting risks to marine life and human health.	**SHORT-TERM OPTIONS** 1. All boats should be required to use holding tanks in marinas. 2. Boatyards should conduct wash downs and all work that releases toxic chemicals in areas where loss to the marine environment is reduced. 3. Provision should be made to collect and properly dispose of all pollutants, especially those known to be toxic. *(continued)*

Issues, Conflicts, and Areas of Concern	Impacts of No Action/No Change	Short-term Options Long-term Recommendations
		LONG-TERM RECOMMENDATIONS 1. Pump out facilities should be provided at all marinas to collect waste from yachts and ensure proper treatment. 2. Boatyards should collect, filter, and reuse wash down water to prevent loss of toxic chemicals. 3. All toxic wastes from boatyard work should be carefully collected, stored and disposed of to reduce risk to the environment and human health.
ISSUE SEVEN **Vessel Impact on the Marine Environment** As yachting activities increase in the waters around Virgin Gorda, and with the more recent introduction of mega yachting in the BVI, damage to coral reefs and seagrass beds by vessel anchors and chains is on the increase. Also, mega yachts in shallow waters tend to re-suspend bottom sediments with their turbulent prop or jet wash. In addition, damage to reefs from fish traps, seines and other fishing gear continues to occur.	Continued anchoring by boats in sensitive environments will degrade the habitats, make them less productive, and reduce the important ecosystem services they provide. The problem will likely worsen as larger yachts, particularly mega yachts, become more common and in the absence of guidelines and regulations from Government pertaining to boat anchorages. Mega yacht activity in shallow waters contributes to increased water turbidity, and poor water quality that may result. Lost traps and fishing gear will further damage reefs and degrade habitats.	**SHORT-TERM OPTIONS** 1. Carrying capacity studies need to be implemented (perhaps as a collaborative effort of DCF, NPT and the Tourist Board) for Virgin Gorda's most popular marine recreational sites. With such data in hand, more informed decisions can be made for the installation of additional moorings in popular anchorages and destinations to reduce the need for anchoring. 2. More effort should be expended by the marine industry and the BVI Government (*e.g.*, Tourist Board, DCF, and NPT) to educate boaters about proper anchoring techniques and how to avoid anchoring in coral. 3. Fishermen should be encouraged to avoid placing their traps and nets directly onto coral reefs. **LONG-TERM RECOMMENDATIONS** 1. An anchoring plan (perhaps under the authority of the VI Shipping Registry and the NPT) should be prepared for Virgin Gorda that designates both safe anchorages and no-anchor zones. Regulations, with enforcement, need to be implemented to control anchoring around Virgin Gorda and the satellite islands. 2. As the presence of mega yachts in Virgin Gorda waters increases, moorings for larger vessels and mega yachts need to be installed as soon as possible at popular recreational destinations. 3. The Department of Conservation and Fisheries should consider how the application of current legislative authority might be used to identify and declare sensitive reef areas as "no-fishing zones" to reduce damage from fishing traps.

Issues, Conflicts, and Areas of Concern	Impacts of No Action/No Change	Short-term Options Long-term Recommendations
ISSUE EIGHT **Tourist Impacts on the Marine Environment** Destructive activities by swimmers, snorkelers and divers on the coral reefs surrounding Virgin Gorda have long been observed and continue to be of concern. Tourism can have both direct and indirect impacts on turtle nesting beaches and can also place increased demands on the Territory for energy, imported goods and other resources.	Popular snorkeling and diving sites around Virgin Gorda will continue to degrade if measures are not taken to educate inexperienced marine users, to increase awareness, and to reduce careless actions by short-term visiting users of the marine environment. Without proper awareness on the part of developers, beaches will continue to be manicured for tourists. Additionally, beach users may interfere with natural beach ecology, resulting in diminished turtle nesting success.	**SHORT-TERM OPTIONS** 1. Divers, snorkelers and swimmers should be encouraged to wear appropriate buoyancy aids to reduce the need to grab and stand on corals in shallow water. Additionally, divers and snorkelers should be directed to less sensitive reef areas for recreational activities. The BVI Marine Awareness Guides (Gore, 2008, 2011) are a positive step in the direction of providing marine education for users of the marine environment. 2. Turtle nesting beaches should be identified and marked so Virgin Gordians and visitors can appreciate and protect the habitats. **LONG-TERM RECOMMENDATIONS** 1. As part of national physical planning efforts in the BVI, reefs and sensitive habitats around Virgin Gorda should be prioritised for recreational use based on formal carrying capacity assessments. Use restrictions might be considered for especially sensitive areas. 2. Educational outreach activities of the DCF and others should target the ecology of turtle nesting, specifically aimed at changing a lack of awareness about turtle nesting into community and visitor interest and active participation in the conservation of marine animals.

6. HISTORICAL HERITAGE RESOURCES

The historical development of Virgin Gorda is reflected in the surviving historical sites that can still be found throughout the island. The sites represent a variety of original uses, and their survival today reminds us of an earlier period of development for Virgin Gorda.

Evidence of pre-colonial occupation of the island—for example at Little Dix Bay and Gun Creek—has for the most part been destroyed by development, although some sites—for example at Little Fort Point—may still be intact.

Remnants of a plantation economy that evolved on Virgin Gorda in the eighteenth century can still be found, as can artifacts of the copper mining industry that was functional until the early 1860s.

Ten heritage sites are detailed in this chapter and are identified by location on **Figure 19**.

6.1 Plantation Era Heritage Sites

6.1.1 Nail Bay I Sugar Works

This site is the most intact sugar works remaining on Virgin Gorda. It is located amongst the grounds of the Nail Bay Resort (see **Figure 19**) and has been landscaped to accommodate garden parties and sometimes weddings.

Structures used during the three main stages of the sugar production are present, including: the mill round or animal round, the boiling house, and the curing house. Four buildings in total are present in varying conditions.

The circular shape of the animal round or mill round can for the most part be traced. Retained edges contiguous to the boiling house are in some places intact with the lime mortar rendering still present (**Photo 72**). Much of the structure has been corrupted, however, by the roots of two trees in particular which have matured on top of the platform.

The ramp upon which dray animals would reach the mill round platform is present and is still used today (**Photo 73**).

In the centre of the platform can be seen the foundation hole into which the central axle of the round machinery would be embedded to assist stability (**Photo 74**). On the surface to the sides of this hole can be found foundations within which the wooden frame of the structure encasing the three rollers (that crushed the cane) would have been placed. The channel used to transport the

Photo 72. Nail Bay I Sugar Works.

Photo 73. Nail Bay I Sugar Works.

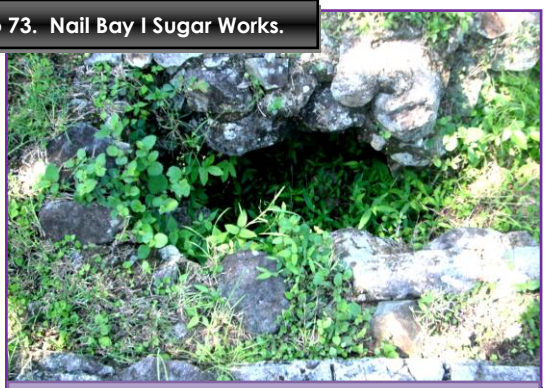


Photo 74. Nail Bay I Sugar Works.

Figure 19.
Location of historical sites identified for the island of Virgin Gorda, British Virgin Islands.

cane juice from the mill reservoir towards the boiling house is also present, represented by a brick lined straight conduit which would have had a lead gutter inserted inside during use.

Photo 75. Nail Bay I Sugar Works.

The boiling house is immediately to the side of the animal round and has a doorway aperture providing access between the two (**Photo 75**). The structure is composed from a variety of materials including, for the most part, Andesite stone; ashlar blocks, which display no markings to suggest they were sawed but are skillfully carved; and red brick (**Photo 76**).

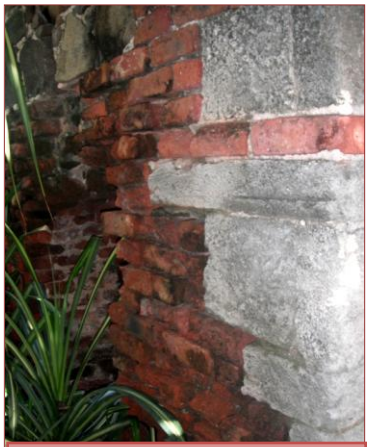


Photo 76. Nail Bay I Sugar Works.

Not unsurprisingly, the copper battery wall facing the coast is in the most decayed condition. The stoking apertures (which are large holes in the wall) and the intense heat employed during use would have contributed to its accelerated decay.

Adjoining this wall, at a right angle running parallel to the animal round, is another wall, which is in far better condition and contains a window aperture (**Photo 77**).

Inside the boiling house, the copper battery wall can be traced with the circular furnace holes beneath. The base for the "grand copper" or first copper is the most intact, built with red brick fashioned into a circular surround to accommodate the large vat known as a copper.

Photo 77. Nail Bay I Sugar Works.

The far end of the copper battery, where the hottest copper was located, has been rebuilt on a number of occasions, and the brickwork displays evidence of exposure to intense heat (**Photo 78**).

Photo 78. Nail Bay I Sugar Works.

To the rear of the copper battery wall, a rectangular depression in the ground can be seen; it would have contained a shallow wooden tray (**Photo 79**). Once the cane juice had been reduced as much as possible by heat, the syrupy

Photo 79. Nail Bay I Sugar Works.

molasses would be "struck" or removed from the last and hottest copper, then poured into the wooden tray to dry and crystallise. From here the sugar would be placed into barrels with holes in the bottom and stacked into the curing house.

The curing house for the Nail Bay Sugar Works is most likely a structure to the rear of the boiling house, which today is the first building encountered when walking into the site. It is a simple square building whose edges have deteriorated badly, with a doorway facing the boiling house and no other structural features except ventilation slits in the walls (**Photo 80**).

Photo 80. Nail Bay I Sugar Works.

The curing process involved draining the remainder of the liquid from the crystallising sugar, which would take place over a matter of weeks or sometimes months. This would occur in a building whose only requirement was to be dry, cool and well ventilated. Once placed into barrels, the sugar would be stored in the curing house (usually stacked but sometimes suspended from the rafters), where the last traces of liquid would drain through holes drilled into the barrel bottom.

The fourth remaining structure was not part of the sugar reduction process but was essential for enabling the heating process to take place. It is a rectangular building with low foundation walls which are punctured on the inside corners with post holes. The location of the structure close to the boiling house stoking apertures, coupled with the low andesite walls whose tops are rendered at an angle outwards, suggests this was once the bagasse shed where the milled cane stalks would be stacked to dry out, then used to fuel the adjacent furnaces. Sturdy wooden poles would have supported a basic timber framed roof, probably covered in palm leaves or something similar to keep the rain out. The sides would have been open allowing the cool coastal breeze to dry out the drained stalks.

A great deal of effort has been made by the management and employees of Nail Bay Resort to aesthetically display this site at considerable cost. Other than the Copper Mine, they are probably the most popular ruins on Virgin Gorda and are mentioned in a tourist booklet for the island as early as 1976.

The site would benefit from more frequent vegetation control within the actual ruins, which, once managed effectively, would allow a skilled mason using traditional lime mortar to render and consolidate much of the structural deterioration. The site would also benefit from a series of interpretation boards describing the sugar reduction process through a combination of text and illustrations.

6.1.2 Nail Bay II Sugar Works

The Nail Bay II site is now part of a private residence and is not accessible to the general public. It is located close to the coast below the main Nail Bay Resort (**Figure 19**) and consists of one primary structure which is a sugar boiling house. The entrance to the interior of the boiling house is now via a modern pathway landscaped on either side, leading to a stone patio used as a sitting area. To the front can be seen the copper battery wall beyond which is the modern residence and then the beach (**Photo 81**).

At the entrance of the boiling house is a circular depression in the ground whose plaster-rendered interior betrays it as a former cistern, used to store cane juice prior to it being poured into the first copper (**Photo 82**).

Photo 81. Nail Bay II Sugar Works.

From the exterior, the copper battery wall has collapsed leaving a visible cross section of the furnace stoking holes for the first and last copper (**Photo 83**). A portion of the red brick surround used to support the first copper is still visible (**Photo 84**), but the remainder of the copper support foundations have collapsed. To the right of the last copper can be seen the foundations for a rum still (**Photo 85**).

There would have been a water cistern close by to condense the distilled vapor, but no structural evidence was found, probably because of the development which has taken place in the immediate vicinity.

It is clear that during the initial construction the owners wished to incorporate the ruins located on their land into the overall property landscape. It is likely that the site will be maintained over time as it adds to the uniqueness and consequently value of the property. Without the permission of the owner however, this site will remain closed to the public and cannot be included in any type of guide book highlighting or promoting its presence.

Photo 82. Nail Bay II Sugar Works.

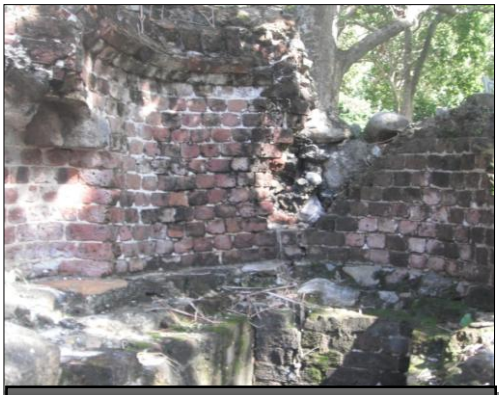


Photo 84. Nail Bay II Sugar Works.

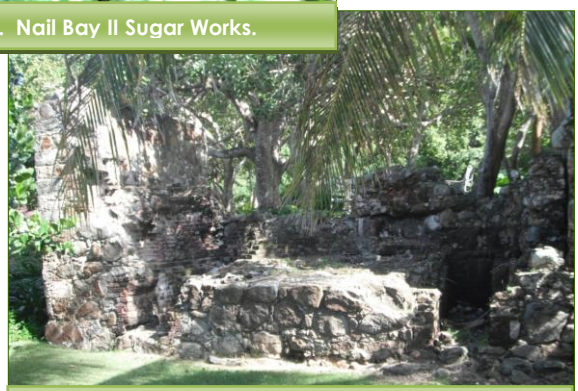


Photo 83. Nail Bay II Sugar Works.

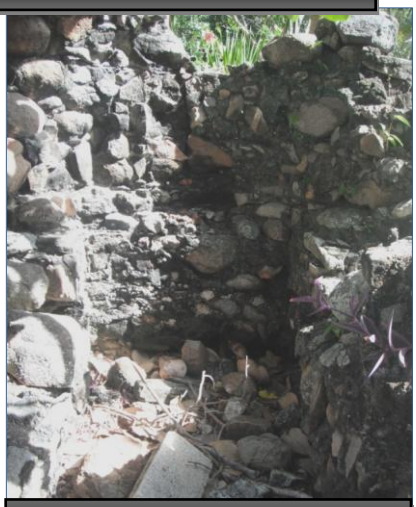


Photo 85. Nail Bay II Sugar Works.

6.1.3 Long Bay Sugar Works

Like the Nail Bay II site, the only visible remains of this sugar works is the boiling house, which is heavily overgrown but presents an ethereal view with a number of trees growing through its structure (**Photo 86**). The construction is far more rudimentary than the two previously described sugar works at Nail Bay, consisting predominantly of large andesite stones rendered with lime mortar.

Photo 86. Long Bay Sugar Works.

Some areas on the side walls—running at right angles to the copper battery wall—have recently been consolidated using the original field stone, but rendered with modern cement. The interior of the boiling house is in poor condition largely due to root corruption which has separated sections of the walls that have subsequently collapsed. Large holes in the front wall, which is the copper battery wall, were once furnace stoke holes, but these have collapsed to the point where they are almost unrecognisable (**Photo 87**).

Photo 88. Long Bay Sugar Works.

To the rear of the main structure but still attached is a large cistern, which may be evidence that rum was once produced at this site. The cistern is relatively intact and covered in vines (**Photo 88**). To the side of the building is a mound with large stones which is all that remains of the animal round platform (**Photo 89**).

A number of people report seeing a series of stone steps close to this ruin leading to the ridge of the point above. Should further reconnaissance reveal these steps, it is likely they lead to another structure above, which may have been a great house or manager's residence as these were usually located above the sugar works. It would be possible to make a feature of this site with the owner's permission and extensive rehabilitation work.

Photo 87. Long Bay Sugar Works.

Photo 89. Long Bay Sugar Works.

6.1.4 Plum Tree Bay Sugar Works

The Plum Tree Bay Sugar nestled in an area which is likely to see development in the not-too-distant future. Each of the previously described works is unique because of some structural differences. At Nail Bay I Sugar Works, a variety of buildings are present representing different stages of the reduction process. At Nail Bay II Sugar Works, there is a rum still foundation present whilst at the Long Bay Sugar Works, there is a cistern present. What makes Plum Tree Bay Sugar Works unique is the condition of the copper battery.

The approach to the works is through the bush, which is quite dense in places. The boiling house is in good condition and composed of the usual andesite field stone and lime mortar aggregate. A profusion of red brick in the battery wall is in remarkable condition, both inside and out. The outside view presents a course of red brick running the length and height of the stoke holes; it is beautifully constructed and a testament to the masons who built it (Photo 90).

Photo 90. Plum Tree Bay Sugar Works.

The inside of this wall where the coppers once sat is in surprising condition considering that the large vats have been ripped out. The four circular foundation supports are still clearly visible and again beautifully fashioned in red brick (**Photo 91**). Looking down the line it is easy to imagine how the coppers would have been placed in their foundations and heated from below. The rims where the lip of each copper would have rested are still clearly visible (**Photo 92**), whilst beneath—in the furnace area—the red brick foundations are still firmly holding together (**Photo 93**).

Photo 91. Plum Tree Bay Sugar Works.

Photo 92. Plum Tree Bay Sugar Works.

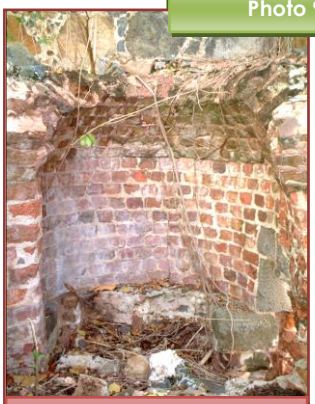


Photo 93. Plum Tree Bay.

Depending on the future of this area, which is in private hands, this site could be a strong addition to most any development landscape. Like the Nail Bay I Sugar Works, the Plum Tree Bay site could potentially attract a significant number of tourists. When future plans are made for the area, it should be remembered that the site's copper battery wall is comparable to the Brewers Bay Sugar Works in Tortola, which is the best preserved boiling house remaining in the modern Territory.

6.2 Industrial Heritage Sites

6.2.1 The Copper Mine

Unquestionably, the Copper Mine at Copper Mine Point on Virgin Gorda is the most important cultural site remaining on the island and indeed one of the few national parks in the Territory dedicated to protecting a historical monument. There are a number of buildings present, the most conspicuous being the engine house and the boiler chimney.

Whether this was where the Spaniards first attempted to mine ore on the island during the early sixteenth century is unknown. There were two separate mining operations working the area between 1839-41 and 1859-62, after which the mine was abandoned.

The first accurate records for the operation state that the property was purchased by an English-registered company called the Virgin Gorda Mining Company. Under the supervision of Mr. P.J. Minvielle, the resident agent, work to prepare the mining operation moved forward over a six-month period in 1839. A considerable amount of ore was eventually removed, but by 1841 the concern had become unprofitable and was closed (Burt, 1982).

Photo 94. The Copper Mine Engine House.

Eighteen years later, an established mining partnership called John Davies and Sons (Burt, 1982) revitalised the mine, and it is from this particular operation that many of the surviving buildings date—including the engine house and chimney.

An almost exact replica of a Cornish tin mine was built at Copper Mine Point and remained profitable until 1862. Some 150 people, mainly local islanders, were employed at the site providing an economical boost to a beleaguered and forgotten island in the British Empire. Unfortunately, the local Assembly considered the mining concern an opportunity to dramatically reduce the colony's financial deficit and saddled the business with unrealistic duties and taxes. This, coupled with the poor quality of the vein and falling metal prices in London, contributed to an early demise in 1862, when the mine was finally closed (Burt, 1982).

The importance of these ruins was recognised by the Government of the BVI when, on 28 March 2003, the site was declared a national park. Since then, a number of rehabilitation projects have been implemented, mainly to consolidate the engine house and the chimney stack structures, which had deteriorated considerably.

The largest individual structure is the engine house, which presents an iconic view, nestling approximately 80 feet above sea level (**Photo 94**). Built from andesite field stone bound with lime mortar, this was once where the single cylinder beam engine was housed, similar to one on display at the Poldark Mining Museum near Helston in Cornwall, England (Holt, 2003). The engine was used to pump water and raise ore from the mine shafts and was powered by a boiler below, which still sits in its original foundation but is heavily deteriorated (**Photo 95**). The chimney stack (**Photo 96**), which vented the coal smoke from the boiler furnace, is of typical Cornish construction with a red brick cap (Burt, 1982).

Photo 95. Boiler remains at the Copper Mine.

Other structures include a large cistern which by today's standards is still massive. Covered by a protective iron grate (**Photo 97**), the cistern is extremely deep (**Photo 98**) and was filled from a catchment platform to the rear (**Photo 99**). Water from this cistern was required for general use but more specifically to fill the thirsty boiler which powered the beam engine.

Other remaining structures were identified by Bolt in 1982 as being mine offices and the powder magazine for explosives. The road joining Spanish Town to Copper Mine Point was also constructed during the two mining phases and is a further legacy from this unusual period in Virgin Gordian history.

Photo 96. The chimney stack,
Virgin Gorda Copper Mine.

Photo 97. Cistern surface, Copper Mine.

Photo 98. Cistern interior.

Photo 99.
Water catchment platform.

6.2.2 Beam Engine Lever, Copper Mine Bay

Copper Mine Bay is located contiguous to Copper Mine Point (**Figure 19**), and evidence remaining suggests that this was most likely the location of a settlement which housed the mine's workers and their families. Ceramics found in the area attest to occupation (**Photo 100**), and the close proximity of the bay to the mine would make it the most likely option for domestic occupation.

Photo 100. Ceramics at Copper Mine Bay.

Although evidence exists which states that once the mine was closed, the engine was dismantled and moved "to the wharf ready for shipment to England" (Burt, 1982, p. 61), a vital component was dragged down to Copper Mine Bay and abandoned on the shoreline. In stating "the wharf," President Longden, who was in charge of the colony at the time, must have meant the dock constructed in St. Thomas Bay to which a road had specifically been built to accommodate mine traffic.

For some reason, however, the beam engine's lever was taken down to Copper Mine Bay, presumably for extraction. The conundrum here rests in the fact that this bay is completely cut off from the open sea by an extended reef, and no vessel large enough to transport the lever could have reached the coastline where it was abandoned.

The beam rests half in and half out of the water in two pieces (**Photo 101**). This important piece of Virgin Gorda history and British Industrial Revolution technology will require *in situ* conservation, probably employing sacrificial anodes* to stabilise the iron's integrity before removing it to a stable environment.

* Similar to those attached to the shafts of outboard motors which absorb the corrosive properties created by salt water immersion.

Photo 101.
Beam engine lever, Copper Mine Bay

6.3 Religious Heritage Sites

6.3.1 St. Thomas Bay Cemetery

This unusual cemetery close to the Government Dock in St. Thomas Bay must be one of the oldest burial grounds on the island. A series of small tombs are present, but the exact number is indefinable without subjecting the site to thorough excavation. The small size of some may suggest that they have children interred beneath, but could also be representative of a conservative burial monument such as those used by Quakers.

The site is very close to the beach and although deliberately fenced off receives little maintenance (**Photo 102**).

Most of the graves present are narrow red brick monuments which have a surface rendering of lime mortar finishing in a triangular shape (**Photo 103**). Some of the graves are close together suggesting the internment of a single family.

Photo 102. St. Thomas Bay Cemetery.

Photo 103. Tomb, St. Thomas Bay

None of the graves have marking, although in the past a flat table slab was visible to the north side of the cemetery commemorating a member of the Flax family who died on Christmas Day sometime in the mid-eighteenth century. This stone has either been removed or is buried under soil debris, but its former presence provides evidence of when the site was in use. Graves similar to others at the cemetery can be found in the planters' cemetery on Tortola, providing an eighteenth-century timeframe for the Virgin Gorda internments.

There is little to see at this site, but an interpretation board for tourists arriving at the nearby ferry dock would at least alert people to its presence.

6.3.2 St. Mary's Episcopal Church

This beautiful little Anglican church lies nestled inland of Spanish Town (**Figure 19**) with a graveyard surrounding it on one side and parking space on the other. The main building was constructed from andesite field stone and lime mortar in approximately 1875 (Koladis, 1976), but has been added to since with an extension to the rear, porch at the front, and bell tower on the south side (**Photo 104**). The main structure now has windows on either side, but the construction variant beneath each of these windows suggests that they were once doors. Red brick has been used to accentuate the window ledges and door frames of the original building.

There are a number of graves in the adjoining graveyard, some of which date to the mid-nine-teenth century. The most interesting funerary monument sits upright at the northeast side of the church and is illustrated with a series of symbols, letters and numbers (**Photo 105**). The crossed hammers found at the top of the stone on one side may indicate that this tomb was commissioned to remember one of the copper miners working on the island during the mid-nineteenth century.

Photo 104. St. Mary's Episcopal Church.

Photo 105. Tombstone at St. Mary's

6.4 Military Heritage Sites

6.4.1 Fort George, Little Fort Point

This site—a declared national park under the jurisdiction of the National Parks Trust— is located on a small peninsula at the western point of St. Thomas Bay, which today still serves as the official port of entry and anchorage for the historical and modern settlement of Spanish Town.

An aerial photograph illustrates that the clearly defined platform is almost completely cut off from any terrestrial approach by an encompassing combination of treacherous boulders and razor-sharp vegetation, including a variety of cacti (**Photo 106**). The coastal approach is made even more daunting by heavy swells, an uneven rocky shoreline, and sheer friable cliffs (**Photo 107**).

Photo 106. Aerial view of Fort George.

Fort George encompasses an area approximately 1.5 acres in size and is surrounded along the shoreline-facing perimeter with a series of earthwork embrasures retained by dry stone, andesite walls (**Figure 20**). There appear to be eight embrasure apertures surviving, but due to their basic construction and age, it is difficult in places to ascertain whether these openings were deliberate or subsequently created by natural erosion.

Few cultural artefacts remain on the surface apart from a small assemblage of typical eighteenth century domestic ceramics which represent the last phase of occupation during the French and Napoleonic Wars. The site today is in the custody

Photo 107. Fort George from the coastline.

of the National Parks Trust. Permission from the Trust would be required to carry out an archaeological excavation, which may provide evidence of an earlier sixteenth century occupation.

The most unique feature about this fort is the powder magazine, which has been constructed in the hard boulders prevalent in the area (**Photo 108**). The magazine is unique in the Territory in that it uses natural features to bolster its own structural integrity. The roof of the magazine is capped with red brick, and its position far away from the battery inland protected it from a coastal assault.

Efforts have been made in the past to locate the land approach to this fort but were not successful. During contemporary use, however, there must have been a land approach. The absence of any cistern suggests that the site was only manned during times of emergency and did not serve as the citadel for non-combatants. In order for this to become a tourist site, a reliable land approach would have to be created as the coastal approach is too dangerous for all but the most adventurous explorers.

Figure 20. Site plan for Fort George, Little Fort Point.

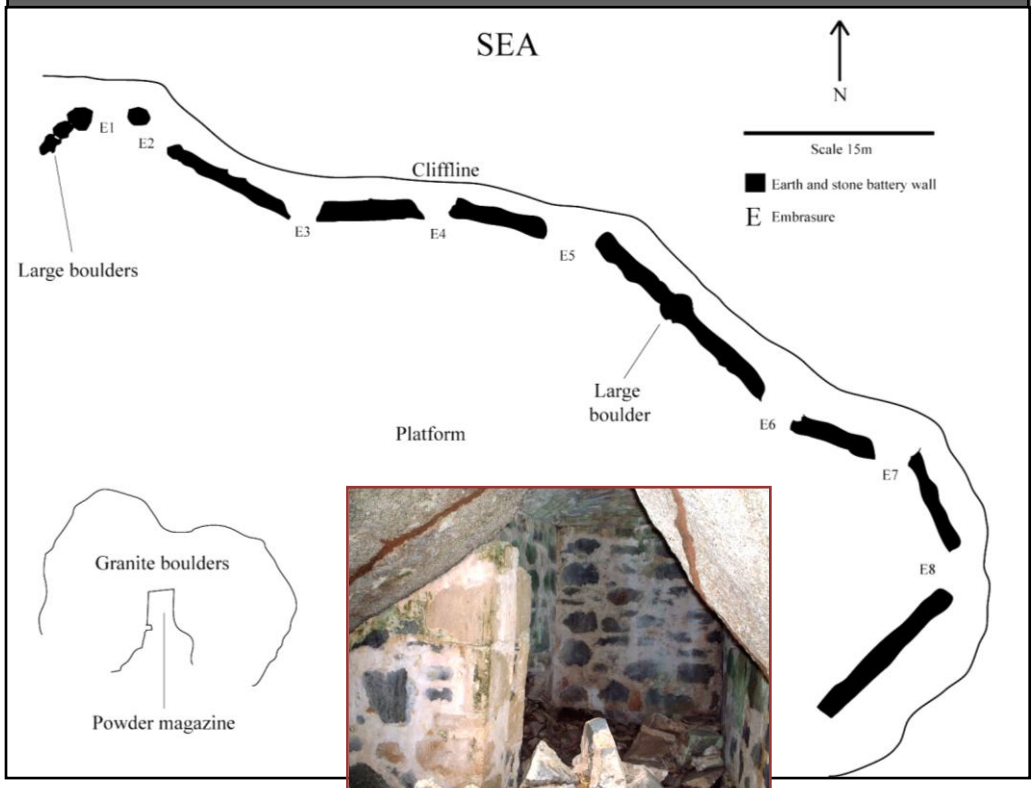


Photo 108. Powder Magazine.

6.5 Other Heritage Sites

6.5.1 Olde Yard Inn Building Base

This large building base located in the Olde Yard Inn Village complex is impressive in size and suggests a considerable occupation of the site during the plantation era. The purpose of the base is ambiguous due to its featureless façade, which is only punctuated by ventilation slits. It was probably either a storage facility or the base to a great house.

Three sides of the building are composed of andesite field stone, whilst one side is almost exclusively composed of carved ashlar blocks on the exterior facing wall (**Photo 109**). The interior is derelict and used today for storage.

There has been little to no effort to consolidate the fabric of the building's construction although clearly in the past, when the complex was being developed, the preservation of this structure was taken into account. It is likely that other ruins are located in this complex unless the development of the site has absorbed them.

Photo 109. South-facing wall, Olde Yard Inn.

Issues, Conflicts, and Areas of Concern	Impacts of No Action/No Change	Short-term Options Long-term Recommendations
ISSUE ONE—Nail Bay I Sugar Works The site lacks interpretative materials to display and explain the cultural and historical significance of the ruins that survive from the original sugar works.	Without proper interpretation of the site, an opportunity will be lost to better understand the development of the site, particularly within the larger context of the plantation economy that once prevailed in Virgin Gorda.	**SHORT-TERM OPTIONS** 1. The private sector owners should be encouraged to prepare an interpretive booklet to describe the various processes that took place within each of the structures at the site. 2. Likewise, a designer or graphics artist should be engaged to create a series of interpretation signs/boards for the site. **LONG-TERM RECOMMENDATIONS** 1. As indicated in the text of this chapter, the sugar ruins at Nail Bay I are among the most popular historic sites on the island, exceeded only by the recognition attributed to the Copper Mine. The private owners of these ruins should be encouraged by Government—and assisted where possible—in enhancing the educational experience to be gained by visitation to the site.
ISSUE TWO—Nail Bay I Sugar Works The ruins at the Nail Bay I Sugar Works require ongoing maintenance to control the spread of vegetation within the actual ruins.	The integrity of the individual buildings will be compromised and placed at risk without an organised programme of ongoing maintenance.	**SHORT-TERM OPTIONS** 1. The private sector owners of the Nail Bay site should be encouraged to develop a plan of work for vegetation maintenance that: • identifies areas where vegetation corruption is currently taking place, • trains maintenance staff to identify potential areas of concern going forward, and • trains staff in methods to combat future problem areas. **LONG-TERM RECOMMENDATIONS** 1. Once vegetation control is more effectively managed at the site, skilled masons could be employed to render and consolidate much of structural deterioration now evident. Using traditional lime mortar, areas of concerns should be repaired; more generally, all stone work could benefit from re-pointing.

Issues, Conflicts, and Areas of Concern	Impacts of No Action/No Change	Short-term Options Long-term Recommendations
ISSUE THREE — **Nail Bay II Sugar Works** **Long Bay Sugar Works** **Plum Tree Bay Sugar Works** These sites are all in private ownership, with the Nail Bay II site now part of a residence. As such, these heritage sites are not available for public visitations or for use as educational/interpretive sites accessible to the wider Virgin Gorda community or visitors to the island.	The current owners of the Nail Bay II Sugar Works have included the ruins in the overall design of the property, and it can be assumed that the ruins at this site will be well maintained over time. Nevertheless, the future of historical and cultural sites located on private property in Virgin Gorda—such as the ruins at these three sites—is ambiguous at best.	**SHORT-TERM OPTIONS** 1. The private-sector owners of these sites should be encouraged to seek professional guidance for ongoing maintenance of their ruins. Such action will better ensure the survival of the extant historical structures located on their property and in their care. The Long Bay site, for example, is heavily overgrown with vegetation, with a number of trees growing through the actual structure. At the Plum Tree Bay site, vegetation around the immediate site needs to be cleared, and a trail could be created to the site. 2. The BVI Department of Culture, in cooperation with resident professionals in the field of Virgin Islands history and historic preservation, need to ensure that the private-sector owners understand the value of the historical sites on their property. This is of particular concern relative to the Plum Tree Bay Sugar Works because it is located in an area that is likely to see development in the not-too-distant future. 3. The private-sector owners could be consulted as to their willingness to support an archaeological excavation of their property in the area of the sugar ruins. **LONG-TERM RECOMMENDATIONS** 1. The BVI Government needs to re-examine its role in protecting historical and cultural sites and artefacts located on private property. Part VI (entitled "Environmental Protection") of the Physical Planning Act of 2004 gives the "planning authority" power to issue an interim and/or permanent preservation order to protect an historic building or site when "it is desirable having regard to the importance of preserving the architectural, cultural, historic or archaeological heritage of the Territory." 2. All three sites have unique characteristics: at the Nail Bay II sugar works, there is a rum still foundation; at the Long Bay sugar ruins, there is a large cistern; and at the Plum Tree Bay sugar works, the site's copper battery wall is comparable to the Territory's best-preserved boiling house on Tortola. With the permission of owners and following varying degrees of rehabilitation work, these sites might potentially attract visitors.

Issues, Conflicts, and Areas of Concern	Impacts of No Action/No Change	Short-term Options Long-term Recommendations
ISSUE FOUR—Copper Mine This important relic from the mid-nineteenth century Industrial Revolution is unquestionably the most important historic site on Virgin Gorda. Further attention needs to be given to interpretation and conservation by the National Parks Trust, which manages the site.	The future integrity of this critical site is at potential risk, with subsequent degradation of a unique piece of Virgin Gorda history and a popular tourism site.	**SHORT-TERM OPTIONS** 1. The Copper Mine site suffers from inadequate interpretation materials, and the NPT should pursue as soon as possible a project to design and install weather-proof interpretation boards, these to be placed strategically around the site to relate the mine's history and its unusual place in BVI and Caribbean history. To assist in offsetting the costs of creating interpretive sign boards for the site, the NPT might approach the private sector of Virgin Gorda for support, with appropriate acknowledgement provided on the materials produced. The Trust might also seek support from the Copper Mine Committee, a local group established prior to the site being declared a national park. Although no longer as active as they once were, the group might be re-engaged to assist with fund raising for interpretation. 2. The Copper Mine site also needs safety signs, and these could be installed at the same time as the interpretation signs. 3. NPT's management plan for the site needs to include: • Strategic planning for emergency maintenance and future site rehabilitation; • Safety procedures at the site; • Vegetation enhancement at the site to reduce surface runoff; • Staffing for the site to assist visitors, to reduce the removal or bricks and plants (both reported by local stakeholders, see Chapter 8, Section 8.2.1.1), and to collect data on visitor levels; • Options for collection of entry fees to offset the costs of interpretation and conservation at the site. **LONG-TERM RECOMMENDATIONS** 1. Additional research could be undertaken for the site to further document the history of the mine (perhaps including research in Cornwall on the original owners). Such research needs to precede preparation of a booklet on the site's unique history. 2. With more consistency, the NPT needs to carry out strategic maintenance at the Copper Mine, focusing, in particular, on site conservation and including techniques applicable, for example, to the exposed boiler and other endangered artefacts present.

Issues, Conflicts, and Areas of Concern	Impacts of No Action/No Change	Short-term Options Long-term Recommendations
ISSUE FIVE—Beam Engine Lever at Copper Mine Bay Another artefact from the island's copper mining era, the beam engine lever lies partially submerged in the waters of Copper Mine Bay.	Survival of the artefact is in jeopardy if not properly conserved.	**SHORT-TERM OPTIONS** 1. Research is needed on *in situ* methods of conservation, in particular, on the attachment of sacrificial anodes to stabilise the artefact's iron integrity. Once researched, the most appropriate *in situ* conservation method should be carried out under the supervision of the National Parks Trust. **LONG-TERM RECOMMENDATIONS** 1. Once *In situ* conservation has taken place, the artefact needs to be removed to an appropriate site for long-term preservation.
ISSUE SIX—St. Thomas Bay Cemetery This burial ground must be one of the oldest on the island, but it is largely ignored.	As long as the full extent of the site remains unrecog-nised, the potential risk of damage remains, particularly from develop-ment within the confines of the cemetery boundary.	**SHORT-TERM OPTIONS** 1. A surface reconnaissance of the site should be carried out to establish visible boundaries, followed by a more formal re-establishment of the cemetery's boundaries in order to prevent future encroachment from other development activities. 2. An interpretation board could be erected for passengers using the nearby ferry dock to alert those passing to the presence of the cemetery. **LONG-TERM RECOMMENDATIONS** 1. An excavation of the site should be carried out to establish the number of graves present and their extent. This could be accomplished by a local community group or by volunteers from overseas NGOs who have been part of similar activities elsewhere in the Caribbean (see, for example, Caribbean Volunteer Expeditions, www.cvexp.org).
ISSUE SEVEN—St. Mary's Episcopal Church There is no interpretive signage to indicate the historical and cultural significance of this church which survives from the nineteenth century.	None	**SHORT-TERM OPTIONS** 1. The Anglican Church, in cooperation with local historians, might undertake additional research on the site in local resources, and then prepare a more thorough history of the church site. 2. The Church might establish a interpretation board at the site for the benefit of its congregation, the community, and visitors to the island. **LONG-TERM RECOMMENDATIONS** 1. None.

Issues, Conflicts, and Areas of Concern	Impacts of No Action/No Change	Short-term Options Long-term Recommendations
ISSUE EIGHT—Fort George Due to the presence of treacherous boulders and razor-sharp vegetation, accessibility to this National Park site is almost entirely impossible from a land approach. Additionally, the site has not been developed as an attraction by the National Parks Trust.	If an existing trail is not identified leading to the site and if it is determined by the NPT to create a new trail, there may be some environmental impact on the immediate area chosen for the path route. Additionally, if the NPT wishes to more prominently display the site in the future, environmental impacts that could result from such activities will need to be considered.	**SHORT-TERM OPTIONS** 1. The National Parks Trust needs to determine if an historic path to the site is present and, if present, take steps to re-open this path. 2. If no former path route can be identified, then the NPT should eventually create a new trail if this site is to be minimally available for visitation. 3. The modern and historic boundaries of the site need to be confirmed. 4. The National Parks Trust should carry out an organised programme to collect and record cultural artefacts to be found at the site. This could be accomplished by NPT staff assisted by local volunteers or volunteers from overseas NGOs who have been part of similar activities elsewhere in the Caribbean (see, for example, Caribbean Volunteer Expeditions, www.cvexp.org). **LONG-TERM RECOMMENDATIONS** 1. More thorough research on the history of the fort is needed, particularly if the NPT determines to more aggressively display the site in the future. Eventually, the site should be excavated with a view to future presentation as a recognised historical site. 2. Figueredo (1974) has asserted that Pre-Colombian occupation may have occurred at the site. This assertion needs to be pursued, and the possible presence of such occupation needs to be re-examined.
ISSUE NINE—Olde Yard Inn Building Base The immediate environment surrounding this site has already been extensively developed.	If steps are not taken to enhance the importance of the ruins at the site, they will undoubtedly suffer further degradation.	**SHORT-TERM OPTIONS** 1. As an immediate action, the solar panels currently stored in the interior of the building should be removed. Additionally, the area surrounding the ruin could be re-landscaped with local plants and vegetation. **LONG-TERM RECOMMENDATIONS** 1. The site would be significantly enhanced if a professional mason could be employed to consolidate the ruins, using traditional materials. 2. The ruins need to be promoted as an integral part of the more modern complex. An interpretation board might be prepared to illustrate the history of the area and to suggest what the ruin might have been within the context of the site's historical development.

7. POLLUTION THREATS

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 sub-system, island to sea* (Towle, 1972).

Perhaps in no area are the constraints of insularity quite as demanding as they are with regard to waste management. Due to the relatively small size of islands, the "environmental dimensions of social and economic actions taken by … society are more immediately evident," and this is particularly relevant to waste management on islands (Georges, 2002). The World Island Network report (WIN, 2006), based on a survey of 51 islands worldwide, tables a broad spectrum of factors influencing the complexity of waste management on islands, as shown on **Table 28**.

Table 28.
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 cost of technology 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.

Waste management is not usually identified as a priority issue in island development planning; at the same time, most small developing islands lack sufficient institutional resources (human, technical and financial) to handle increasing, and more complex, waste streams. In addition, the finite land areas common to small islands—like those in the British Virgin Islands—limit disposal options, thus increasing the urgency to address waste management issues.

Islands are dependent on external markets and exhibit a high dependence on importations. The resulting economies of scale are skewed against small islands and can lead to high costs for managing relatively small quantities of waste. For example, some islands are isolated from mainland markets rendering the cost of transporting recyclables unfeasible.

Within these constraints however lie opportunities—specific to island communities—to develop innovative solutions to manage increasing waste volumes.

Acknowledging the complexity of waste management, many islands in the Caribbean have made concerted efforts to more effectively address waste management policy and procedures. In the BVI, the National Environmental Action Plan (NEAP) identifies waste and pollution, amongst others, as issues which are "serious and anticipated threats to the Virgin Islands environment, which if not immediately addressed will lead to the further deterioration of the environment and endanger the economy and livelihood of the territory" (DCF, *et al*., 2004).

7.1.1 Generation of Solid Waste in Virgin Gorda

7.1.1.1 Waste Categories

Volumes and types of waste categories vary significantly depending on an area's economic development and activities. Hawkins, *et al.* (1999) describe waste as occurring in all forms of matter, namely, solid, liquid, and gas such as "tailings, gangue, fly ash, slurry, sludge, slag, flue gases, construction debris, methane and other wastes."

Typical waste found in a first world urban waste stream might include categories such as organic material, construction and demolition waste, paper, plastics, tyres, metals, wood, textiles, glass, ceramics, white goods, nappies, electrical goods, hazardous waste, chemicals, and sewage sludge.

Although these categories sound inclusive and conclusive, it must be acknowledged that each category listed consists of thousands of variations of each substance. Plastic, for example, although simplistically divided for recycling purposes into six different types, actually consists of thousands of different types, each one a separate entity in itself. Since plastics are often mixed with other materials, possible variations are greatly increased, thus making recycling of plastics very difficult.

In a recent study by McDevitt (2008), data from four Caribbean islands were assimilated to provide an insight into the region's waste stream categories and quantities. When comparing the data from waste audits of the sample population, the organic fraction is consistently the largest waste stream, representing a little over 30 percent of all the combined waste streams.

This is followed by paper and cardboard, representing 26 percent. The third largest overall 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 significantly lower quantities. Although special waste quantities are not large, management of these wastes are important, as they can be hazardous in nature.

McDevitt's 2008 study can be used as a guide to the composition of the waste streams in Virgin Gorda. For example, the data from the multi-island study also indicate there is a recycling and composting potential of at least 65 percent of the waste that originates from residential and commercial (primarily tourism) activities.

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 will determine the size of its waste volume. The population of the British Virgin Islands has grown in the last decade from a little over 23,000 in 2001 to a projected 27,800 in 2012 (see Chapter 1, Section 1.3.1).

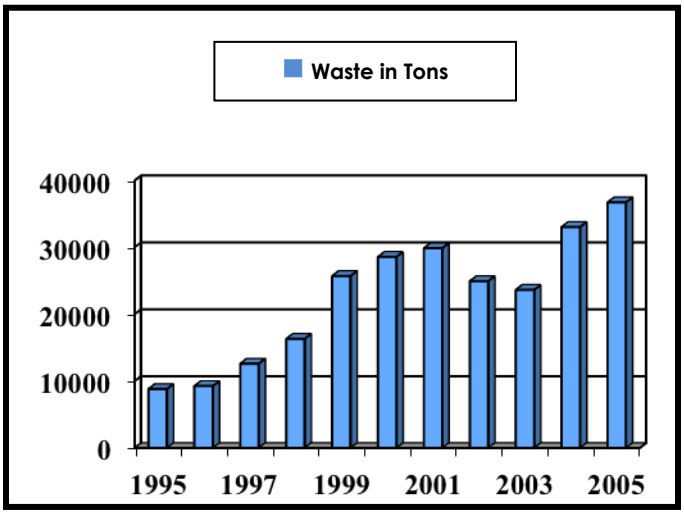


Figure 21.
Growth of waste in the British Virgin Islands, 1995-2005 (source: McDevitt, 2008).

Virgin Gorda's population figures have followed a similar growth pattern with approximately 4,000 people now estimated to be living on the island. Census figures from 2001 (representing the last confirmed data available) put Virgin Gorda's population at 3,200, with the Development Planning Unit currently estimating a figure of 4,085 for 2010. In addition to population increases, the BVI has seen a steady growth in tourism and Gross Domestic Product over the last decade, with corresponding increases in the amount of waste generated.

Waste per capita in the BVI, like the neighbouring USVI, is high due to the high rates of product importation. The Virgin Islands Recycling Partnership (VIRP) reports that its waste volumes per capita are 5 kg (11 lb) per person per day—2.5 times higher than the average waste generated per person per day in the United States (VIRP, 2011). According to the U.S. Environmental Protection Agency (USEPA), in 2010 the average waste generated per capita in the mainland USA was 2 kg (4.43 lb) per day (USEPA, 2012)

In 2004, approximately 28,997 metric tons (31,964 US tons) of waste were generated in the BVI (**Figure 21**). In 2006, the BVI's waste generation amounted to approximately 33,565 metric tons (37,000 US tons), and in 2008, waste generation for the BVI was 39,013 metric tons (43,005 US tons), with Virgin Gorda representing about 3,628 metric tons (4,000 US tons) per annum.

As there is no weigh-bridge at the island's disposal site, the 2008 waste volume figures for Virgin Gorda were based on the per capita amount generated, *i.e.*, 3.6 kg (7–8 lb) per person per day. This could lead to a significant margin of error in calculating the actual amount of waste received.

As most of the Virgin Gorda's population resides in The Valley, the majority of residential waste is generated and collected within this area. **Table 29** provides a few examples of volumes of waste collected at selected sites.

Table 29.
Examples of waste volumes generated by commercial enterprises on Virgin Gorda.

Commercial Enterprise	Off-season Volume (cubic yards/week)	Off-season Collection (frequency/week)	Peak-season Volume (cubic yards/week)	Peak-season Collection (frequency/week)
The Valley	20	7	30	7
Little Dix Bay Resort	20	3 - 4	20	7
Rite Way Supermarket	20	1	20	3
Rosy's Supermarket	30	1	90	3
Virgin Gorda Yacht Harbour	n/a	n/a	30	1
Bucks Food Market	n/a	n/a	25	1

Source: *Pers. comm.,* Lester Maduro, private-sector solid waste contractor in Virgin Gorda, meeting with Charlotte McDevitt, November 2011.

Photo 110.
Organic waste, plastic, and cardboard are among the most common items disposed of in the BVI. Photo is from Virgin Gorda.

Photo 111.
Garbage bin provided by the Department of Conservation and Fisheries at Savannah Bay beach, showing the need for more and larger receptacles to accommodate recreational users.

7.1.2 Collection and Disposal of Solid Waste in Virgin Gorda

7.1.2.1 Overview of the System

The first regulations affecting solid waste were enacted in 1971, requiring households to dispose of "house refuse" in bins with lids and to remove excessive wastes, such as white goods (appliances), at the owner's expense. Solid waste management fell under Environmental Health until 1995 when the Department of Solid Waste (DSW) was formed.

The DSW falls under the Ministry of Health and Social Development and is responsible for the placement of public dumpsters, overseeing contractors who collect waste from dumpsters, maintenance of road verges, street cleaning, the removal of derelict vehicles, management and maintenance of the incinerator and landfills, and waste education activities.

The department on Virgin Gorda consists of a staff of nine, a manager who supervises, and eight sanitation workers, in addition to private-sector contractors. The sanitation workers focus on cleaning roads (see **Photo 112**) and maintaining verges as well as managing the landfill.

The Department of Solid Waste on Virgin Gorda faces many of the obstacles highlighted in **Table 28**, such as limited financial, physical, technical and human resources, as well as a lack of adequate environmental monitoring and supporting legislation. This combination of factors prevents the implementation of better waste management practices such as:

- waste reduction initiatives,
- comprehensive hazardous waste management planning, and
- provision of liners and leachate treatment plants for landfills.

The assumption that waste management on Virgin Gorda holds a generally low priority within Government is reflected by:

- lack of adequate training for DSW staff,
- no official DSW office on Virgin Gorda, and
- insufficient funding for daily operational costs and procurement of necessary equipment.

Photo 112.
A litter-free road on Virgin Gorda.

7.1.2.2 Collection

Ninety percent of the collection of waste in the BVI has been outsourced, a practice that is more likely linked to political patronage pressures than to executing the most efficient waste management practices possible. Outsourced contracting is supervised by the Department of Solid Waste. Numerous private companies have been established in the Territory and, in addition to Government contracts, such companies also serve private businesses and the smaller islands.

Contractors are awarded tenders to collect waste from skips (also called dumpsters or bins) within their designated areas. Collected waste is then disposed in government-managed facilities. No fee is collected by Government for waste disposal, and waste management in the BVI is financed solely by general revenues generated from taxes.

Residents and smaller commercial enterprises in Virgin Gorda place waste in green skips (dumpsters) that are overseen by the DSW and collected by a private waste collector (**Photo 113**). Collection of waste is outsourced to two private waste companies—one serving the North Sound Area and the other The Valley. Annual cost for contracted waste collection services in 2008 amounted to approximately $150,000.

The North Sound collection is scheduled for three days per week—Monday, Wednesday and Friday, although the addition of a fourth day is hoped for by the community. In The Valley, collection has now increased from six days per week to seven. According to a private waste contractor, there are unresolved issues with Government regarding current contracts, such as pay scales on Virgin Gorda which are not comparable with those of Tortola.

Photo 113.
Example of a skip serviced by a local contractor in Virgin Gorda.

Larger waste generators are required to collect and dispose of their own waste at the landfill site. There are numerous private contractors including six garden contractors who haul garden waste to the landfill. Significantly less garden waste is sent to the island's landfill during dry season.

7.1.2.3 Disposal

The DSW operates the disposal and treatment facilities within the Territory with waste in the BVI being either land-filled or incinerated. There are four landfill sites currently in operation in the Territory, situated on Tortola, Virgin Gorda, Jost Van Dyke and Anegada. Open burning, spreading and compacting of waste are common practices, as is the operation of unlined landfills with no leachate treatment plants.

Historically, waste in Virgin Gorda was burned or buried in backyards. An exception was the resort at Little Dix Bay that formerly incinerated its waste in a small on-site incinerator between 1964 and 1966. Waste is also used as fill material, as was done at Handsome Bay when the Little Dix Bay resort was constructed.

Between 1967 and 1995 waste was dumped at the Copper Mine landfill site situated on Crown Land. This site was closed because the area is also a designated historic site and national park, and the smoke from open burning generated complaints from residents and tourists alike.

The current landfill is located at Valley Hill, just off the road between The Valley and North Sound and covers an area of 1.2 to 1.6 ha (3 to 4 ac). It is expected that the government-owned site has a remaining useful life span of 15-20 years. Two DSW workers oversee the landfill site, and their responsibilities include operating the bulldozer and setting waste alight.

Open burning occurs two-to-three times a week. The department reports that it has received few complaints from the resulting smoke as there are no residents directly downwind of emissions. The site is on a hill, and waste is dumped by trucks and then pushed toward the perimeter and leveled with a bulldozer.

Operational issues affecting the landfill site are similar to those previously indicated for the department as a whole, such as a lack of sufficient resources to procure and maintain equipment and to maintain the road to the site.

Photo 114.
Bulldozer at Virgin Gorda landfill site.

Photo 115.
The road to the waste disposal site on Virgin Gorda.

A new bulldozer was purchased in 2008 after the old machine had been out of order for many years (**Photo 114**). A few breakdowns of the new bulldozer occurred in 2011, and during such periods a bulldozer had to be rented. The bulldozer is used to push waste to the perimeter of the site and also to cover waste with soil to reduce vector issues such as rats, flies and mosquitoes.

The road to the landfill was in severe disrepair for many years but has now been concreted to provide better access. Cracks are present in the concrete, but it seems to be holding except for the lower portion of the road. There are problems with waste being dumped close to the road, leaving little space for trucks to turn around and thus creating a safety hazard (**Photo 115**).

Other problematic issues regarding waste disposal in Virgin Gorda include:

- Sewage sludge—the frequency and quantity of which is unknown—is dumped within a designated area at the landfill site.
- Waste oil from larger marinas is barged to Tortola at the expense of local marinas. The oil is burned at the waste oil site at Pockwood Pond, Tortola.
- There are currently no disposal options for tyres, and they are buried or burned.
- There is no separation of hazardous or electronic waste (e-waste).
- The landfill site is not fenced, and wind-blown litter is evident.
- No new site has been identified once the current landfill is full.
- In line with worldwide perception of landfills, the Virgin Gorda site is not viewed favourably within the local community. One Virgin Gorda resident reported, "*I prefer to go there at night so I cannot see how beautiful the area is…. Such a serene area…. Now it is toxic*."

7.1.2.4 Education

Public education initiatives developed by the DSW Education Officer, using television, radio and print media, have centred on teaching residents how to dispose of their waste correctly. School education programmes are complemented by competitions and a mascot. A jingle competition in 2004 proved to be an effective educational tool since the winning jingle was used in subsequent radio advertisements. Community programmes include volunteer cleanups to keep the island clean.

The Department of Conservation and Fisheries assists in highlighting a clean environment with an annual volunteer beach cleanup as part of the International Coastal Cleanup. The three largest categories of waste collected in this initiative were plastic bags, plastic utensils, caps and lids at 14, 13, and 10 percent, respectively (ICC, 2006).

Another education issue is how to confront the negative perceptions associated with waste disposal sites. NIMBY ("*not in my backyard*") is a popular acronym used everywhere to garner public opposition to the siting of landfills and incinerators near to communities (**Photo 116**).

Photo 116.
View from the Virgin Gorda landfill.

7.1.2.5 Legislation

There is currently no Solid Waste Management Plan to guide waste management in the BVI. A Request for Proposals for the development of such a territorial plan was issued in 2009. Tenders were submitted and a candidate selected, but a contract was never awarded.

The Territory's Litter Abatement Act was amended in 2009 to make provision for the appointment of litter wardens to be drawn from DSW staff, environmental health inspectors, the police force, and community volunteers. The intention is to issue warnings to violators in an attempt to change behaviour without clogging the legal system. The programme is currently under review so that it can be strengthened to be more effective.

In 2003, the Derelict Vehicle Act came into effect, requiring the collection of derelict vehicles by a process that would be outsourced. Ferrous and non-ferrous metals are collected, sorted, compacted and exported from the island.

7.1.2.6 Recycling

The British Virgin Islands, as is the case with many small islands, does not have the financial and technical resources, or the associated industries, to recycle materials. The high cost of transportation renders recycling unfeasible in many instances and it is, therefore, not aggressively pursued. Furthermore, economies of scale render the quantity of recyclables insufficient. Metal recycling is one of the more viable waste streams.

A Virgin Gorda contractor collects derelict vehicles and stockpiles them until there is a sufficient quantity to ship to Tortola. The DSW ensures that the vehicles are transported to the scrap metal recycler based in Sea Cows Bay. Here vehicles are compacted and shipped to a scrap yard in Jacksonville, Florida for processing. The associated costs are absorbed by the Department of Solid Waste.

Further recycling options are being explored. Going Green on Gorda is a new private enterprise interested in implementing a recycling programme on Virgin Gorda. They have partnered with Green VI (a BVI not-for-profit organisation focusing on environmental sustainability in the BVI) and BVI Recycling Ltd (a private recycling company formed in 2006). Going Green on Gorda, with assistance from partners, aims to:

- Collect and crush glass to use as aggregate for construction.
- Collect aluminium and steel cans and ship them to Puerto Rico for processing.
- Develop a waste education programme.
- Create biodiesel from old cooking oil.
- Develop and implement a composting programme for Virgin Gorda.

Biras Creek, a commercial development in the North Sound, has purchased a glass crusher and plans to use it for construction purposes.

7.1.3 Environmental Impacts

No specific empirical data exist on the environmental impacts from current waste disposal practices in Virgin Gorda. Profile data have been gathered through desktop research extrapolated to the Virgin Gorda scenario.

It is known that environmental impacts from waste management practices contribute to soil, water and air pollution, environmental degradation, and associated health concerns. The sub-sections that follow are some of the areas of concern for Virgin Gorda.

7.1.3.1 Emissions

Emissions from the open burning of waste pose significant potential health impacts including the release of dioxins and furans. Persistent organic pollutants (known as POPs), such as dioxins and furans, are chemical substances that persist in the environment and bio-accumulate in the food chain.

According to Rogers (2005):

> *Materials containing chlorine compounds like plastic, table salt and bleached paper were burned together with organic matter that contained carbons like wood formed new bonds that created a net increase in dioxins.... By the late 1980s some of those dioxins were revealed to be among the most toxic molecules known. Dioxins are carcinogenic, reduce fertility, affect fetal development, cause the skin condition 'chlorachne' and compromise the immune system. …they accumulate in the body over time. …they can cause harm at very low exposure levels.*

Methane is emitted as part of the decomposition process and is highly flammable. Risks of landfills catching alight are a common concern as the fire is difficult to extinguish and control. In addition, methane is known to contribute to global warming. As it filters up through layers of buried garbage, methane can pick up carcinogens like acetone, benzene and ethyl benzene, xylenes, trichloroethylene, and vinyl chloride (Royte, 2005).

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) seep through waste and pick up molecules from items discarded. The toxicity of leachate, and associated runoff, is thus dependent on the waste stream of the landfill.

In Virgin Gorda, there is no separation of hazardous waste so it is most likely that leachate will contain heavy metals (such as mercury, lead and cadmium), major ions and volatile organic compounds. Furthermore, the co-disposing of sewage sludge may contaminate leachate and runoff with pathogens, including fecal coliform, E. coli, viruses and protozoa.

The danger of leachate and associated runoff from the landfill is that they have the potential to contaminate groundwater supplies as well as the environment within the landfill watershed area. There are many gaps in knowledge regarding the long-term impact 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.

Even if the Virgin Gorda landfill was to be redesigned and lined according to sanitary landfill standards with leachate treatment plants, long term risks would remain. According to Royte (2005):

> *[E]ven the most sophisticated liners will eventually leak. Geomembranes are eaten away by common household chemicals.… And then there's human error—seams improperly sealed, holes poked by heavy equipment. Leachate collection pipes become clogged with silt or mud, or are blocked by the growth of microorganisms or the precipitation of minerals. Weakened by chemical attack, pipes are crushed by garbage. … state-of-the-art landfills merely delay, rather than eliminate, massive pollution to groundwater.*

7.1.3.3 Vector and Pest Problems

Vectors and pests, such as flies, rats, mosquitoes, cockroaches and other animals, are common problems at the landfill site and around public bins. Fly bait is used at the disposal site to control flies, and waste is covered as often as possible to minimise vectors, pests and animals.

7.1.3.4 Litter and Illegal Dumping

Virgin Gorda is generally clean and tidy although some observe that litter and illegal dumping are on the increase. Roadside litter is evident, but regular cleanups by the DSW help to ensure that roadside litter is managed. Litter and illegal dumping are cause for concern for a variety of reasons, including:

1. Litter and the debris from illegal dumping are visually unappealing and send a message that an area is not cared for.
2. Litter and debris from illegal dumping decrease the likelihood of return visits by tourists.
3. Litter and debris from illegal dumping can block drains and contribute to flooding.
4. Litter and debris from illegal dumping kill marine and bird life through strangulation and ingestion.

Photo 117.
Sign posted in Virgin Gorda providing information on the fine for littering.

The DSW requests that all bulky waste such as refrigerators, furniture and mattresses be taken directly to the landfill site. The department has conducted public relations activities to this end including an information sticker on skips as shown in **Photo 118**.

Photo 118.
Notice on a Virgin Gorda dumpster informing residents about the proper disposal of bulky waste.

Photo 119.
Illegal dumping of bulky waste around a Virgin Gorda dumpster.

Despite these steps, illegal dumping and disposal of bulky waste around skips is a significant problem on Virgin Gorda. Bulky items continue to frequently be found in the immediate area of skips, as depicted in **Photo 119**, or are discarded illegally elsewhere on the island.

Illegal dumping sites exist on both public and private land, and are regularly cleaned-up by the Department of Solid Waste at additional expense

to the public. This includes additional costs for collecting derelict vehicles, which often become traffic hazards and are potential breeding grounds for insects and vermin and an eyesore to both residents and tourists.

7.1.4 Future Planning for Solid Waste Management

7.1.4.1 Options for Waste Disposal in Virgin Gorda

The newly elected National Democratic Party in their 2011 Manifesto outlined its vision for Virgin Gorda's waste management. The Government plans to commission a feasibility study for BVI recycling and to review Virgin Gorda's waste system with the long-term objective of closing the Virgin Gorda landfill site. Waste would then be barged to Tortola to make use of extra capacity of a new incinerator at Pockwood Pond.

Potential obstacles would be the cost of barging waste and the capacity of the incinerator. In season, even with both incinerators online at Pockwood Pond, there is not sufficient capacity to process Tortola's waste, much less adding the waste from Virgin Gorda.

Alternatively, the head of the Department of Solid Waste recommends that a small incinerator be placed on Virgin Gorda with a capacity of 36-45 metric tons (40–50 US tons), costing approximately 5-to-6 million dollars.

7.1.4.2 Integrated Waste Management

The process for creating the National Environmental Action Plan (DCF, *et al*., 2004) included the convening of a number of focus groups to determine issues and perceptions of residents and visitors respecting the environment and to identify mechanisms to protect and preserve the Territory's natural resources. With regard to disposal of solid and liquid wastes (including waste from boats), 60 percent of respondents indicated that current waste management in the Territory (including sewage systems) was inadequate (DCF, *et al*., 2004).

The NEAP supports policies to provide safe and effective waste management services and standards to meet the needs of the society served. Should Government adopt the NEAP, new environmental legislation will be required to measure and monitor pollutants, as well as introduce standards for waste management practices (see also Chapter 2, Section 2.1.5.3). With respect to waste management, NEAP proposals call for:

- the monitoring and control of pollution from landfills and the incinerator;
- early warning systems for potential waste disposal hazards such as oil spills;
- the need for the development of a national strategy for waste management;
- charging a tariff for waste disposal services; and
- the installation of scrubbers on incinerators.

Draft legislation to provide a more comprehensive approach to environmental protection and management is now under consideration by Government (Environmental Management and Conservation of Biodiversity Bill, see also Chapter 2, Section 2.1.4.5). The proposed law brings the BVI into conformity with important national, regional and international protocols, treaties and conventions that guide environmental policy.

Provisions under the Bill would develop mechanisms for a "waste audit" to further understanding about the wastes generated in the Territory. Hazardous wastes are to be classified with licensing and permitting standards implemented to manage wastes safely; monitoring mechanisms to measure forms of pollution, including those derived from waste management practices, would be established. If the proposed legislation was to become law, its implementation—with respect to solid waste management—would require a greater allocation of resources to, as well as a prioritisation of, waste management within Government.

McDevitt (2008) recommends various short- and long-term strategies for waste reduction and resource management, which are also in line with recommendations of the NEAP report, the Virgin Islands Recycling Partnership, the Caribbean Environmental Health Institute (CEHI, 2004) and the WIN report (2006). Recommendations are based on the principal of *utilising waste as a resource*.

As part of resource management planning for the Territory, and, specifically, for an integrated waste management strategy for the BVI, the following components have been identified as necessary for the achievement of comprehensive and effective solid waste management and should be a part of any Waste Management Plan for the British Virgin Islands:

1. ***Implementation of procedures to generate accurate data for current waste stream constituents, quantities and origins***. Such data are required before embarking on any waste reduction initiatives.
2. ***Development of a "futures scenario" of waste volumes, proposed costs, and methods of management*** to demonstrate the importance of waste reduction.
3. ***Introduction of policy frameworks with performance indicators*** to measure progress for each resource stream.
4. ***Identification of physical and non-physical instruments for policy implementation***. Physical requirements include facilities and technologies necessary for waste reduction, and non-physical instruments refer to policies, legislation, capacity building, skills development, management and education.
5. ***Completion of a feasibility analysis*** to assess costs and appropriateness of proposed initiatives.

   Financing mechanisms can take the form of taxes, environmental levies, subsidies, public/private partnerships, and donors. The WIN report (2006) cautions that donor projects must be locally owned and include sufficient skill transfer to ensure ongoing project success.

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 approximately 30–40 percent of the waste stream in Virgin Gorda. Commercial fertilisers are imported, whilst 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 would 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 subsidising home composting bins and locally produced compost. Imported fertilisers could be subjected to increasing taxes.
2. **Extended Producer Responsibility (ERP).** EPR 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. EPR 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. **Regional and BVI Inter-departmental Partnerships.** Waste management affects economic, social and environmental facets of BVI society and is not simply the sole responsibility of the DSW. Inter-departmental co-operation within government is required to successfully execute a new BVI waste management policy. Additionally, the BVI Government could actively partner with BVI organisations outside of the public sector, such as the Virgin Islands Recycling Partnership and Green VI, so that resources are shared.

The BVI could also partner outside of the Territory, for example, with Jamaica, Trinidad and Tobago, and the U.S. Virgin Islands, all of which are currently focusing on electronic or e-waste initiatives and legislation to develop strategies to deal with increasing quantities of e-waste.

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 stipulate the reuse of certain materials in construction and the deconstruction of buildings to enable reuse.
6. **Plastic Bag Legislation.** Plastic bag legislation, such as implemented in South Africa and Ireland and parts of the United States, can 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.

Improving current waste management practices and implementing a waste management plan 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 betterment.

7.2 Pollution and Associated Environmental Risks

Maintaining a pollution-free environment and preserving the very attributes—such as unique landscapes, white coralline beaches, aqua-marine waters teaming with marine life—that ensure a quality of life for Virgin Gordians and attract visitors to their shores are increasingly a challenge for the people of Virgin Gorda and their government.

Natural resource pollution—especially within an insular system—can have severe negative impacts on the health and wellbeing of the people who live on or travel to an island and on the natural ecosystems on which local inhabitants depend.

Issues related to pollution are greatly intensified on small islands like Virgin Gorda and are compounded by the island's dependence on tourism. Dealing with environmental concerns related to solid waste (Section 7.1), domestic sewage, and other point-source or non-point-source pollutants on Virgin Gorda has only been intensified by increased coastal development and the arrival of multitudes of visiting yachts and tourists each year and the impacts that these added waste streams have had on already stressed disposal systems.

7.2.1 Domestic Sewage and Liquid Waste

During the opening ceremony of the "*Greening the Economy: Sustainable Development for the BVI*" seminar on 22 February 2012, the Minister of Natural Resources and Labour, the Honourable Dr. Kedrick Pickering, stated, "*The most important issue in the BVI is that the BVI faces a problem in respect to waste, especially waste water* [liquid waste]. *The Virgin Islands is neck deep in a waste crisis*" (Pickering, 2012).

Because of the small size of Virgin Gorda's population, the Government does not maintain any central sewage or waste-treatment facilities on the island. All waste water and sewage have historically been discharged in the ocean or by use of septic tanks, soak-aways, sump holes, or field beds. The septic tank is the most common method of disposal for households and small commercial establishments.

Septic systems, although practical, require periodic maintenance and disposal of sludge material. In more recently constructed apartment or commercial buildings, mechanical systems such as Cromaglass have been used. There seldom is a need to de-sludge the newer systems, but when this is required, the waste is taken away by a sewage hauler usually to an undisclosed location, far removed from residential locations. In some areas, such as the Leverick Bay Resort and the new residential development at Leverick Bay, all facilities have Cromaglass systems that create grey water for irrigation.

The application of such a system is illustrated at The Baths National Park (**Photo 120**). As part of a major renovation to rest rooms and guest facilities at The Baths, the National Parks Trust, with technical advice from Cromaglass and other consultants, was able to install and now operates a full tertiary treatment system. The treated effluent is being stored and reused for flushing of toilets and urinals.

There is no evidence that a policy for sludge disposal has been carried out on a regular basis for Virgin Gorda or that an official disposal site for the community exists. Too often, homeowners dispose of their sludge by whatever means possible and wherever practical. As septic systems age, particularly if they have not been properly maintained, the likelihood of malfunction increases.

Photo 120.
Cromaglass system installed at The Baths National Park. The system is designed to use recycled treated water for toilets and urinals.

Septic systems often malfunction during heavy rain events when rainwater carries unknown quantities of effluent that eventually reach coastal waters. The increase of effluents and nutrients over time has contributed to the deterioration of coastal water quality throughout the Virgin Islands, including Virgin Gorda.

Eutrophication is a process by which coastal waters become rich in dissolved nutrients from runoff such as liquid waste, domestic sewage and fertilizers, thereby causing changes in marine habitats, most of which are undesirable. Sites most vulnerable to eutrophication and decreased water quality are usually found along developed coastlines where water currents and flushing are weak. An increase in algal blooms from eutrophication has been noted in many Virgin Gorda embayments, specifically at Gun Creek, Biras Creek, St. Thomas Bay, and Fishers Cove. Eventual increase in algae growth will smother other plant species that are normally found in such marine habitats.

Most new hotels and resorts on Virgin Gorda have installed small package plants that treat sewage and waste water. Some of the waste water is reused in irrigation during dry seasons, although this is done on an individual site basis.

The disposal of untreated waste water and sewage in coastal waters also poses health-related risks to Virgin Gorda's population, both residents and visitors. As both the local population and tourist visitation increase, current disposal practices will need to be modified to prevent a buildup of disease-producing bacteria in nearshore marine environments and the consequential negative impacts on human health and natural ecosystems.

7.2.2 Coastal and Marine Water Quality

Coastal water quality of Virgin Gorda and neighbouring islands is generally good but declining significantly in areas associated with marinas, recreational vessel activity, and resort development.

The growing number of yachts and more recently mega-yachts in the bays of Virgin Gorda is a contributing cause to increasing levels of pollution. Nearshore contamination is at least partly the result of sewage and waste water discharges from boats, particularly "live-aboard" vessels.

As also described in Section 7.2.1, the effect of discharging untreated or inadequately treated sewage into the marine environment significantly contributes to nutrient loading (eutrophication) and is known to promote the growth of planktonic algae, resulting in increased water turbidity and growth of macro-algae which compete for space with other benthic flora and fauna. The disposal of raw sewage can also lead to unacceptable levels of coliform bacteria, which can have a detrimental impact on human health.

Although most new marinas and dock facilities are fully serviced (electricity, water, garbage disposal), they are not—with the exception of Yacht Club Costa Smeralda—equipped with pump-out stations (see **Table 30**). Compounding the problem, the Territory has no legal requirement for vessels to retain waste in their holding tanks or provide pump-out and treatment facilities—despite the fact that most modern vessels are equipped with holding tanks. This has unfortunately encouraged boat operators, intentionally or unintentionally, to discharge vessel wastes while anchored, moored or navigating territorial waters. This routine discharge of vessel waste from charter vessels entering BVI waters is a direct consequence of the lack of appropriate legislation.

Additionally, adequate receptacles for solid waste disposal by visiting yachts are not always available at anchorages and marinas, resulting in improper disposal of these waste products.

Table 30.
Marinas and dock facilities on Virgin Gorda and neighbouring islands.

Name	Type of Facility	Full Service	Slips	Moorings	Garbage Disposal	Pump-out Facility
Biras Creek	Dock(s)	Yes	Yes	19	Yes	No
Bitter End Yacht Club	Marina	Yes	25	70	Yes	No
Eustatia Island	Dock			Yes		No
Fishers Cove	Dock	No		No		No
Gun Creek	Dock	Yes		No	Yes	No
Leverick Bay	Marina	Yes	30	28	Yes	No
Little Dix Bay	Dock(s)	Yes	No	Yes	Yes	No
Malone Bay	Dock			No		No
Mango Bay/Plum Bay	Dock(s)			No	No	No
Money Bay	Dock			No		No
Mosquito Island	Dock(s)			Yes	No	No
Necker Island	Dock(s)	Yes		Yes	No	No
Oil Nut Bay	Dock(s)			No		No
Prickly Pear Island	Dock					No
Saba Rock	Marina	No	8	17	Y	No
Spanish Town Ferry Dock	Main Dock	Yes			Yes	No
Virgin Gorda Yacht Harbour	Marina	Yes	120		Yes	No
Yacht Club Costa Smeralda	Marina	Yes	38	3	Yes	Yes

7.2.2.1 Pollutants from Marinas and Related Facilities

The only haul-out facility on Virgin Gorda is conveniently located just south of the Virgin Gorda Yacht Harbour at St. Thomas Bay. It is one of the largest haul-out yards in the northeast Caribbean, serviced by a 70-ton travel lift capable of hauling vessels of over 100 feet in length.

The island's haul-out facility, boatyards and marinas are another potential source of pollution, including accidental spills of fuel and oil, pumping of contaminated bilge water, and improper disposal of solvents. Pollution by heavy metals is another concern associated with boatyard and marina operations, in particular from the use of tin-based anti-fowling paints, which are not yet illegal in the British Virgin Islands.

The lack of government controls and proprietor oversight is a growing concern associated with boatyards and marina facilities. Although wastes generated from the operation of marinas on Virgin Gorda should be disposed of at the island's landfill (Section 7.1.2.3), this is not necessarily what occurs. Marina operations cannot afford to implement inclusive environmental safeguards while trying to survive in an increasingly competitive economic climate. The result is that toxic anti-fouling paints, hazardous residues, and remains from fiberglassing and other yacht work—including oil and fuel—may leak into nearby coastal waters, with detrimental impacts on marine life.

In addition, boatyards (as well as auto service stations) have become storage areas for large quantities of 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 coastal waters.

7.2.2.2 Vessel Traffic and Turbidity

North Sound and St. Thomas Bay (home to the Virgin Gorda Yacht Harbour) are principal focal points for vessel traffic and watersports activities. North Sound in particular is the principal luxury resort and yachting destination in the Territory, including, most recently, for the promotion of mega (or super) yachts. Benefiting from its geographically sheltered waters and scenic beauty, the North Sound has experienced a significant increase in yachting as new facilities such as the Yacht Club Costa Smerelda (YCCS) have come into operation. **Photo 121** was taken on Monday, 6 February 2012, the morning after Super Bowl festivities at Bitter End Yacht Club (BEYC), Saba Rock, and other North Sound destinations. It was estimated that over 100 vessels were moored and docked at BEYC and Saba during that weekend, not including those in anchorage areas.

With the increase of yachting activity, including the new mega yachts, the turbidity levels in the North Sound are visibly increasing. Mega yachts are rarely over 4 m (13 ft) in draught and are able to access shallower nearshore waters. Degradation of shallow seagrass beds by their propellers can contribute to the exposure of bottom sediments and increased turbidity.

Photo 122 provides a view of mega yachts docked recently at YCCS. The marina is located at the mouth of Biras Creek Bay to the west of the Bitter End Yacht Club. No dredging took place in the construction of the marina. However, its coastal waters are characterised as shallow and sheltered from high waves and strong currents, which can make for poor flushing.

The overcrowding of vessels in the North Sound is not just a pollution issue but could become a socio-economic issue. The perception of overcrowding is linked to the character of a particular setting and its environmental qualities. An overcrowding situation in the North Sound environment may result in a loss of scenic value and possible decrease in the quality of visitor experience. The overcrowding perception is also influenced by the type of vessels present. Bareboat charter vessels usually have a higher "crowding threshold" than mega yachts and large cruisers.

Photo 121.
A partial view of the North Sound looking toward Mosquito Island (centre of the photo) from the Bitter End Yacht Club.

Photo 122.
Yacht Club Costa Smeralda viewed from the Bitter End Yacht Club.

7.2.3 Erosion and Sedimentation

The physical and geological landscape ot Virgin Gorda and most of its offshore islands is marked by short but steep slopes terminating in sensitive wetlands and marine environments. This combination of habitats makes the island's coastal areas extremely vulnerable to erosion and sedimentation caused by land clearing for residential, commercial, and road construction.

7.2.3.1 Land Clearing for Residential and Commercial Development

The typical approach in Virgin Gorda for preparing land for small-scale residential development is to burn and bulldoze vegetation to entirely clear a parcel of land of its vegetative cover. Such methods expose the underlying soil making it susceptible to erosion during heavy rains. When best management practices (BMPs) are not properly employed and land-clearing is extended to adjacent parcels, the negative impact to the environment may be cumulative and widespread over time.

Major land development projects in the Territory now require environmental impact assessments under the Physical Planning Act (2004). Unfortunately, a regulatory framework in support of the Act has not yet been provided, and inconsistencies in implementing the EIA process as called for in the Act have permitted private-sector, large-scale projects on Virgin Gorda to proceed without completing EIA studies, for example, the resort development at Oil Nut Bay and the new Yacht Club Costa Smeralda in the North Sound (see also Chapter 2, Section 2.1.4.2).

In the public sector, a comparable example of a development project allowed to proceed without proper adherence to the requirements of the Physical Planning Act can be found in the Government's greenhouse project located in the coastal area of Virgin Gorda's South Sound. The hydroponic project, under the Ministry of Natural Resources and Labour, moved to a construction phase in 2010 without a development application having been submitted to the Department of Town and Country Planning. Only after DTCP issued a non-compliance order was an application submitted, although apparently without an EIA having been completed.

The Virgin Gorda project is one of two greenhouse facilities planned by Government (the second is at Paraquita Bay, Tortola), offering what officials hypothesise might become a third economic pillar for the Territory. Excavation for the project began

in September 2010, which was promoted by Government as a facility that would provide jobs for local farmers while reducing the BVI's reliance on food imports. Even then, many residents were concerned about costs, and some complained that no environmental impact studies had been carried out (*www.bviplatinum.com*, 22 November 2010).

The construction site is currently a giant 25,000 m^2, (27,340 yd^2) exposed earth platform designed to accommodate greenhouses. The fill was excavated from the base of a steep hillside (**Photo 123**). In its incomplete state, it is exposed to severe erosion, which is further aggravated by the fact that no erosion control measures were applied and the little sediment control measures that exist remain dysfunctional (**Photo 124** and **Photo 125**). This situation is clearly impacting the important nearby Fisheries Protected Area located along Taylor Bay and Handsome Bay.

Photo 123.
Photo is taken standing on top of the 25,000 m^2 platform for the unfinished greenhouses at South Sound, looking inland. Most of the fill material for the platform was excavated from the hillside. The entire surface area of the excavated hill has no protection from rain-induced erosion and wind-blown sediments.

Photo 124.
The edge of the platform constructed at the site of the unfinished greenhouses is about 4 m (13 ft) in height, and its steep slopes show signs of intense "rill" erosion.

Photo 125.
Dysfunctional silt fences downstream from the greenhouse development have little effect for sediment retention. The barrier was trampled by livestock and left in disrepair.

7.2.3.2 Land Clearing for Road Construction

Road construction induces changes in the rate, the magnitude, and the flow path of surface runoff. Alterations to the soil surface that tend to accompany road development—such as the removal of vegetation and the compaction of soil due to the use of heavy machinery and other vehicles—induce a decrease in the ability of soil to infiltrate rainwater. In turn, this leads to a higher magnitude and frequency of surface runoff relative to undisturbed conditions.

The impacts are particularly significant given the geologic and climatic setting of Virgin Gorda, where there are no continuously flowing streams (*i.e.*, perennial streams) and where the generation of runoff from currently undisturbed areas is exclusively associated with extreme and relatively infrequent storm events.

Recently, to the west of Leverick Bay along its steep hillsides, construction of a major public road is underway; it is designed and cut by Government to provide access for a subdivision project to provide housing lots for local ownership (**Photos 126-129**).

The road has two major, very steep switchbacks along its upper portion. Along its lower portion, the road generally follows the approximate 50 metre contour before it abruptly ends short of reaching an important ghut valley (Money Bay), where it is still a good distance from the shoreline (**Photo 126**).

The Profile team inquired about the availability of an Environmental Impact Assessment for this major earth-movement project. The Department of Town and Country Planning referred IRF to the Ministry of Natural Resources and Labour, under whose jurisdiction, reportedly, the project fell. However, the team was unable to learn anything more from this source regarding the availability of an EIA for the project—or, indeed, if one had been completed.

The entire road corridor was recently examined by two IRF researchers (February 2012). Some of their observations are highlighted as follows.

1. Except for a few segments such as the end segment which generally follows the contours, most of the road is cut into very steep topography (**Photo 127**).
2. The clearing for a wide road bed has necessitated deep hillside cuts which have:
   - **(a)** Scarred the landscape (**Photo 126**);
   - **(b)** Adversely impacted biodiversity (see also Chapter 4, Section 4.5.1);
   - **(c)** Exposed more bare ground to potential erosion (**Photo 128**).
3. The entire road segment was examined and there was a noticeable absence of any erosion and sediment control measures (**Photo 129**).
4. No permanent or temporary storm drainage structures were in place for the road.

Photo 126.
A view of the highly visible Leverick Bay road cut, while approaching from the water.

Photo 127.
The first major switchback along the upper section of the Leverick Bay public road. Below the switchback, the road dramatically steepens.

Photo 128.
Road surface, Leverick Bay public road, showing deep erosion scars. The damage will require future re-grading, thereby recreating a highly erosive surface typical of freshly constructed roads.

Photo 129.
Pictured is the last switchback before the Leverick Bay Road levels off near the coastline. No sediment control measures (such as silt fences) are in place, and the site lacks drainage structures and energy dissipaters (erosion control measures).

7.2.4 Road Construction and Sediment Yield Assessment

7.2.4.1 An Island-tested Model

Research conducted on the island of St. John indicates that while approximately 6 cm (2.4 in) of rainfall are required for surface runoff to be generated from undisturbed catchments, **only 6 mm (0.24 in)** are necessary to generate runoff from unvegetated and well-compacted surfaces that typify unpaved roads (Ramos-Scharrón and MacDonald, 2007a/b).

Since runoff probably represents the most important medium by which marine resources become connected with terrestrial environments, the potential alteration in the hydrologic regime imposed by land disturbance implies an undesirable but enhanced degree of connectivity between land and sea. On the one hand, runoff and all of its components (*e.g.*, nutrients and sediments) are only sporadically delivered from the terrestrial environment to coastal waters under *undisturbed* conditions, but *when disturbed*, the land can generate runoff even during small and infrequent rain storms.

One particularly important consequence of the alteration of runoff generation caused by land disturbance is that it also increases soil erosion and the delivery of sediment to coastal waters. Previous research studies conducted on St. John and Puerto Rico, with similarly dry, sub-tropical climates as those found throughout Virgin Gorda, indicate that:

(1) Hillslopes disturbed by unpaved roads erode at a rate that is between ***ten to ten-thousand times faster than undisturbed hillslopes*** (Ramos-Scharrón and MacDonald, 2007a; Ramos-Scharrón, 2010), and

(2) These roads are capable of increasing watershed-scale sediment yield rates into the marine environment between ***three and 320 times higher than undisturbed sediment yields*** (Ramos-Scharrón and MacDonald, 2007c; Ramos-Scharrón, *et al.*, 2012), depending on the undisturbed sediment yield rate, the abundance and characteristics of the unpaved road network, and the presence of wetland environments or man-made structures capable of retaining sediment on land.

Local-level increases in sediment delivery rates into the marine environment resulting from land development activities are considered one of the most important factors contributing to the multi-decades-long deterioration of coral reef systems throughout the entire Caribbean Region (Gardner, *et al.*, 2003; Burke and Maidens, 2004). Implementation of Best Management Practices on critical watersheds is one of the priorities for coral reef restoration efforts being driven by the US National

Oceanic and Atmospheric Administration (NOAA) throughout Puerto Rico and the US Virgin Islands (Commonwealth of Puerto Rico, 2010; Territory of the US Virgin Islands, 2010).

Prioritising watersheds at a territory-wide or island-wide scale in order to assess erosion concerns and implement erosion control strategies is a key goal of the NOAA approach.

A simple method—based on numerous applications of the STJ-EROS model to watershed in St. John (US Virgin Islands) and Vieques and Culebra (Puerto Rico)—has been applied to Virgin Gorda to rank the island's 15 watersheds in terms of their sediment delivery potential. The ultimate objective is not to provide an accurate measure of sediment yields for Virgin Gorda but to gauge the erosion problem on the island compared to other watersheds in the region and to rank Virgin Gorda's watersheds in terms of their relative potential to cause harm to coastal resources by sediment contamination.

STJ-EROS is a Geographical information System (GIS) model that uses empirical sediment production functions and sediment delivery ratios to estimate sediment yields into coastal waters. STJ-EROS is capable of estimating surface erosion rates from both natural sources of sediment and unpaved road networks. STJ-EROS has been applied to three watersheds on St. John, one watershed on the island of Vieques, and eight watersheds on the island of Culebra.*

7.2.4.2 Application for Virgin Gorda

This assessment was based on the relationship between unpaved road densities and sediment yields estimated by full application of STJ-EROS to numerous watersheds in St. John, Culebra and Vieques. Road densities in Virgin Gorda were determined from data in the BVI National Geographical Information System and from a combination of aerial imagery interpretation and profile team knowledge of the island's road network to differentiate between paved and unpaved road segments.

The map of Virgin Gorda depicted in **Figure 23** displays the names and location of the island's 15 watersheds and their road networks. Unpaved road densities in Virgin Gorda ranged from 0.0 km km^{-2} in the Soldier Bay, Joe Bay, and Fanny Hill watersheds up to 1.87 and 2.62 km km^{-2} in the Little Dix Bay and Taylors Bay watersheds, respectively (**Table 31; Figures 22 and 23**). Even though the unpaved road densities for individual watersheds in Virgin Gorda are lower than on most watersheds in Culebra and Vieques, the higher density areas are within the range of values of the Fish Bay watershed on St. John (2.11 km km^{-2}), a location known for its high sediment yield rates and one which is ranked as a priority site in the USVI in imminent need of an erosion control mitigation programme (Government of the USVI and NOAA, 2010).

Fanny Hill, Soldier Bay, and Joe Bay are the watersheds assessed as having the lowest estimated sediment yields on an annual basis in Virgin Gorda.

Taylors Bay and Little Dix Bay watersheds have the highest estimated sediment yield rates, followed by Trunk Bay, Blunder Bay, and South Sound. Taylors Bay and South Sound represent the two watersheds with the highest total estimated sediment load rates for sediment discharge into their respective coastal waters (**Table 31** and **Figure 24**). (Total load equals the product of the estimated sediment yields times the total watershed area.) Other areas expected to receive high total loads include St. Thomas Bay and Blunder Bay.

* For readers who wish a more detailed analysis of STJ-EROS, please refer to IRF's website at www.irf.org.

Table 31.
Name, characteristics, road densities, and estimated sediment yields for the fifteen watersheds encompassing Virgin Gorda.

Watershed	Drainage area (km^2)	Watershed-Scale Average slope (degrees)	Total Length of Roads (km)	Total Length Unpaved Roads (km)	Unpaved road density (km km^{-2})	Estimated sediment yield (Tons km^{-2} yr^{-1})	Estimated total load (Tons yr^{-1})
Taylors Bay	1.36	12.2	8.4	3.6	2.62	51.1	69.5
Little Dix Bay	0.65	18.6	4.5	1.2	1.87	36.1	23.4
Trunk Bay	0.9	6.6	6.4	1.04	1.16	23.1	20.8
Blunder Bay	1.96	19.4	6.3	2.0	1.02	20.8	40.7
South Sound	2.82	21.2	6.0	2.8	0.98	20.1	56.7
St. Thomas Bay	2.21	6.13	25.1	1.9	0.84	17.9	39.6
Eustatia Sound	1.52	19.2	1.1	1.0	0.66	15.0	22.8
Berchers Bay	0.67	23.5	0.39	0.37	0.55	13.2	8.8
North Sound	2.11	21	9.1	0.75	0.35	10.3	21.6
Long Bay	1.9	21.3	6.0	0.51	0.27	9.0	17.0
Savannah Bay	1.85	21.7	5.6	0.50	0.27	9.0	16.6
Crooks Bay	0.69	12	2.1	0.08	0.11	6.7	4.6
Fanny Hill	0.9	21.1	1.2	0.0	0.00	5.1	4.6
Joe Bay	0.75	26	0.0	0.0	0.00	5.1	3.8
Soldier Bay	1.49	23.7	3.7	0.0	0.00	5.1	7.6
	-		-	-	-	-	-
Total	***20.4***		***78***	***12***			***289***
Area-weighted average		***18.7***			***0.59***	***14.1***	

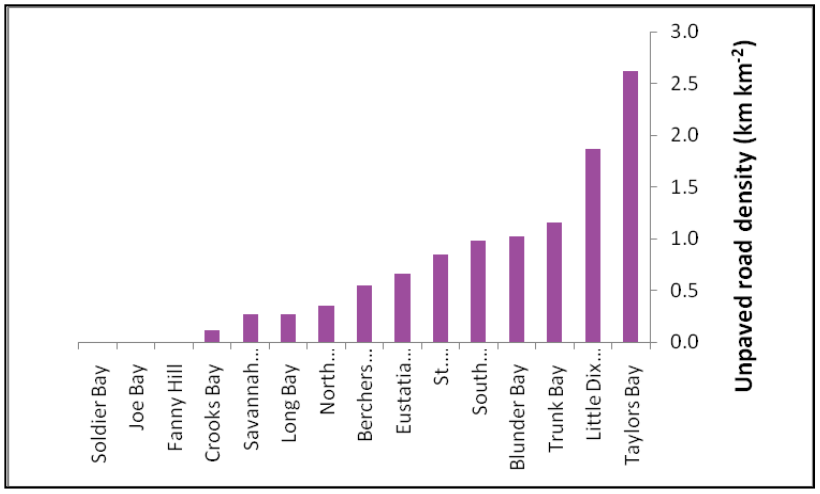


Figure 22.
Unpaved road densities for Virgin Gorda's 15 watersheds.

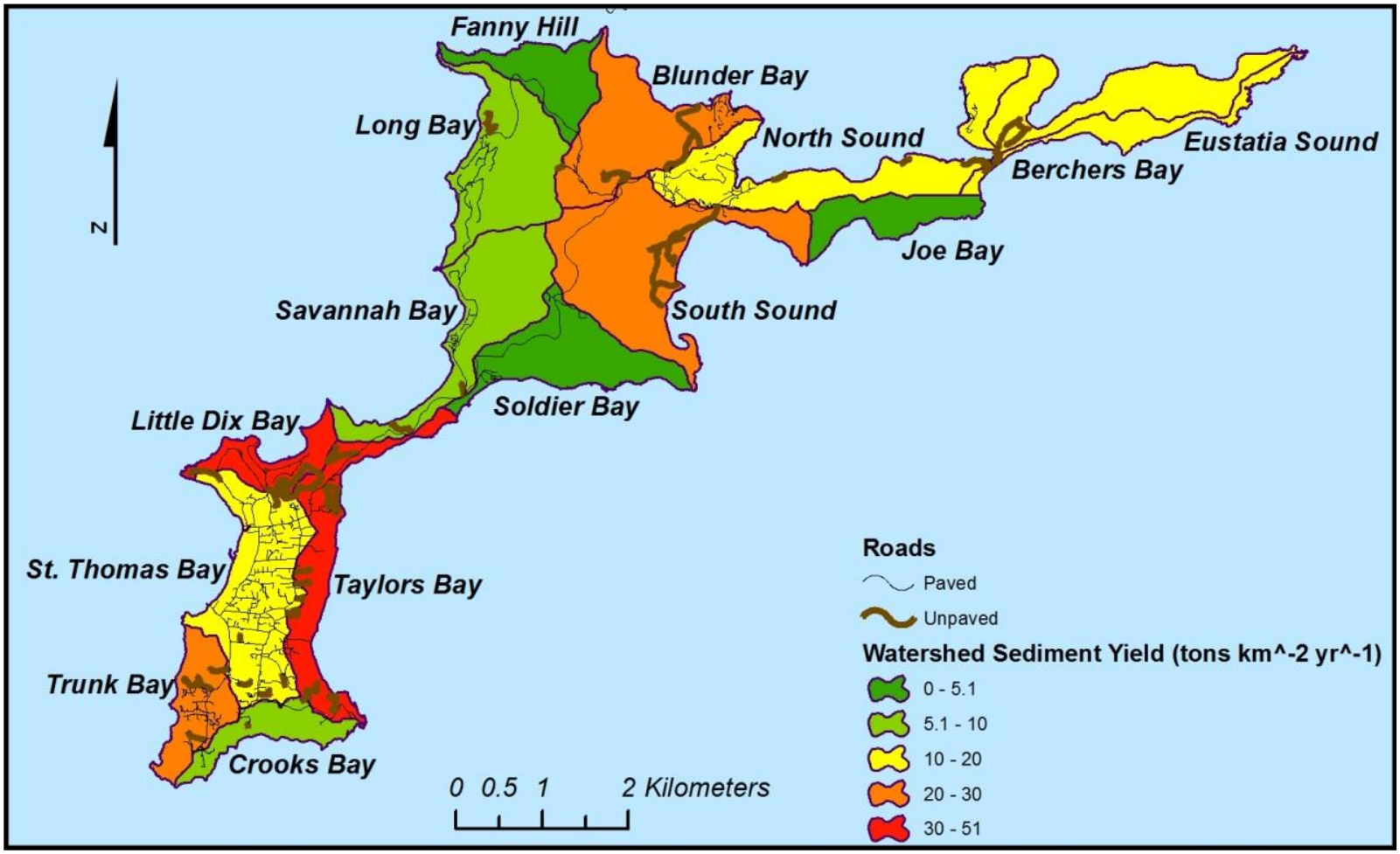


Figure 23.
Map of Virgin Gorda showing the names and locations of its fifteen watersheds and their road networks, with estimated annual sediment yields.

Note: The estimates included on this figure are not the result of a full application of STJ-EROS. A full discussion of the simpler methodology employed by Dr. Ramos-Scharrón for this Virgin Gorda exercise is nonetheless too complex for inclusion in this Environmental Profile, but IRF can make Dr. Ramos-Scharrón's study paper available upon request to irf@irf.org.

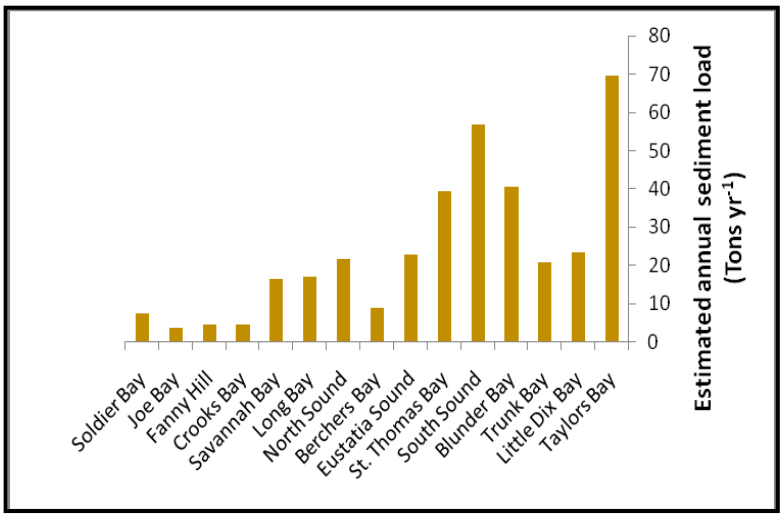


Figure 24.
Watershed-scale sediment load rates estimated for the 15 watersheds of Virgin Gorda. The figure shows that Taylors Bay and South Sound watersheds have the highest total estimated sediment load rates for sediment discharge into their respective coastal waters.

Overall, Virgin Gorda's island-wide sediment yield rates associated with both natural sources of sediment and unpaved roads are estimated to be roughly between ***two to three times higher*** than estimated undisturbed levels. The simple assessment described here suggests that terrestrial sediment is a serious factor affecting the quality of the coastal waters of Virgin Gorda and poses an equally serious threat to its coral reef systems.

Assessing watershed-scale sediment yields is only one factor that must be considered when devising erosion mitigation strategies to reduce threats to coral reef systems (Ramos-Scharrón, *et al*., 2012).

An interdisciplinary approach is best when it bases erosion mitigation decisions on:

(1) watershed sediment yields;

(2) the location, abundance and condition of reef systems relative to those sediment yields; and

(3) the cost-effectiveness of various best management scenarios.

Such an approach can be expected to produce streamlined and better targeted mitigations plans that are based on scientifically derived information and incorporate the best mitigation technologies available.

Issues, Conflicts, and Areas of Concern	Impacts of No Action/No Change	Short-term Options Long-term Recommendations
ISSUE ONE **Solid Waste Management: Emissions from Open Burning** Emissions from open burning at the landfill site cause smoke and the release of toxins such as dioxins and furans. Methane, produced by the decomposition process, is not trapped.	Emissions from open burning cause visual and olfactory impacts. These conditions are further exacerbated with toxins such as dioxins and furans that 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. Methane can cause uncontrollable fires in the landfill and contributes to global warming.	**SHORT-TERM OPTIONS** 1. Procedures need to be put in place to measure the emissions from open burning at the Virgin Gorda landfill site. There is insufficient data currently available on emissions from open burning at all BVI landfill sites, including the facility on Virgin Gorda. 2. Related to Option #1 above, water and soil downwind of emissions at Virgin Gorda's landfill need to be tested on a regular basis. 3. The volume of waste materials subjected to burning at the landfill can be reduced through the design and introduction of a glass and aluminum recycling programme. 4. The feasibility of a commercial composting system should be explored by creative entrepreneurs. **LONG-TERM RECOMMENDATIONS** 1. An Integrated Waste Management Plan for the Virgin Islands—based on reduce-reuse-recycle strategies—needs to be drafted, approved by Cabinet, and implemented across government departments and agencies and in the private sector. 2. A strategy to rehabilitate Virgin Gorda's landfill site needs to be put in place.
ISSUE TWO **Solid Waste Management: Leachate and Associated Runoff** There is no separation of hazardous waste at Virgin Gorda's landfill,, and therefore it is likely that leachate will contain heavy metals (such as mercury, lead and cadmium), major ions and volatile organic compounds. The co-disposing of sewage sludge may contaminate leachate and runoff with pathogens, including fecal coliform and E. coli.	Leachate and associated runoff at Virgin Gorda's landfill have the potential to contaminate groundwater supplies as well as the environment within the landfill's watershed area. There are many gaps in available knowledge about the implications of leachate and runoff in the Virgin Islands; no data are currently available.	**SHORT-TERM OPTIONS** 1. Groundwater, soil and seawater around the landfill site need to be periodically tested by a designated Virgin Islands Government agency. 2. The feasibility of a commercial composting system that can accept sewage sludge should be explored by creative entrepreneurs. **LONG-TERM RECOMMENDATIONS** 1. An Integrated Waste Management Plan for the Virgin Islands—based on reduce-reuse-recycle strategies—needs to be drafted, approved by Cabinet, and implemented across government departments and agencies and in the private sector. It needs to include a rigorous hazardous waste management strategy. 2. Home composting educational initiatives should be carried out as a precursor to commercial composting.

Issues, Conflicts, and Areas of Concern	Impacts of No Action/No Change	Short-term Options Long-term Recommendations
ISSUE THREE **Solid Waste Management: Vectors and Pests** Vectors and pests such as flies, rats, mosquitoes, cockroaches and other animals are common at Virgin Gorda's disposal site and around the island's public dumpsters.	The presence of vectors and pests at the landfill and around public dumpsters carries health risks and has potential to spread disease. Livestock can die from ingesting waste.	**SHORT-TERM OPTIONS** 1. Covers should be used for all public dumpsters, and every effort should be made at the landfill to cover waste on a daily basis. **LONG-TERM RECOMMENDATIONS** 1. An Integrated Waste Management Plan for the Virgin Islands—based on reduce-reuse-recycle strategies—needs to be drafted, approved by Cabinet, and implemented across government departments and agencies and in the private sector, in conjunction with a home composting education programme and a commercial composting system.
ISSUE FOUR **Solid Waste Management: Litter and Illegal Dumping** Although the problem is not nearly extensive as it is in Tortola, both litter and illegal dumping are on the increase in Virgin Gorda.	Littering and the random dumping of solid waste outside of designated areas is an ongoing problem everywhere in the Virgin Islands. Both activities are detrimental to the environment. For example: • Litter and debris from illegal dumping are visually unappealing and send a message that an area is not cared for. • Litter and debris from illegal dumping decrease the likelihood of returning tourists. • Litter and debris from illegal dumping can block drains and contribute to flooding. • Litter and debris from illegal dumping kill marine and bird life through strangulation and ingestion.	**SHORT-TERM OPTIONS** 1. The community should support efforts by the Department of Solid Waste to implement waste education strategies, including periodic cleanups and "adopt a spot" campaigns to engage local businesses. **LONG-TERM RECOMMENDATIONS** 1. An Integrated Waste Management Plan for the Virgin Islands—based on reduce-reuse-recycle strategies—needs to be drafted, approved by Cabinet, and implemented across government departments and agencies and in the private sector, including educational programmes focusing on recycling, home compositing, the litter law, beautification campaigns, and the like.

Issues, Conflicts, and Areas of Concern	Impacts of No Action/No Change	Short-term Options Long-term Recommendations
ISSUE FIVE **Pollution Risks: Domestic Sewage and Liquid Waste** The coastal waters surrounding Virgin Gorda and its neighbouring islands need protection from land-based sources of pollution. Domestic sewage and liquid waste from households or small commercial outlets is an ongoing threat to coastal water quality especially if domestic and industrial septic systems are aging, dysfunctional and/or improperly maintained. Proper disposal of sewage and liquid waste is critical in a tourism-based economy, not only for public health, but also to maintain a pristine marine environment to attract visitors.	Seepage and discharge from household and commercial septic systems are likely the primary cause of deteriorating coastal water quality in the British Virgin Islands. The situation is exasperated during rain events when untreated waste water collects on the ground surface and moves downhill as runoff into canals, drainage ghuts, and—ultimately—coastal waters.	**SHORT-TERM OPTIONS** 1. The Ministry of Health and Social Development should undertake a public consultation with local residents and commercial outlets to raise awareness about the negative impacts of improperly maintained septic systems. A programme of community education on topics where individual action can make a difference would help increase public understanding of pollution issues, such as septic tank design and use, sludge removal and disposal, and water conservation. The Environmental Health Unit of the Ministry can provide a design for a septic tank that is better at filtering effluent than older models. This agency is able to provide guidelines and technical expertise regarding the use of septic tanks and other environmental health issues, and its expertise should be more widely known and available. 2. Government needs develop a process to identify residential areas within the coastal zone that have aging septic systems prone to seepage and accidental discharge into coastal waters. 3. The Government needs to identify appropriate sludge disposal areas on Virgin Gorda and require that the public use the identified areas, in order to discourage *ad hoc* disposal around the island. **LONG-TERM RECOMMENDATIONS** 1. The BVI Government should develop guidelines on the proper construction of septic systems and drainage fields and enact regulations for regular inspection and certification. This recommendation should be part of a broader initiative by the Government to modernise public health legislation with standards for water quality, pollution control, and waste management. As noted in Chapter 2, environmental pollution is not defined in law in the BVI, and regulations providing environmental quality standards have never been enacted. 2. As part of development control planning, the Department of Town and Country Planning might provide guidelines for ecologically sensitive sewage disposal systems, designed for specific locations based on topography, soil thickness, and drainage conditions.

Issues, Conflicts, and Areas of Concern	Impacts of No Action/No Change	Short-term Options Long-term Recommendations
ISSUE SIX **Pollution Risks: Pollution Associated with the Marine Industry** Most major marinas in Virgin Gorda do not have pump-out systems to service vessels using their facilities. The increase in charter vessel activity in the North Sound, St. Thomas Bay, and other popular bays in Virgin Gorda has contributed to deteriorating water quality as boaters—with no options available at local marinas—continue to use territorial waters to dispose of vessel wastes. The issue is exacerbated because charter vessels entering BVI waters are not required to be equipped with holding tanks for wastes.	Without a change in Government policies and requisite resource user behaviour, the following actions—in combination with the poor flushing capacity of many of the island's most visited bays—will continue to contribute to deteriorating water quality and mounting negative impacts on Virgin Gorda's coastal and marine ecosystems: • The lack of pump-out systems at most Virgin Gorda marinas. • No regulations regarding waste discharge by vessels in BVI waters. • Increased boating activity and crowding at the most popular of Virgin Gorda's marine recreational sites and harbours.	**SHORT-TERM OPTIONS** 1. Marine industry-funded efforts in collaboration with the BVI Government—such as the BVI Marine Awareness Guides (Gore, 2008, 2011)—have been extremely useful in educating visiting boaters about practices that minimise marine pollution. Such efforts need to be encouraged and expanded by both the public and private sectors of Virgin Gorda. 2. Collaboration between the marine industry and the BVI Tourist Board also needs to be encouraged and strengthened, particularly as each sector is desirous of promoting environmentally friendly attitudes and practices by visiting and local yachters. **LONG-TERM RECOMMENDATIONS** 1. As indicated in Issue Five above, the BVI needs a major overhaul 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 BVI Government in the near term: **(a)** A comprehensive water quality monitoring protocol for the coastal waters of Virgin Gorda needs to be developed and approved, including implementation of a uniform and ongoing water quality monitoring programme for Virgin Gorda embayments with high visitation. **(b)** As part of a broader review and updating of pollution legislation, regulations need to be drafted and enacted requiring major marinas to be equipped with pump-out and waste treatment systems, or to have a means to dispose of waste at an offsite facility. **(c)** Guidelines need to be established and put in place at major boatyards and haul-out facilities for the proper storage and disposal of hydrocarbon and other toxic wastes. **(d)** BVI public policy needs to aggressively discourage the discharge of wastes in the nearshore environment and critical marine habitats. Areas of "no discharge" should be designated by the Government.

Issues, Conflicts, and Areas of Concern	Impacts of No Action/No Change	Short-term Options Long-term Recommendations
ISSUE SEVEN **Pollution Risks: Erosion and Sediment Runoff** Water quality degradation from erosion and sediment runoff—associated with land clearing for residential, commercial, and road construction—remains an ongoing issue for Virgin Gorda. The problem has been exacerbated on Virgin Gorda (for *both* public and private sector projects) when environmental guidelines and BMPs have not been identified at the outset of development activities (glaring examples are the Leverick Bay public road and the Government's greenhouse project at South Sound). BMPs need to be identified with submission of an Environmental Impact Assessment as well as the Environmental Monitoring Plan and Protocol.	Every phase of a construction project that leaves soils unprotected can result in large quantities of sediment being transported off-site, into ghuts or down slope, ultimately reaching coastal waters. Eroding dirt roads and hastily cleared construction sites are a major cause of sediment runoff and the resulting deterioration of water quality and marine ecosystems.	**SHORT-TERM OPTIONS** 1. The Government of the British Virgin Islands needs to adopt erosion and sediment control guidelines that best reflect the natural environment and terrain conditions of the Territory, including the island of Virgin Gorda. Guidelines for the BVI could draw guidance from existing procedures and documentation already in use in the US Virgin Islands (UVI, 2002, a/b), and as recommended by the UNEP for the Insular Caribbean (Anderson, 1994). 2. The Department of Conservation and Fisheries could create a more intensive public awareness and education programme for individual land holders, the construction industry, and developers focusing on the negative impacts of improper land clearing and construction practices and encouraging the broader application of BMPs for new construction (such as are currently being employed for the development project on Mosquito Island). Since the abandonment of Island Erosion (a collaboration of environmentalists, building contractors, architects, engineers, and others), there has been no concerted effort to promote BMPs in construction in the BVI, and the DCF should take the lead in this, in cooperation with the private sector. **LONG-TERM RECOMMENDATIONS** 1. The Department of Town and Country Planning should require that erosion and sediment control BMPs are addressed in all EIAs associated with land clearing and road construction, including earth-movement actions initiated by Government. 2. Likewise, the DTCP should require and enforce the application of erosion and sediment control BMPs in the environmental monitoring and compliance process for all major development projects in the BVI.

8. PROTECTED AREAS AND RESOURCE CONSERVATION

Sustainable development, however defined, is primarily about attaining a fine balance between the development of a people and the integrity of the systems and natural resources that support that development. The economy of Virgin Gorda epitomises the link between environment and development and the pursuit to achieve that balance. Natural and heritage resources form the foundation of the main economic sector (tourism). However, the areas of greatest resource use for tourism contain some of the most fragile resources, and thus require higher levels of management intervention.

The attempt to achieve a balance between optimal resource use and maintenance of resource integrity on Virgin Gorda is dependent on the establishment of a resource conservation strategy that has at its heart the management of the island's protected areas.

8.1 Management Framework for BVI Protected Areas

The globally accepted definition of a 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)*.

The BVI's National Parks Act (2006) defines protected area as "*a park or other protected area established under this Act*".

Protected areas in the British Virgin Islands have been declared under:

- the Protection of Trees and Conservation of Soil and Water Ordinance (Cap 86, 1954),
- the Wild Birds Protection Ordinance (Cap. 98),
- the National Parks Ordinance (1961),
- the Marine Parks and the Protected Areas Ordinance (1979), and
- the Fisheries Act (1997).

The National Parks Ordinance (1961) also contained provisions for the establishment of the National Parks Trust (NPT). The National Parks Ordinance and the Marine Parks and the Protected Areas Ordinance were repealed and replaced by the National Parks Act (2006). These laws provide the basis for the establishment of 13 categories of protected areas in the BVI (**Table 32**). The National Parks Act (2006) also mandated the preparation of a protected areas system plan.

Environmental protection areas can also be established under the Physical Planning Act (2004). This legal framework falls within the management purview of several agencies and ministries (see Chapter 2, Section 2.1.3).

The British Virgin Islands Protected Areas System Plan 2007-2017 provides the policy framework for the development and management of protected areas in the BVI. The System Plan includes:

- A statement of the goals for the system of protected areas;
- An articulation of the institutional arrangements to be established for protected areas management;
- An articulation of the support systems needed for system development and management during the 10-year period;
- A clear statement of priorities in protected areas management for the 10-year period; and
- A process for evaluating progress in protected areas system development over the first five years.

The overall goal for the protected areas system plan for the period 2007-2017 is "*to manage important natural and historical resources in ways that will contribute to an improvement of the quality of life of BVI residents*".

* The British Virgin Islands Protected Areas System Plan 2007-2017 contains the earlier definition of a protected area, which was published by IUCN in 1994.

The associated specific objectives are to:

(a) Maintain vital natural areas that are:

Important to the productivity of commercial species and other valuable wildlife;

- **i.** Essential to the protection of endangered species, such as turtles, and to the life patterns of other critical species, such as seabirds; and
- **ii.** Important to retaining representativeness and diversity of the Territory's natural heritage.

(b) Maintain areas that are physiographically, geologically or otherwise aesthetically unique as sources of attraction, recreation, education and research.

(c) Maintain and utilize historical resources, such as wrecks, for recreation and study.

(d) Maintain, where possible, economic uses such as fishing and tourism under the guidance of proper resource management.

(e) Provide for the continued growth of economic and recreational opportunities in a manner that can be sustained by available resources.

(f) Encourage public understanding and enjoyment of the resources contained within protected areas.

Table 32.
Categories of protected areas in the British Virgin Islands.

Legal Instrument	Category of Protected Area	IUCN Equivalent
National Parks Act, 2006	Strict Nature Reserve	Category Ia: Strict Nature Reserve
	Wilderness Area	Category Ib: Wilderness Area
	National Park	Category II: National Park
	Natural Monument	Category III: Natural Monument or Feature
	Habitat or Species Management Area	Category IV: Habitat/Species Management Area
	Protected Landscape or Seascape	Category V: Protected Landscape/Seascape
	Managed Resource Area	Category VI: Protected Area with sustainable use of natural resources
	Urban Park	none
	Historic Site	none
Fisheries Act, 1997	Fisheries Protected Area	Category IV: Habitat/Species Management Area
Wild Birds Protection Ordinance, Cap. 98	Bird Sanctuary	Category IV: Habitat/Species Management Area
Protection of Trees and Conservation of Soil and Water Ordinance, Cap. 86	Forest Reserve	Category IV: Habitat/Species Management Area
	Water Area	Category VI: Protected Area with sustainable use of natural resources

Source: Adapted from Gardner, *et al*., 2008.

8.2 Existing Protected Areas on Virgin Gorda

There are eight existing protected areas on Virgin Gorda, and three on adjacent cays (**Table 33** and **Figure 25**).

These eleven sites include two fisheries protected areas (under the jurisdiction of the Department of Conservation and Fisheries) and nine national parks (under the jurisdiction of the National Parks Trust).

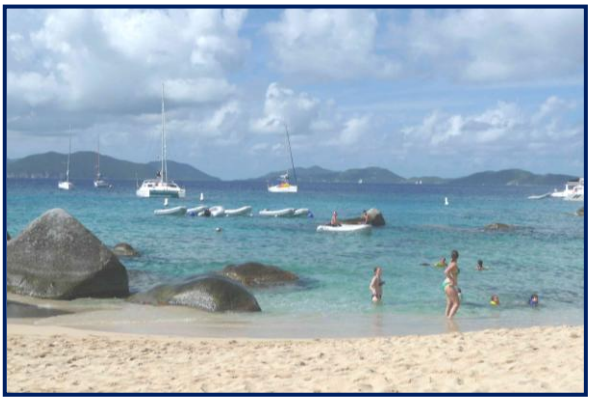


Photo 130.
The Baths National Park.

Table 33.
Existing protected areas of Virgin Gorda and environs.

Name of Site	Date Declared	Size ha. (acres)	Management Institution
Copper Mine National Park	2003	7.3 (18.36)	National Parks Trust
Devil's Bay National Park	1964	23.2 (58)	National Parks Trust
Fallen Jerusalem National Park	1974	19.2 (48)	National Parks Trust
Gorda Peak National Park	1974	104 (260)	National Parks Trust
Little Fort National Park	1978	14.4 (36)	National Parks Trust
Prickly Pear National Park	1988	72 (180)	National Parks Trust
Spring Bay National Park	1964	2.2 (5.5)	National Parks Trust
The Baths National Park	1990	2.8 (7)	National Parks Trust
West Dog National Park	1974	9.6 (24)	National Parks Trust
South Sound Fisheries Protected Area	2003❁	125.1(312.8)	Department of Conservation and Fisheries
Taylor Bay Fisheries Protected Area	2003❁	259.2 (647.9)	Department of Conservation and Fisheries

Prickly Pear, West Dog and Fallen Jerusalem were previously declared as Bird Sanctuaries in 1959 (Bird Sanctuaries Order [S.R.O. 20/1959]).

❁ The Virgin Islands Court of Appeal, in the case of Quorum Island (BVI) Limited vs. the Virgin Islands Environmental Council and the Minister of Planning (HCVAP2009/021), found that protected areas declared under the Fisheries Regulations 2003 were not validly declared, as the correct section of the Fisheries Act was not used as the authority for the Regulations. The Fisheries Regulations 2003 are currently being revised to ensure the validity of declaration of the Fisheries Protected Areas.

Source: Adapted from Gardner, *et al.*, 2008.

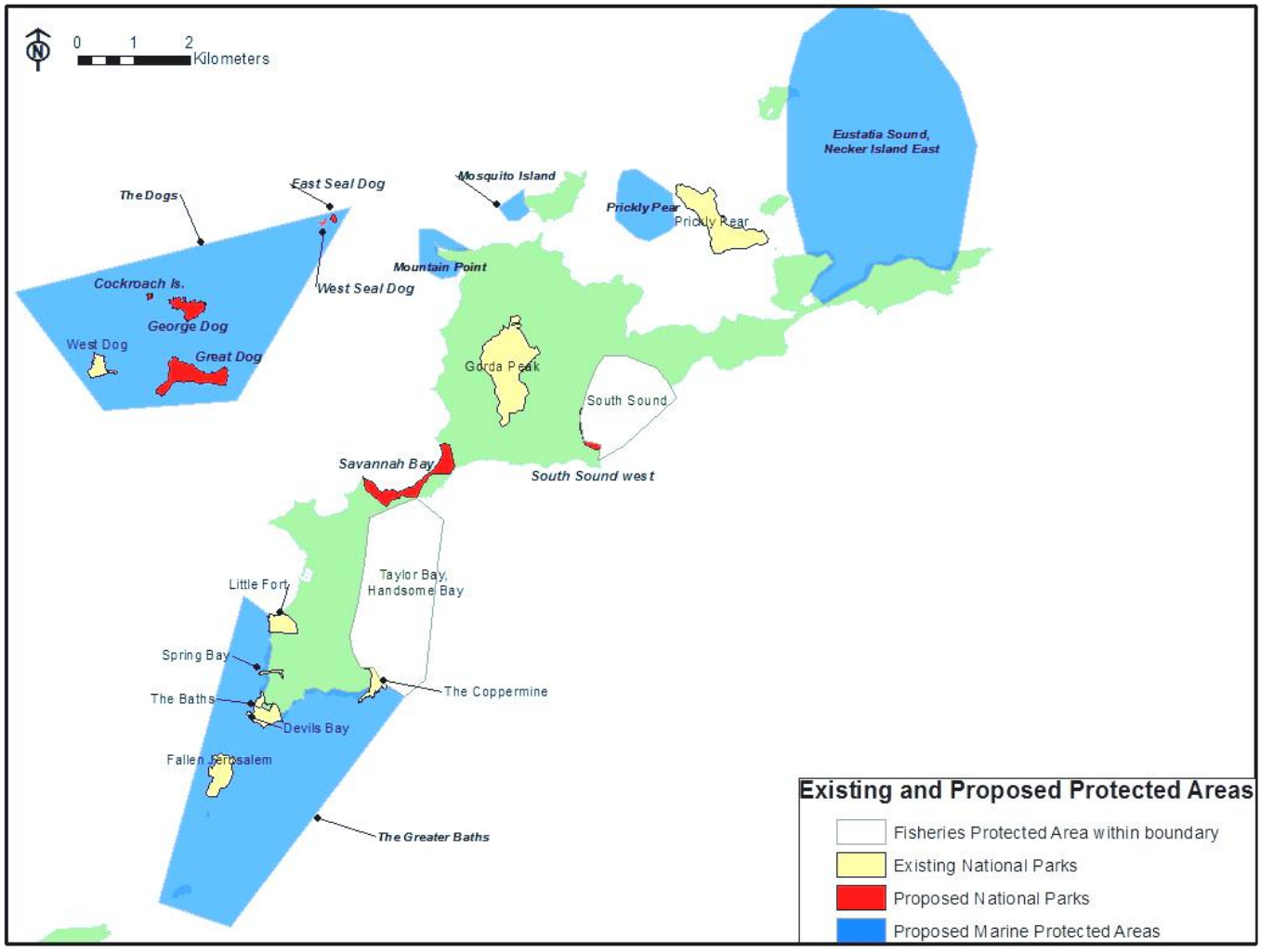


Figure 25.
Existing and Proposed Protected Areas for Virgin Gorda and Environs.

8.2.1 Overview of Protected Areas on Virgin Gorda

8.2.1.1 Status of the Resources

Quantitative information on the status of the natural resources in the protected areas is generally lacking. Resource assessments within the national parks are usually conducted by the National Parks Trust, but focus on reporting the absence or presence of particular species.

Assessments by stakeholders are also qualitative, based on stakeholder perceptions of change in particular resources. Gorda Peak National Park is considered by stakeholders to be relatively "pristine" and unchanged over time. All other national parks are considered to be experiencing resource degradation, primarily from overuse or inappropriate use of some sites (**Table 34**).

Table 34.
Stakeholder perceptions of protected area resources, Virgin Gorda.

Protected Area	Status of Resources as Provided in Stakeholder Interviews
Copper Mine National Park	Resources are being degraded by removal of bricks and from surface runoff. Vegetation in the area is changing, most notably the loss of the Pope cactus. Additional interpretative and safety signs are needed.
Devil's Bay National Park (**Photo 131**)	No opinion stated by stakeholders.
Fallen Jerusalem National Park	No opinion stated by stakeholders.
Gorda Peak National Park (**Photo 132**)	Site is fairly undisturbed. Restroom and picnic tables available. Additional interpretative and safety signs are necessary.
Little Fort National Park	Attractive vista. Trail overgrown, making landward access currently unavailable. The property is being degraded due to lack of maintenance. Significant damage to reefs off Fort Point.
Prickly Pear National Park (**Photo 133**)	Restroom and restaurant available. Vegetation is being degraded by feral goats. Safety signs are needed.
Spring Bay National Park (**Photo 134**)	Runoff from major rainfall events erodes the trail, and the discharge from the ghut breaches the sand berm. The displaced sand is usually replenished over time. Restroom facilities are lacking. Picnic tables are available. Additional signs are needed.
The Baths National Park	Sand is darker and trail is eroding. Lifeguards and more interpretive signs are needed. Restroom facilities inadequate for volume of visitors. Decrease noted in abundance of Ground Dove, Turtle Dove, thrushes, Black Wick, and ground lizards. Capacity of site occasionally exceeded, resulting in shoving and excess noise.
South Sound Fisheries Protected Area	Damage to reefs from poor fishing practices. Water quality deterioration resulting from sedimentation from housing construction in area. The site is the main breeding ground around Virgin Gorda for jack, but few were observed during the 2011 season.
Taylor Bay Fisheries Protected Area	Damage to reefs from poor fishing practices.
Dive Sites (**Figure 26**)	The number of moorings is inadequate, resulting in anchor damage to reefs and seagrass beds. Sewage from boats degrades water quality and amenity value of sites. Siltation from road cuts and other construction activities reduces quality of water and impacts negatively on reefs. Fish abundance has increased within the past 10 years, and Nassau Grouper and sharks are now routinely observed. Some reefs are showing signs of recovery following the 2005 bleaching event. New colonies of staghorn, elkhorn, and star corals are found at Maho Bay, Savannah Bay, Mango Bay, The Baths, and Spring Bay. New colonies are typically found in areas with strong currents.

Source: Compiled from interviews held on Virgin Gorda, 23-25 November 2011.

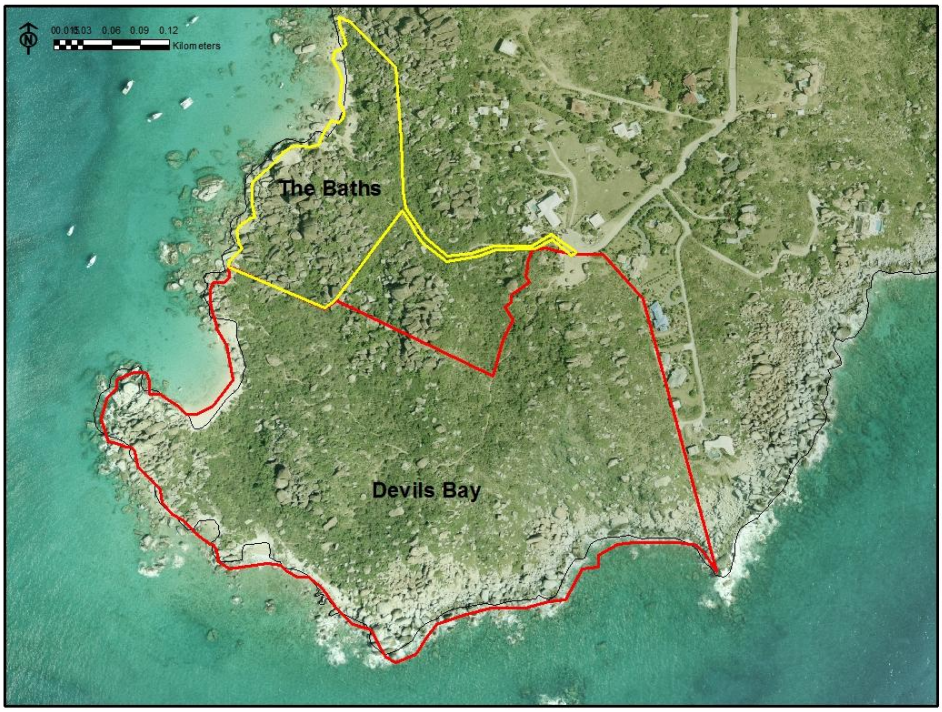


Photo 131.
Arial view of Devil's Bay National Park and The Baths National Park, Virgin Gorda
(Park boundaries provided by National Parks Trust).

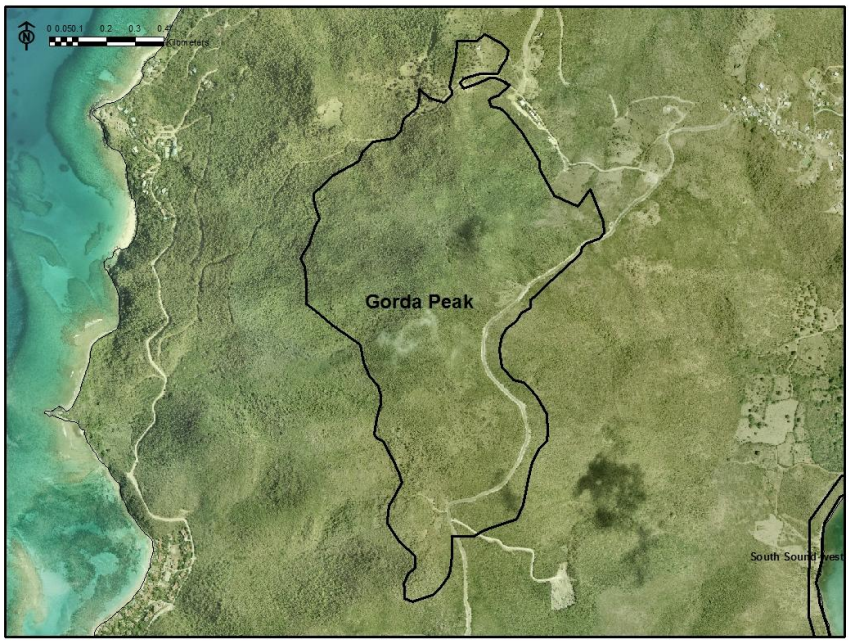


Photo 132.
Aerial view of Gorda Peak National Park
(Park boundaries provided by National Parks Trust).

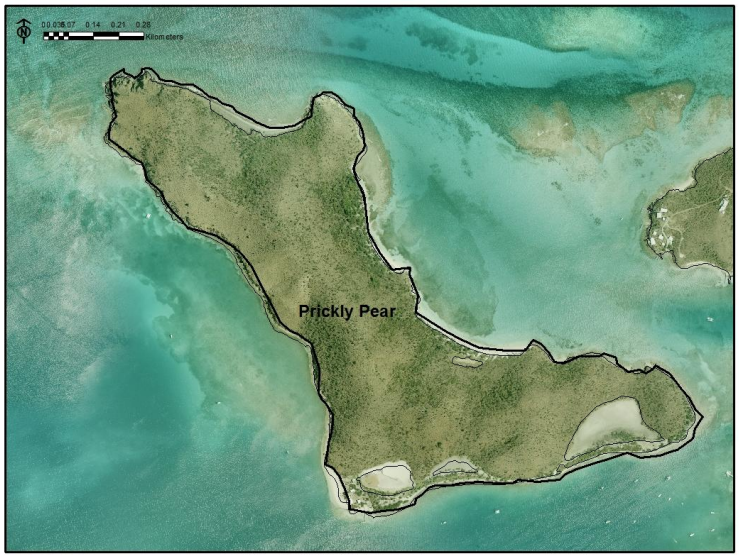


Photo 133.
Aerial view of Prickly Pear National Park
(Park boundaries provided by National Parks Trust).

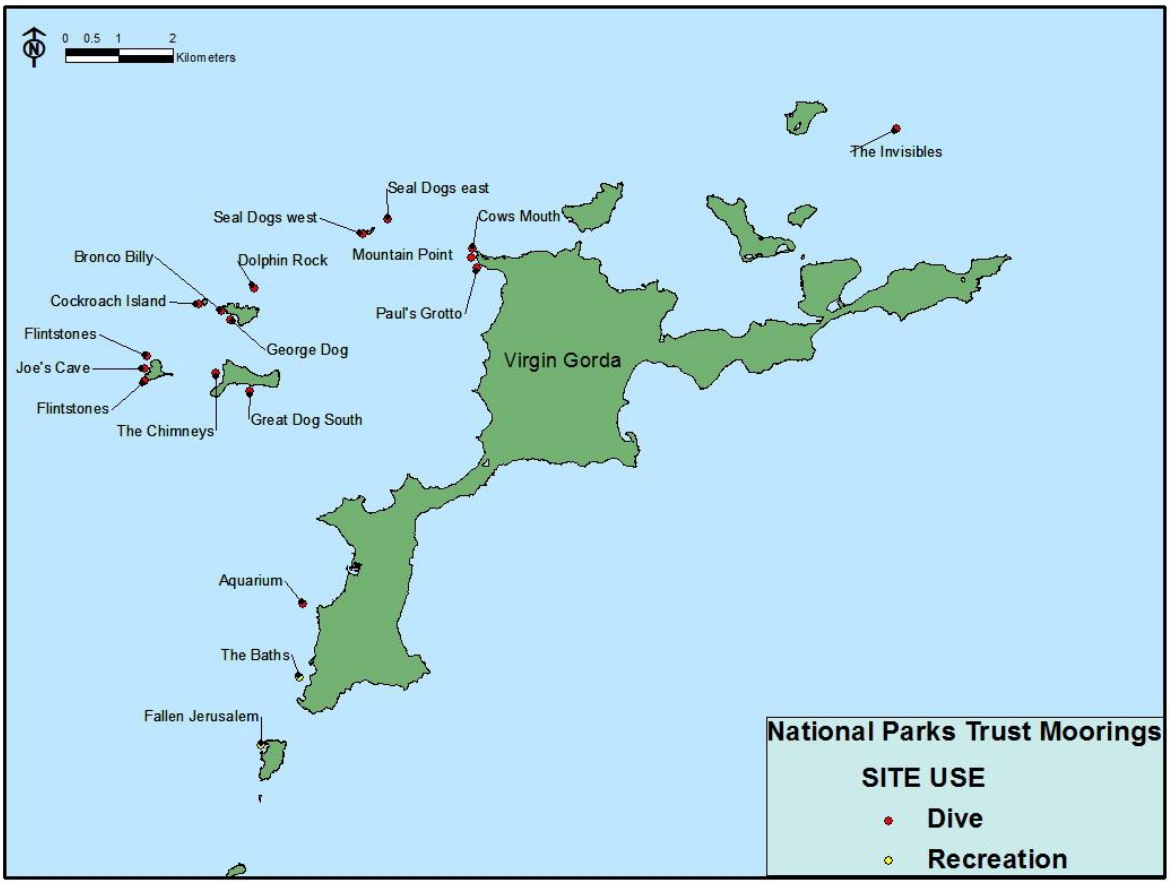


Figure 26.
NPT moorings at dive and recreation sites, Virgin Gorda and environs.

The BVI Protected Areas System Plan 2007-2017 (www.bvinationalparkstrust.org/downloads/NPT_Protected-Area-System-Plan-2008.pdf) identifies the stressors and challenges faced by the national parks. More detailed information on threats to marine and coastal resources within the Greater Baths Management Unit was generated as part of a 2007 management planning exercise.

However, detailed surveys and analyses are needed for determining the resource status in the other existing and proposed protected areas. Gorda Peak National Park is an example of the need for standardised assessments. The Protected Areas System Plan indicates that the site faces challenges from invasive species and harvesting of plants by persons visiting the site; yet public perception is that the site remains relatively undisturbed.

While many of the threats to protected area resources are chronic, two sources of threats have been increasing in impact and size. These are (i) sedimentation in surface runoff resulting from excavation of roads or building sites, and (ii) discharge of sewage to ghuts by waste haulage contractors (*pers. comm*., stakeholder consultations on Virgin Gorda, 23-25 November 2011).

The need for resource assessments, a monitoring and research programme, and periodic reporting is addressed in the Protected Areas System Plan. The regulatory framework currently empowers the National Parks Trust to address pollution in marine protected areas. That authority is provided by Section 48 of the National Parks Regulations (2008), which addresses discharge of "*harmful substances or things*" adjacent to marine parks.

8.2.1.2 Resource Use and Demand in Virgin Gorda's Protected Areas

The main economic sector on Virgin Gorda is tourism, which in turn is based primarily on resources contained within protected areas. To underscore this point, The Baths is the primary environmental feature used in tourism promotions for the British Virgin Islands and is probably its most internationally recognised symbol.

In the past decade, tourist arrivals have increased from 535,111 in 2001 to 842,497 in 2010, peaking at 948,425 in 2007 (www.dpu.gov.vg). However, it is unclear what proportion of tourists visit national parks. Under the National Parks Regulations (2008), entry fees to national parks can only be charged for The Baths and Devil's Bay on Virgin Gorda. As with tourism data in general, there is no compilation of data on the number of visitors to the two parks, and there is little information on the pattern of use in other protected areas on Virgin Gorda by visitors or residents.

The general consensus among public sector managers and stakeholders in Virgin Gorda is that The Baths and Spring Bay National Parks are overcrowded, and that visitors should be encouraged to use other national parks and amenity areas. It is also agreed that increased use of other national parks will require the development of appropriate infrastructure at those sites, particularly restrooms.

8.2.2 Management of Virgin Gorda's Protected Areas

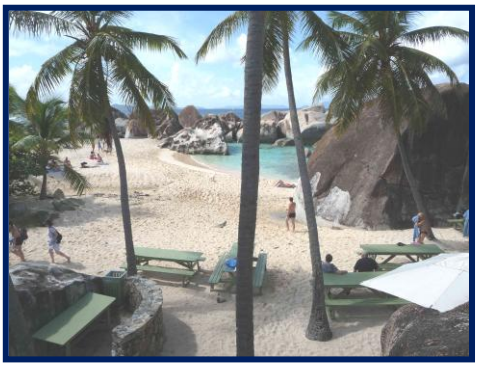


Photo 134.
Spring Bay National Park.

Protected areas in the British Virgin Islands are managed by three different institutions, with several other public and civil society institutions playing supporting roles (see Chapter 2, Section 2.1.3). On Virgin Gorda, the National Parks Trust is engaged in site management operations mainly at The Baths National Park, though maintenance activities are routinely carried out at all the national parks, with the exception of Fort Point National Park. Stabilisation of the Copper Mine ruins takes place as external funding and technical assistance

are obtained, and some infrastructure work (such as drainage) is carried out by other public agencies.

The NPT approach to the preparation of management plans for protected areas is to either prepare a plan for a single site or to cluster sites into a larger management unit, the latter approach based on ecosystem considerations (NPT, 2006). Management planning for the Greater Baths Management Unit (which incorporates The Baths, Devil's Bay, Spring Bay, and Fallen Jerusalem) was carried out in 2007, and a draft management plan was prepared in 2008.

The NPT also manages a Reef Protection Programme to install and maintain a system of mooring buoys within protected areas and at dive sites. The objective of the programme is to protect coral reefs from anchor damage. As such, the moorings are for day-time recreational uses only (snorkeling and diving) (*www.bvinationalparkstrust.org*).

The two institutions with protected area management responsibilities on Virgin Gorda—the National Parks Trust and the Department of Conservation and Fisheries—have limited capacity to undertake the full range of interventions necessary to adequately manage the sites. That limited capacity is primarily a result of not having adequate financial resources. The establishment of a stable source of financing for protected areas management is identified as a priority activity in the Protected Areas System Plan. A number of initiatives are currently being undertaken by the National Parks Trust to increase funds for site operations (*pers. comm*., Joseph Smith Abbott, Director, National Parks Trust, interview with Lloyd Gardner, 27 October 2011).

In addition to the efforts of the primary management institutions, other institutions from the public, private, and civil society sectors also contribute to the development and operations of protected areas on Virgin Gorda (NPT, 2009). Opportunities for additional collaborative arrangements (in infrastructure development, surveillance, and monitoring) have been identified by a number of stakeholders (*pers. comm*., stakeholder interviews, 22-25 November 2011).

8.3 Proposed Parks and Protected Areas for Virgin Gorda

The designation of additional protected areas for Virgin Gorda (**Figure 25** and **Table 35** is the result of a 2005-2007 assessment of marine and coastal areas. Proposed sites were vetted by the community during the process to prepare the Protected Areas System Plan, and their inclusion in the approved System Plan indicates public policy approval for site designation and development.

Interviews with public agencies, private firms, and civil society organisations identified selected resources and features/sites that should be included in the BVI's system of protected areas, or at a minimum, be accorded special conservation status (**Table 36**).

8.4 Protected Areas and Development Planning

8.4.1 The BVI's Development Planning Process

Economic planning in the British Virgin Islands is usually conducted by the Ministry of Finance, based on the four-year development strategy adopted by a sitting administration. That development strategy in turn is a translation of the election Manifesto of the ruling party.

The BVI Government prepared a national integrated development plan in 1999, the purpose of which was "… *to establish the broad strategies, policies, and the implementation framework to promote integrated development* (DPU, 1999, page 4).

Table 35.
Areas of Virgin Gorda proposed for protected area status.

Name of Site	Resources Included	Proposed Category
Broken Jerusalem	Terrestrial and marine resources	National Park
Greater Baths Management Unit	Integration of existing protected areas and adjacent marine resources into a single management unit	Protected Landscape/Seascape
Mountain Point	Marine	Marine Park
Round Rock	Terrestrial	Habitat Management Area
Savannah Bay	Terrestrial and marine resources	Protected Landscape/Seascape
South Sound	Expansion of existing fisheries protected area	Marine Park
South Sound West	Terrestrial	Habitat Management Area
Taylor's Bay/Handsome Bay	Expansion of existing fisheries protected area	Protected Landscape/Seascape
The Dogs	Declaration of the remaining Dogs and Cockroach Island as protected areas, and incorporating the marine space as a single marine protected area	Marine Protected Area

Source: Gardner, *et al*., 2008.

That National Integrated Development Plan (NIDP) was not formally adopted as the national development plan for the BVI. However, each ministry and department was responsible for translating the development goals identified in the plan to sector development strategies and plans (*pers. comm*., Raymond Phillips, Director, Development Planning Unit, interview with Lloyd Gardner, 7 December 2011).

One of the objectives of the NIDP was to ensure greater integration between land use/land development, overall physical development (*e.g*., social infrastructure and transportation), and economic planning. The National Physical Development Plan (2006) sets the overall framework for land use planning and development control, but there is inadequate correlation with overall development planning for the Territory (*pers. comm*., Ronald Beard, Deputy Director, Department of Town and Country Planning, and Raymond Phillips, Director, Development Planning Unit, interviews with Lloyd Gardner, November-December 2011).

8.4.1.1 Development Planning for Virgin Gorda

The National Physical Development Plan (2006) is used as the framework to prepare area development plans, which in turn guide the development control process. The current land use plan for Virgin Gorda (**Figure 27**) is outdated, and is generally considered to be inaccurate. The preparation of area development plans for Virgin Gorda has been accorded a medium priority in the biennial work plan of the Department of Town and Country Planning, and the proposed area development plan will focus only on Spanish Town/The Valley (*pers. comm*., Ronald Beard, Deputy Director, DTCP, interview with Lloyd Gardner on 25 November 2011).

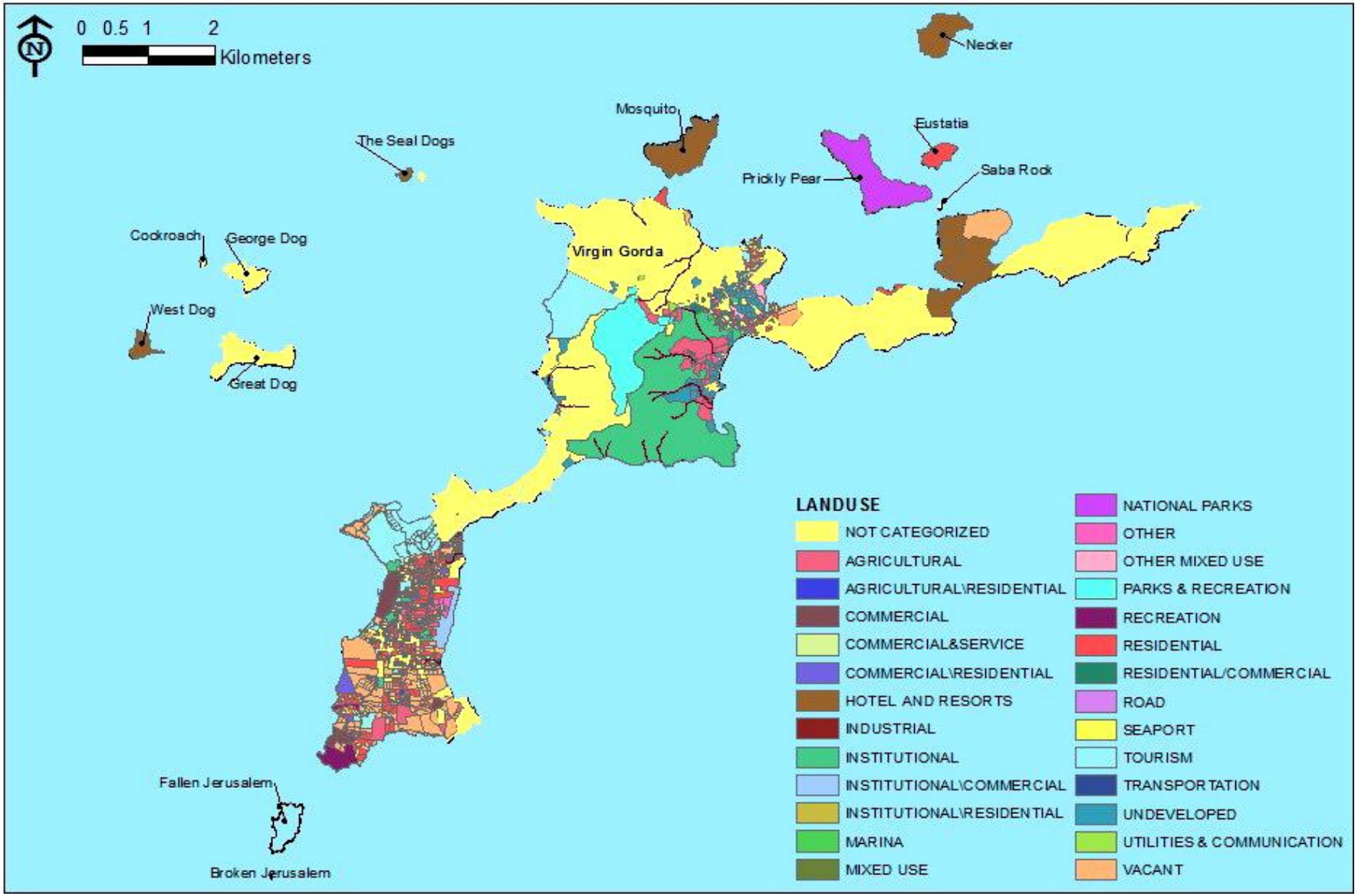


Figure 27.
Land use, Virgin Gorda, British Virgin Islands (source: Department of Town and Country Planning, Government of the BVI).

Table 36.
Outstanding features of Virgin Gorda to be considered for special protection.*

Feature/Location	Rationale for Protection
All wetlands, including major ghuts	Both features are necessary for mitigating coastal vulnerability and flooding.
Beaches and sand dunes	Important nesting areas for sea turtles and birds; important physical feature for mitigating coastal vulnerability.
Hill tops	Protection of remnants of forests, reduction of soil erosion, and reduction of potential flooding of low-lying areas.
Coastal strip from Devil's Bay to Fort Point	The beaches of Big Trunk Bay and Little Trunk Bay are beautiful and their protection would relieve use pressure on Spring Bay. A trail would have to be established for linking the sites. The boulders are culturally/historically significant. They were called Washing Rocks because the water collected in the holes in the boulders was used by the community for washing clothes. Some of the boulders were also used for storage purposes.
Historical Resources at Nail Bay	The ruins of sugar works at Nail Bay (Nail Bay I and Nail Bay II) are detailed in Chapter 6, Sections 1.1.1 and 1.1.2. Both are situated on private property. Other than the Copper Mine, the Nail Bay I sugar works are the most visited historic site on Virgin Gorda (on the grounds of the Nail Bay Resort).
St. Thomas Bay Cemetery	One of the oldest burial grounds on Virgin Gorda (see Chapter 6, Section 6.3.1).
St. Thomas Bay /Fishers Cove	The pond is close to Little Fort and supports a significant amount of wildlife species
Crooks Bay	Possible historical significance. Name reportedly resulted from the site being used to smuggle contraband.
Fringing Mangrove Forest along Deep Bay and Oil Nut Bay	The largest continuous wetland area on Virgin Gorda, comprising fringing mangroves and shallow seagrass beds (see Figure 17 in Chapter 4). Site at risk of destruction due to development at Oil Nut Bay.
Eustatia Sound	The coral reefs in this area contain recovering stands of *Acropora spp*. coral. The reef system is used for diving and snorkeling and suffers from anchor damage.

Source: Compiled from stakeholder interviews (October-December 2011) and IRF marine stakeholders meeting (8 February 2012).

* The reader is also referred to Chapter 9, Section 9.2.2 for further discussion of areas of special concern.

Environmental planning is currently integrated into the physical planning process in two ways:

(1) By the designation of conservation areas by the Department of Conservation and Fisheries and the National Parks Trust, and the incorporation of such designated areas into land use and development plans; and

(2) By requiring environmental impact assessments (EIAs) for certain types of developments, particularly adjacent to protected areas.

Photo 135.
Signage at trail to Gorda Peak National Park.

There is currently no plan to utilise the environmental protection area (EPA) provisions of the Physical Planning Act (2004), and, if used, these would be applied primarily during the processing of individual development applications (*pers. comm*., Ronald Beard, Deputy Director, DTCP, interview with Lloyd Gardner, 25 November 2011).

New approaches to conservation planning currently used by the Department of Town and Country Planning are: (i) requiring hazard vulnerability assessments for developments, and (ii) proposing the establishment of buffer zones around protected areas. The buffer zone approach is being applied for the first time during preparation of the Carrot Bay (Tortola) Development Plan (*pers. comm*., Ronald Beard and Dylan Penn, DTCP, interview with Lloyd Gardner, 25 November 2011).

The continuing clearance of land up to the boundaries of national parks makes clear the need for buffer zones around national parks. During the course of conducting flora assessments around Gorda Peak in 2011, scientists from the Royal Botanical Gardens Kew identified many areas surrounding the park that had been deforested, or were at risk of being cleared, which had once contained populations of endangered or threatened species (*pers. comm*., Nancy Woodfield-Pascoe, National Parks Trust, 12 January 2012). Species lost from such areas, or at risk, include: *Calyptranthes thomasianum*, *Machaonia woodburyana*, and *Zanthoxylum thomasianum* (BVI endemics).

The two main economic drivers in the BVI are the financial services sector and tourism. Tourism requires significant land for development, but also relies to a significant degree on the quality of the natural resources. The National Tourism Development Strategy (Coopers & Lybrand, 1996) not only identifies Virgin Gorda as the primary tourism destination in the BVI, but also identifies the need for comprehensive development planning to ensure sustainable tourism development. The development pressure on Virgin Gorda has intensified due to increased demand for residences and tourism facilities.

The proposed establishment of new protected areas, the need to promulgate regulations to address threats to protected areas from adjacent activities, increased housing density on slopes, expanding tourism development, and the emerging threat of climate change, all underscore the need for a new development plan for Virgin Gorda.

Subdivision of land for residential purposes is occurring on steeper slopes, and the increased number of marinas, docks, and anchorages, particularly for mega-yachts, has increased the threats to coastal and marine resources.

8.4.2 Tourism Planning and Protected Areas

Data provided by the Caribbean Tourism Organisation indicate that in 2009 there were 2,353 tourist rooms in the BVI, comprising hotel rooms and rooms at guest houses and apartments (www.onecaribbean.org/statistics/countrystats/). There is no data on the dispersion of tourist rooms across the BVI. However, the BVI's National Tourism Development Strategy (1996-2005) confirms that Virgin Gorda is the primary tourist destination in the BVI. The broad policy objective articulated in the tourism strategy clearly shows the intention of the government at the time to make the environment the basis of the tourism product. The broad policy objective reads:

> *To be a quality nature-based tourist destination retaining and showcasing the enduring values, heritage and culture of the BVI; in an industry which is strategically managed, guided by the principles of sustainability, for the enjoyment and benefit of the population of the British Virgin Islands* (Coopers & Lybrand, 1996).

The implementation of the strategy is based on five strategic elements, one of which is the environment. The stated policy is to develop and manage the tourism industry in harmony with the physical environment, guided by its carrying capacity. This environmental strategy focuses on development of attractions, protection of environmental quality, enhancement of visitor experience, and development of a sustainable environmental resource base.

The strategy for development of tourism products was based on four development zones, one of which would be Virgin Gorda. The product strategy for Virgin Gorda was to follow a comprehensive plan for the island, which would "… *address heritage, social and environmental protection and enhancement, park space dedication, resource management and infrastructure and land development*" (pages 5-30).

The Virgin Gorda tourism development plan called for in the National Tourism Strategy has not been prepared, but the Tourist Board conducts annual stakeholder consultations to inform its annual work plan. In addition to working with other agencies to address specific issues, the Tourist Board implements a sustainable tourism programme. That programme includes promoting national parks and resource conservation. In November 2011, the Tourist Board launched its Sustainable Tourism Environmental Programme (STEP) project. The project, which is the first phase of a Green Tourism Initiative, focuses on assisting four properties to obtain international environmental certification.

The Protected Areas System Plan 2007-2017 identifies the need for a more structured relationship between tourism development and protected areas management. The Tourist Board supports a more structured approach, and the revision of the National Tourism Development Strategy in 2012 presents an opportunity for design of appropriate institutional arrangements (*pers. comm*., Hadassah Ward, Director, Tourist Board, interview with Lloyd Gardner, 7 December 2011).

8.4.3 Environmental Management Framework

The preparation of a National Environmental Action Plan (NEAP) in 2004 was an attempt to rationalise the environmental management framework for the Territory. The NEAP was not approved, but a number of its recommendations (such as the need for reform of the institutional arrangements for environmental management) were given further attention. In 2008 a report from the BVI's Law Reform Commission, titled *Environmental Management and Conservation of Biodiversity Reform*, was

submitted to Cabinet (see also Section 2.1.4.5). The report addresses matters such as proposed conservation laws, amendments to existing laws, and the establishment of an Environmental Management Trust (*pers. comm*., Ray Harris, Chairman, Law Reform Commission, interview with Rosemary Delaney-Smith, 28 November 2011).

Similarly, attempts to develop thematic conservation plans, such as the Wetland Management Plan (DTCP, 2006), did not result in approved national conservation plans.

The National Parks Trust notes that it prepares an annual report, employs programme coordinators, and currently has a senior warden on Virgin Gorda. The NPT also prepared a Public Awareness Strategy and a Strategy for Management of Tourism and Recreation in Protected Areas. Both strategies were produced in 2001 and have not been updated, while interviews with stakeholders for preparation of the Environmental Profile seem to underscore the need for a revised public engagement strategy by the NPT.

Environmental management is therefore driven by institutional mandates, rather than a national plan. In that context, there is no conservation plan specifically for Virgin Gorda. At the same time, stakeholders involved in the tourism industry on Virgin Gorda are requesting a more detailed focus on the conservation issues relevant to the island.

> *We need more interaction and synergy with the agencies on the different islands. Virgin Gorda is the jewel that brings much of the tourists to the Virgin Islands, but we are not involved in decision making for the parks. Different groups could support infrastructure development in the parks, but we need site development plans, a regular State of the Parks Report, and a Virgin Gorda Coordinator within the National Parks Trust* (pers. comm., Sharon Flax-Mars, Rosewood Little Dix Bay Resort, and Tracey Flax, Virgin Gorda Green Team, interview with Lloyd Gardner, 24 November 2011).

The landscape on Virgin Gorda has been altered by activities such as grazing, clearance, and agriculture. Development pressure on land alters not only the terrestrial landscape, but is increasingly affecting marine ecosystems. Additionally, it is anticipated that increased variability in weather, frequency of severe storms, and sea level rise—all associated with global climate change—will result in changes to ecosystems. Protected areas therefore play an important role in preserving populations of species that may be threatened from this variety of threats, as reflected in the following statement from a senior staff member at the National Parks Trust:

> *Over the years places like Gorda Peak and [other] parks seem to hold small populations of species not found elsewhere—with surprises still—like when we found* Acacia anegadensis *on Fallen Jerusalem in 2008, previously thought to be an Anegada endemic* (pers. comm., Nancy Woodfield-Pascoe, National Parks Trust, 12 January 2012).

8.5 Challenges and Opportunities

The development of a comprehensive resource conservation framework for Virgin Gorda, including the development of protected areas, currently faces a number of challenges. Some of those challenges are inherent to current management frameworks (policy, legal, and institutional), some are based on prevailing socio-political dynamics, and others emanate from external sources.

8.5.1 Management Challenges

Challenges that are inherent to the current policy, legal, and institutional frameworks for resource conservation in the BVI are detailed in the enumerated sub-sections that follow.

(1) Strengthen the Territory's Environmental Management Framework

The current framework for development planning in the BVI does not place protected areas and

resource conservation within a cohesive development strategy. Despite the articulation of the interdependence of development and quality of the natural resource base, the development planning process makes the practice of environmental management secondary to economic and social development considerations.

The scope of the pending legislative initiative to create an Environmental Management Trust (see Section 2.1.4.5) should be broad enough to facilitate re-design of agencies with environmental management responsibilities other than the Department of Conservation and Fisheries and the National Parks Trust. In addition to the harmonisation of environmental laws, the proposed legal framework must ensure greater integration of environmental standards and environmental planning into sector-specific and economic planning processes. It must ensure increased cohesiveness in policy, regulations, and practice between physical planning agencies and resource management agencies. Though there is pending legislation that requires registration of non-governmental organisations, the legal framework for resource conservation and protected areas development should facilitate the participation of civil society in a broader range of collaborative arrangements.

(2) Identify Adequate Financial Resources for Protected Areas Development

The National Parks Trust estimates that full deployment of the system of recreational moorings will generate enough revenues to support the current operations of the Trust (*pers. comm*., Joseph Smith Abbott, Director, NPT, interview with Lloyd Gardner, 27 October 2011). There has not been an assessment of the cost of implementing the full range of management functions in all existing national parks, nor in the proposed national parks. Additionally, the need to undertake capital development in all areas will make any final estimates beyond the financial capacity of the National Parks Trust.

The Protected Areas System Plan for 2007-2017 highlights the need for detailed financial planning for the development and management of the system of protected areas. It seems logical that if Virgin Gorda is the premier tourism destination in the BVI, then the investment in bringing tourists to the BVI should bear some correlation with the investment in the development and management of the natural and historical resources that form the basis of Virgin Gorda's tourism industry.

(3) Managing Concessions within Protected Areas

The national parks on Virgin Gorda offer potential of revenue generation for private firms operating within the parks. Concessionaires currently operate food services and recreational equipment facilities within The Baths and Prickly Pear National Parks.

Several stakeholders expressed concern about the quality for the concessions, particularly at The Baths. The concern was that the quality was not high enough to meet visitor expectations for a site of international renown, even though the National Parks Trust has been upgrading the facilities at the park over several years. At Prickly Pear National Park, the NPT has struggled for many years to have the concessionaire operate the facilities and conduct the recreational activities in accordance with NPT guidelines.

These concerns underscore the need for clarifying and strengthening NPT guidelines and regulations for the operation of concessions within national parks, and for more oversight and enforcement of such regulations when concessionary licences have been issued.

The Protected Areas System Plan (2007-2017) identifies a number of system policies and standard operating procedures for site management. These include concessions management and commercial services planning. The development and implementation of such policies and plans will require additional legislative support, capacity development within the NPT, the participation of other agencies, and political and community support.

(4) Building Institutional Capacity

The Territory's two primary protected areas management institutions (NPT and DCF) currently lack adequate capacity to execute the full range of management tasks and responsibilities necessary to:

- provide enhanced services to visitors,
- ensure protection of natural and heritage resources,
- achieve improved financial planning, management, and oversight, and
- participate in collaborative arrangements to protect and promote the protected areas.

Some stakeholders expressed concern that the human resources at the national parks were inadequate, in that these services were unable to meet the expectations of the "high-end" tourists that visit Virgin Gorda.

In 2011, the National Parks Trust undertook a detailed operational analysis, including risk analysis for each area of operations and an analysis of its heath and safety processes. The results will be used to prepare a health and safety plan, an operations manual, and a strategic plan. These outputs will facilitate the alignment of the NPT's programmes and management systems with the requirements of the National Parks Act (2006) and the Protected Areas System Plan (*pers. comm*., Joseph Smith Abbott, Director, NPT, interview with Lloyd Gardner, 27 October 2011).

(5) Provide Adequate Infrastructure at National Parks and other Amenity Areas

The national parks on Virgin Gorda form the basis of the tourism product. However, visitation is concentrated in a small number of parks, resulting in overcrowding at those sites. Solutions discussed by the community, tourism agencies, and NPT focus mainly on the dispersal of visitors to under-used sites, and construction of facilities at sites currently used. The infrastructure said to be most needed are restroom facilities on the terrestrial side and moorings on the marine side of operations.

How the private sector might contribute to development of restroom facilities on selected beaches has been a focus of discussions between private sector tourism interests in Virgin Gorda and the National Parks Trust (*pers. comm*., Sharon Flax-Mars, Rosewood Little Dix Resort, interview with Lloyd Gardner, 24 November 2011).

The moorings managed by the NPT are for daytime recreational uses (diving and snorkeling), and serve to protect coral reefs and seagrass beds within the protected areas from anchor damage. There are currently 68 moorings at 18 sites within the Virgin Gorda protected areas, with the largest concentration of buoys at The Baths (40) and The Dogs (21).

The number of moorings is considered inadequate by both the NPT and the marine industry. Sites identified as needing additional moorings are: all beaches, Little Fort, Trunk Bay, The Dogs, Fallen Jerusalem, and The Baths. An increase of 50 percent in the number of moorings at The Baths has been recommended, subject to the findings of a carrying capacity study (Marine Industry Stakeholder Meeting, 8 February 2012).

In addition, members of the marine industry noted that many of the boats using the moorings are larger than the maximum vessel size recommended for installed moorings, and that NPT recreational moorings were sometimes used as night-time anchorage. These misuses have had a significant adverse impact on the NPT's ability to adequately maintain the moorings, raising concerns about the safety of the mooring system.

The recreational mooring system also provides a source of revenue for the NPT. In 2007, 10,190 marine conservation permits were issued throughout the Territory to vessels using the NPT moorings. The permits generated $617,733 in income to the Trust, or 40.6 percent of NPT revenues for the year (NPT, 2009). The installation and maintenance of the system of moorings is undertaken by staff of the NPT. There is concern however—particularly within the marine industry—that, given NPT staff and resource constraints, the experience and revenues gained by the Trust for managing the system may be offset by decreasing confidence by users in the overall integrity of the mooring system.

(6) Meeting the Challenge of Climate Change

Although climate change is an external source of stress, it places internal demands on the resources of the institutions and collaborating institutions engaged in managing protected areas. The health impacts of climate change will affect both resi-

dents and visitors, and impose new operational costs on institutions that manage protected areas and institutions that provide health services (Ebi, *et al*., 2006 and Ragster, 2010). Climate change impacts are also expected to significantly reduce the value of coastal and marine resources in the BVI (Economic Commission for Latin America and the Caribbean, 2011).

8.5.2 Development Planning Challenges

The major challenges for resource conservation and protected areas resulting from the current development planning process in the BVI are detailed in the sub-sections that follow.

(1) Provide a Development Plan for Virgin Gorda

The National Tourism Development Strategy calls for a comprehensive development plan for Virgin Gorda. This plan would assist the island to:

- rationalise the use of land,
- facilitate improved infrastructure planning,
- facilitate more orderly tourism development, and
- provide mechanisms and processes for protecting critical ecological and heritage resources.

(2) Harmonise Development Strategies for Tourism and Protected Areas

Though the two sectors are so intertwined, the current planning processes and operational procedures of the NPT and the DCF are not sufficiently harmonised with the tourism sector. The two resource management agencies need to improve institutional arrangements with the Tourist Board and private-sector tourism investors.

(3) Managing Land Use in Areas Adjacent to National Parks and Other Critical Resources

The impact of commercial activities on coastal resources (*e.g*., the coral reefs at Fort Point) is well known. The reduction in the amenity value of recreational attractions within protected areas, from overuse and unplanned development, is harder to define. As stated in the Tourism Development Strategy, by the time the change is obvious, tourists may have already changed their preferences to other sites, and impacts may be virtually irreversible.

Land uses adjacent to protected areas have to be managed in order to:

- reduce discharges to the protected areas,
- ensure orderly development,
- improve land management practices to reduce land-based sources of pollution,
- allocate space for expansion of park services, and
- maintain access to coastal areas and natural and heritage resources that form a part of the tourism product.

(4) Improve Waste Disposal

Public agencies are given fairly high marks by residents for improvement in the collection of solid waste on Virgin Gorda. However, serious concerns continue to be expressed within the community regarding the odour and air pollution resulting from burning at the island's dump site.

Sewage disposal is also an ongoing concern with respect to the following:

- difficulty of waste-water disposal due to the slow permeability of island soils,
- inadequacy of facilities for disposal of septic tank waste, and
- the lack of holding tanks on boats and pump-out facilities at marinas.

Issues, Conflicts, and Areas of Concern	Impacts of No Action/No Change	Short-term Options Long-term Recommendations
ISSUE ONE The responsibility for resource conservation and protected areas management in the BVI is spread across several agencies (see Sections 2.1.3 and 8.1). Associated laws do not require the establishment of formal inter-agency coordinating mechanisms to ensure integrated planning. Thus, management interventions are driven by individual institutional mandates rather than by a cohesive national strategy. The National Parks Act (2006) and National Parks Regulations (2008) provide a good basis for development and management of the system of protected areas. However, other laws need to be updated, and appropriate regulations approved, to improve resource conservation and protected areas management in the BVI.	Unless the BVI's environmental management framework (laws, policies, and institutional arrangements) is strengthened, decisions regarding the use of land will be based on short-term considerations and the priorities of individual development projects. Historically, decisions made on an *ad hoc* basis have in the long-term resulted in adverse environmental change. As such, in the absence of a strengthened environmental management framework, there will be continued degradation of the natural and historical resources identified with the protected areas of Virgin Gorda.	**SHORT-TERM OPTIONS** 1. The Protected Areas System Plan (2007-2017) identifies a range of actions necessary to improve management of the system of protected areas. The Government of the British Virgin Islands should develop additional regulations, guidelines, and operational procedures under the National Parks Act (2006) to support the broad range of management interventions necessary for management of protected areas, both at the site and system levels. 2. he National Parks Trust should establish more formal and systematic institutional linkages with relevant public agencies in order to utilise laws and resources residing in those agencies for protected areas management. 3. The involvement of civil society organisations in the decision-making process for protected areas management is both a policy and legal requirement. As such, the National Parks Trust could establish a "friends of the parks" group on Virgin Gorda to encourage improved communication with and support from stakeholders in the development and management of protected areas. **LONG-TERM RECOMMENDATIONS** 1. In the absence of an approved development plan, island-specific tourism strategy, or conservation plan for Virgin Gorda, there will continue to be significant challenges to the integration of environment and development strategies. Government should pass framework environmental legislation to integrate resource conservation and development planning (see Section 2.1.4.5).
ISSUE TWO The cost of undertaking the full range of management functions for existing national parks is beyond the current financial capacity of the National Parks Trust. Additionally, there is no active management of other types of protected areas, due to the lack of financial and other resources.	Without adequate financial resources, the capacity of the NPT to undertake necessary management interventions and provide appropriate infrastructure for the park system is limited. If this situation persists, there will be continued over-crowding (*continued*)	**SHORT-TERM OPTIONS** 1. The National Parks Trust should increase entry fees to national parks on Virgin Gorda and should develop new mechanisms for collecting entry fees. 2. The Tourist Board should allocate part of its tourism promotions budget to the National Parks Trust for infrastructure development and maintenance within the national parks on Virgin Gorda. 3. The National Parks Trust should establish a "friends of the parks" group to provide additional support (including fundraising) tor protected areas management.

Issues, Conflicts, and Areas of Concern	Impacts of No Action/No Change	Short-term Options Long-term Recommendations
In addition to the operational costs of managing the protected areas, financial resources are needed to undertake the infrastructure development at both existing and proposed national parks.	at a small number of national parks on Virgin Gorda, continued deterioration of ecological and historical resources, increased potential for accidents at overcrowded sites, and reduced tourism earnings.	**LONG-TERM RECOMMENDATIONS** 1. The Government of the British Virgin Islands should develop legal and economic instruments to encourage donations to the National Parks Trust. 2. The National Parks Trust should prepare a financing plan for development of the system of protected areas and should also establish a perpetual fund, as stated in the Protected Areas System Plan. 3. The National Parks Trust should update its commercial services policies and arrangements.
ISSUE THREE The National Parks Trust has been unable to bring the concessions at national parks on Virgin Gorda into compliance with its operational guidelines.	The NPT's continued difficulties to improve management of park concessions adversely impact its ability to ensure protection of natural and historical resources, and will result in possible reduction of the amenity value of the sites.	**SHORT-TERM OPTIONS** 1. The National Parks Trust should review existing concession lease agreements to ensure compliance with applicable regulations, as well as national and international obligations. 2. The National Parks Trust should revise as necessary the operational guidelines with current lease-holders. **LONG-TERM RECOMMENDATIONS** 1. The National Parks Trust should establish formal and uniform policies and procedures for concession management in protected areas.
ISSUE FOUR The institutional capacity of both the National Parks Trust and the Department of Conservation and Fisheries is not sufficient for the full range of resource protection and management responsibilities assigned to each institution.	Without acceptable and sufficient institutional capacity within the BVI's primary resource management institutions, the Territory will continue to experience difficulties in maintaining the integrity of its natural and historical resources, including those within designated national parks and protected areas. Over the long term, as the quality of the natural environment deteriorates, the BVI will see reductions in its tourism revenues.	**SHORT-TERM OPTIONS** 1. Government should increase funding support to the National Parks Trust to improve the Trust's management capacity on Virgin Gorda. 2. The NPT should establish more formal and systematic institutional linkages to draw on the institutional capacity of other agencies and organisations in the public, private, and civil society sectors. 3. The NPT should explore options for obtaining external technical assistance to assist with some of its planning functions. **LONG-TERM RECOMMENDATIONS** 1. The NPT and the DCF should continue to develop collaborative relationships with internal and external research institutions to assist with BVI monitoring and research programmes.

Issues, Conflicts, and Areas of Concern	Impacts of No Action/No Change	Short-term Options Long-term Recommendations
		2. The National Parks Trust should explore the option of delegating responsibility for, or the outsourcing of, certain management functions at selected sites to approved and competent institutions.
ISSUE FIVE Several national parks do not possess infrastructure to support visitor use, while infrastructure at the most heavily used national parks is inadequate to support the current level of visitation.	Without appropriate types and levels of infrastructure at existing and proposed national parks, overcrowding will continue at a small number of Virgin Gorda park sites, with potential for continued deterioration of ecological resources, increased potential for accidents, and negative impact on tourism earnings.	**SHORT-TERM OPTIONS** 1. The National Parks Trust, in cooperation with the Tourist Board, should actively promote visitation to under-used national parks on Virgin Gorda. 2. The National Parks Trust should encourage community co-financing for basic infrastructure in national parks, particularly at recreational areas. Install-and-operate agreements may be appropriate for the development of moorings and food service/restroom facilities. **LONG-TERM RECOMMENDATIONS** 1. Government should include park infrastructure in the Public Sector Investment Programme. 2. Government should design economic incentives for private sector investment in infrastructure within protected areas.
ISSUE SIX At present, the collection of ecosystem data within protected areas focuses primarily on resource mapping, which is generally done on an irregular basis as supported by externally-funded projects. Data on the status of the resources within protected areas are generally lacking. Lack of comprehensive data sets on the status of biophysical resources within protected areas severely limits the ability of management institutions to determine and design appropriate programmes to maintain the integrity of resources and evaluate the effectiveness of its management plans.	In addition to ongoing deterioration of resources and infrastructure within protected areas, insufficient, current-state data also reduces the ability of management institutions like the NPT and the DCF to defend their budget requests, plan for infrastructure development, and communicate effectively with stakeholders and the community at large.	**SHORT-TERM OPTIONS** 1. The National Parks Trust and the Department of Conservation and Fisheries should conduct environmental and socio-economic baseline surveys for the most heavily used protected areas. 2. The National Parks Trust should implement environmental monitoring programmes for the most heavily used protected areas under its management. 3. The National Parks Trust and the Department of Conservation and Fisheries should explore establishment of community monitoring programmes with local Virgin Gorda NGOs and civic organisations and with the Bregado Flax Secondary School. Citizen volunteers could assist with surveillance or basic monitoring activities, as appropriate. Such community-supported monitoring activities were explored on Jost Van Dyke, following completion of that island's Environmental Profile. 4. The National Parks Trust needs to collect site-specific data on visitation levels and patterns.

Issues, Conflicts, and Areas of Concern	Impacts of No Action/No Change	Short-term Options Long-term Recommendations
		LONG-TERM RECOMMENDATIONS 1. The National Parks Trust must strengthen its data management capacity. 2. The National Parks Trust should review current and future research collaborations with internal and external institutions to ensure that research results can be applied to meet the NPT's management requirements as well as the research needs of collaborating institutions. 3. The Tourist Board should collect data on visitor use of national parks and other amenity areas on Virgin Gorda.
ISSUE SEVEN Researchers familiar with the marine environment of the British Virgin Islands state that the coral reefs around Virgin Gorda are just recovering from the bleaching event of 2005. However, future weather variability linked to climate change is expected to significantly reduce the value of coastal and marine resources in the British Virgin Islands (ECLAC, 2011).	To reduce the negative impact of climate change on environmental resources, the anthropologic sources of stress on those resources must be reduced. If the current sources of stress on the natural environment of Virgin Gorda are not removed or reduced significantly, impacts of climate change will add to the deterioration of natural resources, will increase damage to social infrastructure and private property, and will ultimately result in the deterioration of the quality of life for residents.	**SHORT-TERM OPTIONS** 1. The environmental and disaster management agencies of the BVI should emphasize climate change issues within their public awareness programmes, in coordination with the Territory's emerging Climate Change Policy. 2. The BVI's environmental management agencies should increase their efforts to reduce the current sources of stress to coastal and marine resources. 3. The National Parks Trust should assess its management plans for national parks to ensure adequate attention is given to climate change issues, and should incorporate climate change considerations in future management planning efforts. **LONG-TERM RECOMMENDATIONS** 1. The Department of Town and Country Planning should prepare a development plan for Virgin Gorda that incorporates climate adaptation measures.
ISSUE EIGHT The absence of adequate sewage waste disposal facilities on Virgin Gorda has resulted in waste disposal practices that increase the potential for pollution of coastal waters and degradation of coastal resources.	If the challenge posed by inadequate facilities and inappropriate disposal of sewage waste is not addressed, the amenity value of Virgin Gorda (*continued*)	**SHORT-TERM OPTIONS** 1. The National Parks Trust must utilise the best available technology for sewage treatment and disposal within national park sites. 2. The National Parks Trust should establish processes for tracking pollutants entering the national parks, as well as increase the fines for discharge of sewage and other pollutants within or affecting protected areas.

Issues, Conflicts, and Areas of Concern	Impacts of No Action/No Change	Short-term Options Long-term Recommendations
	tourism sites will be diminished through odour problems, potential health impacts from pollution of recreational waters, and deterioration of coastal ecosystems—all of which will produce a negative impact on tourism attractions and earnings.	**LONG-TERM RECOMMENDATIONS** 1. The National Parks Trust should collaborate with other regulatory agencies to ensure that developments on sites adjacent to protected areas use appropriate waste treatment and disposal technologies. 2. The National Parks Trust should strengthen its surveillance system to reduce the incidence of sewage disposal by boats within national parks.
ISSUE NINE Conservation planning is not adequately integrated into development planning and development control in the BVI. As such, land management practices and development activities adjacent to protected areas can result in non-point source pollution and other stresses to protected area resources.	Development planning processes, such as the use of buffer zones, must be instituted on Virgin Gorda. Otherwise, *ad hoc* development will result in the continued deterioration of environmental quality. Such a result will have negative consequences for tourism earnings and the quality of life for residents.	**SHORT-TERM OPTIONS** 1. The Department of Town and Country Planning should strengthen procedures and practices for land management during construction in order to reduce pollution loading to the marine environment. **LONG-TERM RECOMMENDATIONS** 1. The Department of Town and Country Planning should use the environmental protection area provisions of the Physical Planning Act (2004) to protect critical ecological resources (*e.g.*, salt ponds, mangroves, and ghuts) that fall outside of protected areas.
ISSUE TEN The protected areas of Virgin Gorda represent a significant portion of the engine that drives the BVI economy. However, the behaviour and activities of residents and visitors often create adverse impacts on these economically critical areas. How Virgin Gorda's communities, stakeholders, and resource users feel about and use the island's protected areas is critical to their development. It requires ongoing dialogue between these groups and resource management institutions, particularly the NPT.	If the relationship between user groups and resource management institutions is strained, or if the community does not sufficiently understand development issues associated with protected areas, community support for these areas and their management institutions will be low. Such an outcome has budget implications for the management institutions and will negatively impact support for national parks and other protected areas on Virgin Gorda.	**SHORT-TERM OPTIONS** 1. The National Parks Trust should establish a Virgin Gorda national parks support group. A useful model can be found at the neighbouring Virgin Islands National Park in St. John, USVI, where the "Friends of the Park" group has been extremely successful in providing volunteers, funding, and other support services for the park system. 2. The National Parks Trust should implement procedures for annual reporting to the Virgin Gorda community. **LONG-TERM RECOMMENDATIONS** 1. The National Parks Trust should design and implement a public engagement strategy, in keeping with the recommendations of the Protected Areas System Plan. 2. The National Parks Trust should prepare and widely disseminate periodic "State of the Parks" reports.

9. DIRECTIONS FOR THE FUTURE

Tourism is the mainstay of Virgin Gorda's economy. Most other economic activities on the island are tied in some way to the tourism base. It was here that the tourism sector in the British Virgin Islands came of age in the 1960s and 1970s, and it is Virgin Gorda that still boasts the upscale accommodations that have gained the BVI a global reputation in travel and leisure circles. The island is home to a vibrant yachting and water sports tourism niche, and the sheltered waters of the North Sound have attracted boaters and marine enthusiasts for more than 40 years. The island is graced with physical beauty from the lofty slopes of its central mountain peak and its white sandy beaches to the dramatic landscape of The Baths with its giant boulders and underwater caves at the southern end of the island.

In short, Virgin Gorda seems to have it all. Its resources should guarantee a prosperous future for the 4,000 Virgin Gordians who inhabit the island. Its small-island attributes seemingly ensure that the tranquility the island has enjoyed in the past will extend well into the new century.

But is this the reality? What have we learned in our examination of Virgin Gorda's resource base?

- About the island's ongoing consumption and use of its resources?
- About Virgin Gorda's economic promise—so dependent on the health and wellbeing of those resources?
- About what needs protection now to ensure a quality of life tomorrow?

This final chapter of the *Virgin Gorda Environmental Profile* will highlight some of these issues.

9.1 The North Sound: Who's in Charge?

A recent editorial (16 February 2012) in *The BVI Beacon* noted that "… planning has never been the VI's strong suit …." To enlarge upon this observation, this section of the *Virgin Gorda Environmental Profile* provides a case in point that is illustrative of the editor's conclusion.

The persistent development of one of Virgin Gorda's most remarkable assets—the North Sound—is that case in point. The Sound is an area of incomparable beauty and natural features and certainly a critical component of not only Virgin Gorda's but the BVI's economic future. It is also a semi-enclosed insular community of small cays and islets nurtured by the sea and a larger mother island that, only in recent decades, emerged from its relative isolation to create a vibrant marine-based economy. The changes experienced in the North Sound might to some seem extreme and excessive, to others a sign of prosperity and success. But what does seem irrefutable is that change has generally proceeded in an *ad hoc* fashion, with too little appreciation or understanding of the *interconnectedness* of the development choices being enacted by singular players, be they from the public or private sector.

In short, we might ask — ***what is happening to the North Sound of Virgin Gorda?*** — and what lessons have emerged from its development over the last 40 years?

9.1.1 The North Sound—As It Was

An undated paper written in the early 1970s was discovered not too many years ago in the files of Island Resources Foundation (O'Neal, *circa* 1970). The paper was prepared by a Virgin Gordian who would go on to become the first Premier of the Territory and who, at the time, recognised—along with others—that the North Sound was balanced on the precipice of change. The writer, Ralph T. O'Neal, made several specific recommendations, among them:

> *…a* [BVI] *Town Planner on secondment from the* [United Nations] *should be asked to prepare a master plan for the area. The Caribbean Research Institute of the College of the Virgin Islands should be approached now to carry out a survey of the area with special emphasis on the development of marinas, the effect on the harbour of cutting roads on the surrounding hillsides, cleaning of the beaches in the area, and to make recommendations on the prevention of pollution and contamination in the area.*

Mr. O'Neal not only proposed direction for the public sector, he also made reference to the private sector:

> *The owners of land around the area should get together to ensure that there is co-ordination of effort and that development takes place in a planned fashion. Even if development is slow, and this has advantages, the crux of the matter is to have planned development to ensure the orderly development of a beautiful area.*
>
> *It would be a pity to lose an opportunity to have a model development* [process in the North Sound].

The O'Neal paper notes that the North Sound area remained mostly undiscovered even by the people of the Territory well into the 1950s. What the author describes as the "first blow" occurred in 1957 when an American, Stanley Washburn, fell in love with Anguilla Point and created a home and coconut grove at that site. At about the same time, an investor group headed by a Mr. Herbert Lee was granted a 99-year lease on Prickly Pear, Eustatia and Little Saba.

Mr. O'Neal writes that this agreement was later surrendered but also notes that if his readers found this action by government (*i.e.*, in granting the initial lease without "an overall plan of the area" being in place) was "bad," then he assumes they would find subsequent exchanges of land—both offshore islands and on the mainland of Virgin Gorda—to be equally egregious (his listing of such land exchanges goes on for several pages).

Mr. O'Neal sums up his accounting of land transfers by stating that all private lands with sea frontage from Anguilla Point (at the entrance to North Sound) to Cleaning Point (Bitter End) had been sold or were under option to be sold. But it is not the land sales that the future Premier characterises as "bad;" it is that these land transfers were taking place without the guidance of an overall development planning framework for the area.

The writer states Government has proposed that electricity be provided for the North Sound by June of 1971 and that a surfaced road was being created from The Valley to North Sound via the southern side of Gorda Peak. However, dock facilities for North Sound settlements at Gun Creek are described as "meagre" and proper harbour facilities would need to be developed if there was to be a "push forward" for the Sound.

Again reiterating the immediate need for a comprehensive development plan *before* further development took place, Mr. O'Neal emphasises why planning was important while the area was still mostly underdeveloped:

> *If for example Mosquitoe Island (Drakes Anchorage) is really developed and the Symonette development (The Bitter End) goes ahead, one can see what can happen with the sewage and other refuse from yachts and boats at the Bitter End. This will end up down at Drakes Anchorage, which is at the western end of the Harbour …. Similarly* [Stanley] *Washburn* [at Anguilla Point] *and* [Robert] *Eastham* [at Blunder Bay] *will be at the receiving* [end]. *This is just one small but important point.*

Yet, despite Mr. O'Neal's foresighted recommendations, his plea to the Development Control Authority to "concern itself with the area," and repeated calls in this paper for comprehensive development planning, no such effort was undertaken. Instead, in subsequent years, development in North Sound would move forward in piecemeal fashion, executed by individual developers equipped with their own singular development plans, with insufficient thought given to the *cumu-*

lative impact of development project after development project on the wellbeing of North Sound.

At about the same time that Mr. O'Neal was providing his counsel for the North Sound, important changes were beginning to take place at Bitter End.

In an article focusing on Virgin Gorda, the 2010 issue of *Business BVI* hypothesises that in the development of the island's travel market reputation, there were two visionary developers who saw potential in "positioning this little corner of the Caribbean as a global competitor." The first was Laurance Rockefeller who at Little Dix Bay found the two key components that upscale resort developers desire—"virgin land that lends itself to … exclusivity and privacy" (*BVI Business*, 2010).

The second of Virgin Gorda's visionary developers, according to *Business BVI*, were Myron and Bernice Hokin of North Sound, who, in 1973, purchased 75 acres of land and a small group of cottages, originally constructed for charter captains looking for a night ashore, and converted what began as a Hokin family retreat into a world-class yachting destination—the Bitter End Yacht Club. The emergence of Bitter End in the mid-1970s was followed by the development of other high-end resort and marina properties in the Sound up to the most recent such project at Oil Nut Bay, a low-density resort community with yacht club and marina.

The North Sound now glitters as a jewel in the crown of BVI tourism. But all is not well.

Photo 136.
Aerial view of the Yacht Club Costa Smeralda (YCCS) looking north, with the Bitter End Yacht Club in the background (source: Jeff Brown Superyacht Media).

9.1.2 The North Sound—As It Is Now

9.1.2.1 What Do We Know?

At a stakeholder consultation in Spanish Town with marine industry representatives, sponsored by the BVI Environmental Profile Programme in February of 2012, participants emphasised the need for contemporary data on the level of marine resource use by marine resource users in the North Sound (IRF, 2012b). The most recent study of the BVI's boating industry, for example, was completed over

30 years ago (Jackson, 1980). Yet the sector continues to expand but does so with no centralised datasets easily accessible for more comprehensive planning, not only by the private sector but also by the public sector, whose responsibilities include: (i) supporting the economic wellbeing of the marine industry and (ii) protecting the marine resource base upon which that industry is dependent.

As a minimum, components of the marine industry that use and depend on the resources of the North Sound include:

- bareboat charter companies (based in the BVI and USVI);
- crewed charter yachts and other pleasure boats;
- members of the Charter Yacht Society (BVI);
- members of the Virgin Islands Charter Yacht League (USVI);
- day sail operators (based in the BVI and USVI);
- dive operators;
- private cruising boats;
- small boat operators that cater to cruise ship passengers;
- race vessels participating in periodic regattas;
- marinas and other marine-service businesses.

But the dimensions of these components are generally unknown—for example, the extent of the industry's contributions to the BVI economy or how and where and how often individual components of the industry use the shared natural resource base. Such data are primarily available only as anecdotal evidence or lie within inaccessible sources maintained by individual marine businesses.*

While there was a consensus at the February 2012 meeting with marine stakeholders that the number of daytime moorings in the North Sound and elsewhere around Virgin Gorda needed to be increased, most felt this could not (and should not) happen until a proper assessment of the carrying capacity of sites being targeted for additional moorings had been carried out. Unfortunately, no government agency is currently taking the lead to determine the carrying load of popular marine recreational sites at North Sound, The Baths and elsewhere around Virgin Gorda.

Some in the yacht charter business maintain that Government does not fully recognise or acknowledge the contribution of charter boats and marine-related businesses to the BVI economy. For example, the Caribbean Tourism Organisation reported that in 2009 there were 2,353 tourist rooms available in the BVI (see Chapter 8, Section 8.4.2), but little documentation is ever included in such reporting about the number of overnight charter boats in the BVI, which are in effect "floating hotel rooms."

Likewise, the BVI Tourist Board's recently launched Sustainable Tourism Environmental Programme (STEP) has selected four hotels in the BVI for its pilot initiative but could have included a charter boat or charter company in its project given the large number of tourist "beds" (bunks) on boats that add to the volume of visitor accommodations in Virgin Gorda (*pers. comm.*, Trish Baily, captain of Yacht *Serendipity*, in email to Lloyd Gardner, 9 February 2012).

The widely held perception by those who charter the waters of the North Sound and perhaps know them best is that there are too many boats for too few anchorages with substantial overcrowding during seasonal peaks and substantial risk of negative experiences for tourists. Added to overcrowding concerns are increasing concerns for safety issues in North Sound waters that serve a variety of users, and the lack of sufficient regulation to control ever-escalating pollution loads in the harbour. It is obvious that the North Sound has long ago left behind the simplicity of the 1970s (Section 9.1.1).

Yet, writes one long-time observer of the North Sound, compared to most other places to sail in the Caribbean, the North Sound remains a sub-

* At the February 2012 marine stakeholder meeting, a representative from the National Parks Trust reported that the NPT conducts an annual survey of marine vessels, including data on fleet size, length of boats, and demand for moorings (IRF, 2012b).

It was also reported at the marine industry stakeholders meeting that the Department of Conservation and Fisheries was to undertake an assessment of the marine industry. Details on this effort are not yet available (IRF, 2012b).

stantially more attractive and less spoiled destination. "It is the only large totally protected deep water harbour in the eastern Caribbean that is not (yet) surrounded by oil storage tanks, commercial wharves, and otherwise unpleasant surroundings, traffic, crowds and a sense of insecurity" (*pers. comm*., Richard Hokin, BEYC, in email to Judith Towle, 20 March 2012).

In his 1980 study of the BVI boating industry Ivor Jackson (1980) sums up his various recommendations by calling on the BVI Government to maintain the "vibrancy" of the boating industry by providing:

(1) support ***for*** the industry, and

(2) regulation ***of*** the industry—minimal regulation, writes Jackson, to keep the industry "vibrant," yet sufficient "to realise the economic, social and environmental objectives of the Territory."

Perhaps we need to add to Jackson's directive to the BVI Government the need to *plan* for the industry, and nowhere is that need more urgent than in the North Sound where incremental growth in the absence of holistic planning has created not-so-incremental change, much of which has been damaging, even irreparable, to the very marine environment upon which the marine sector has been built.

9.1.2.2 Lessons Learned

While it is unfortunate that the kind of comprehensive planning proposed for the North Sound in the early 1970s did not occur at that time, it is not too late to provide a planning framework for the North Sound going forward. The Department of Town and Country Planning has already identified Spanish Town/The Valley on Virgin Gorda for preparation of an area development plan (Chapter 8, Section 8.4.1.1). The North Sound is critically in need of similar area planning by the Government's lead planning agency.

The only given about the North Sound's future is that change will continue. The North Sound of 2040 will undoubtedly be as different from the North Sound of 2012 as the North Sound of 2012 is from the Sound of the 1970s.

New road infrastructure for residential housing (at Leverick Bay) and tourism development (at Oil Nut Bay and for the Yacht Club Costa Smerelda) are among the most recent North Sound developments. Each was permitted to proceed without benefit of an Environmental Impact Assessment.

While the BVI Government is to be commended for its forward-looking Physical Planning Act (2004), it must now fully acknowledge the value of the EIA process contained within this law. If executed properly and as intended in law, the EIA process will help the Territory move away from the very kind of piecemeal growth that has characterised development in the North Sound in the past.

An EIA allows private developers and government planners to look more holistically at the implications of each *added* development activity within a given area, particularly critical when the economic and environmental stakes are as high as they are in the North Sound. Exceptions must not be granted to that process if the promises of growth and development are to be sustainable.

The North Sound's newest component in the mix of activities and enterprises that make up the area's economy is the addition of mega-yachting. For a number of years, through two different administrations, a tacit government policy has been in place to encourage super-yachting in the Territory. The newly opened (January 2012) Yacht Club Costa Smeralda (YCCS) was built for larger yachts, with a state-of-the-art marina that can accommodate 38 yachts up to 100 metres (328 ft) in length and a draft of up to six metres (20 ft). Across the water from YCCS, the Bitter End Yacht Club has added a new dock in part to take advantage of the growing mega-yacht market (**Photo 136**).

Not all are enthusiastic about the presence of the larger marine vessels, which are privately owned and not a part of the local charter fleet. Reportedly, there have even been visits by "giga" yachts, over 91 m (300 ft) in length (IRF, 2012b). A primary concern focuses on the availability of appropriate anchorages for the mega yachts that cruise the BVI. The yachts are too large for traditional moor-

ings generally in place throughout the Territory (most have been installed to take boats up to a maximum of 18 m [60 ft]). Reports of larger vessels anchoring (because of their size) in ecologically sensitive areas with coral reefs or seagrass beds are prevalent throughout the local yachting community, and many find the out-sized yachts to be less traditional, out-of-scale, and not in keeping with long-established boating patterns and habits in the North Sound.

Still others question the actual economic value of this yachting niche to the BVI, particularly in the absence of the larger economies and more substantial commercial infrastructure of ports such as St. Maarten and St. Thomas to support the super yachts. The potential for construction of additional, potentially intrusive marinas to accommodate the mega yachts is yet another concern.

On the other hand, some in the North Sound have pointed out that—assuming the mega yachts do not discharge their holding tanks in the North Sound harbour or other inshore waters of the BVI—they may be less of a pollution concern than 100 smaller yachts anchored in and around the Sound, pumping their sewage overboard. And, while the size of the super yachts can be overwhelming to observers accustomed to less immense vessels, a 200-foot mega yacht may have on board fewer people to crowd North Sound facilities than five 40 foot catamarans with eight bunks occupied.

But the point may not be what are the advantages and disadvantages of encouraging mega yachting in the BVI as a public policy. That policy is already in effect. What is needed now is the kind of forward-looking planning that was not in place in the 1970s and 1980s in the Sound—the absence of which allowed for the growth of an industry that most stakeholders today perceive as having too many boats, too few anchorages, and too much pollution.

It is an opportune time to rethink the benefits of comprehensive sustainable planning for the North Sound. Gun Creek will soon be a designated Port of Entry; consideration is being given to the declaration of North Sound as a Harbour which will expedite inter-agency implementation of management strategies for the area (VISR, 2012).

There is an obvious need to assess the carrying capacity of targeted marine resources in the area in order to develop new anchorages and mooring fields to handle growing recreational demands.

Pollution levels in the harbour must be curtained through implementation of new policies and regulations, particularly as these relate to waste discharge by vessels and the need for pump-out systems on shore (see Issue 6 in Chapter 7 and Issue 1 in Chapter 2).

As mega yachts take their place in the North Sound's economic mix, other resource users in the Sound need to know that someone is in charge of this new tourism niche other than marina developers. As is the case for all facets of the marine industry, mega yachts will have an impact on the environment. However, at the present time, there is too little understanding of the cumulative impact of this new and, for many, exciting niche in the BVI tourism market.

And lastly, development planning for the North Sound must not take place in isolation from the rest of the island of Virgin Gorda. Some say there is a north/south dichotomy in Virgin Gorda and that the interests of the community in the south at The Valley are separate from those of the community in the north at the Sound. Yet development planning for the hub of the marine industry in North Sound logically extends to the south of the island where the yachting centre at the Virgin Gorda Yacht Harbour offers, for example, a possible alternative to having all the mega yachts docked all the time in the North Sound.

To return to the Jackson study of 1980—the most "modern" study of the BVI's marine industry to date—the author emphasises that Government needs to maintain the "vibrancy" of the boating industry. Good advice in 1980 and still good advice in 2012.

He also encourages Government to support the marine industry and to regulate the marine industry sufficiently to maintain the economic, social and ***environmental*** objectives of the Territory. Good advice in 1980 and good advice in 2012.

9.2 The Specialness of Virgin Gorda

9.2.1 True Belongers

Think not of me as wild savage bush—
tendrils and spines waiting to squeeze, shred, maim and bruise thee.
Please remember me. I am of you, this people, I am this land.
These emerald leaves I bear, this weight I carry, the fruits of my labour.
Though I stand still, I have journeyed far and long.
I am your grandfather many times; great grandmothers of millennia we are—
sisters, brothers, children.
I have planted roots here—strong roots, deep roots.
I go back countless nights and days, too many to tell you when.
I have lived, and I have thrived.
This bush that I am, I am a true belonger, me born ya.

[Anonymous]

Photo 137.
Kiaerskov's Lidflower (*Calyptranthes Kiaerskovii*), endemic to Virgin Gorda and Tortola.

In this final chapter of the *Virgin Gorda Environmental Profile*, we want to highlight many of the indigenous "born-here" species of the environmental profile islands, beginning with native plants.

These species are also true "belongers" of the Virgin Islands. When Virgin Islanders say "me born ya," they are saying they were born in the Virgin Islands, that they "belong" to this place. "Born here" is a refrain that is heard up and down the chain of Caribbean islands and speaks to a "*belonger's*" sense of connection to his or her island home, with roots that go deep and wide.

Like its people, many of the plants of Virgin Gorda and its nearby neighboring isles and islets are "belongers," and are considered "born here" or—as some may say—"born ya." According to ecologist Dr. Gary Ray, who has been studying the plants of neighbouring St. John for more than 20 years, a native plant "is that part of our flora that has arrived here by its own devices—transported by birds or insects, or the wind or the sea, with absolutely no intervention by humans" (Roberts, 2012).

Over the centuries, Virgin Gordians have honed their sense of identity. Islanders worked the land, turned the soil about between their fingers, crushed that organic smell and breathed in the deep earthy scent. They touched the leaves of plants and knew them, understood them, controlled them. Many species have been used in medicine and folklore, many trees have offered shelter and fuel, many fruits were harvested, many guava berries celebrated in wine at Christmas time.

What is so special about these native plants? Why are these "belonger species" important to Virgin Gorda? It is because the born-here plants are restricted to only a few islands in the West Indies; a smaller few are even more restricted because they are found only in the British and US Virgin Islands. Therefore, each is a special part of Virgin Gorda's natural history narrative—that distinctive story that is only Virgin Gorda's to tell.

The belongers possess a uniqueness and stature all their own. They are unlike the colourful flowers and manicured plantings that can be seen at Virgin Gorda's fine resorts because most of those plants and trees have been propagated elsewhere (Florida, Hawaii, Madagascar or Indonesia) and imported to the Virgin Islands.

The natural environment of Virgin Gorda has shaped her inhabitants, from the easternmost peninsula with its dry-brown, austere beauty to the boulder fields in the south, with their intricate, mysterious and dizzying twists, turns and precipitous falls. The island is rare and irreplaceable—and, with its born-here flora, there can only be one Virgin Gorda.

Our use of the word "special" is to highlight plants that are restricted (or endemic) to the West Indies, including some found only in Puerto Rico and the Virgin Islands and three species that are found only in the Virgin Islands. There are at least 97 plants that we can call true belongers of Virgin Gorda and the other environmental profile islands.

And there may be others yet to be discovered. Recent field work as late as February 2012 has added new species to Virgin Gorda's natural history narrative, and further study will undoubtedly add more.

Table 37 lists the 97 belonger plant species for Virgin Gorda and the other environmental profile islands. Three of these species are plants endemic to the British Virgin Islands:

(1) *Calyptranthes Kiaerskovii*.

(2) *Metastelma anegadensis*.

(3) *Vachellia anegadensis*.

Table 37.
Belonger plant species of Virgin Gorda and the other environmental profile islands.

No.	SPECIES	COMMON NAME	PLANT TYPE	BELONGER STATUS	CONSERVATION STATUS
1	*Agave missionum*	Corita; Virgin Island Century Plant	Agave	★	♦
2	*Allotoonia agglutinata*	Spotted Jawfish	Vine	★	♦
3	*Anthurium cordatum*	Organ Mountain laceleaf	Anthurium	★	♦
4	*Argusia gnaphalodes*	Sea Rosemary	Shrub	★	♦
5	*Argythamnia candicans*	Sharpleaf Silverbush	Shrub	★	♦
6	*Badiera penaea*	Crevasoja	Shrub	★	♦
7	*Calyptranthes Kiaerskovii* (**Photo 137**)	Kiaerskovii Lidflower	Tree	★	♦
8	*Calyptranthes thomasiana*	St. Thomas Lidflower; Thomas Lidflower	Tree	★	♦
9	*Canella winterana*	Wild Cinnamon	Tree	★	♦
10	*Chromolaena sinuata*	Wavyleaf Thoroughwort	Shrub	★	♦
11	*Coccoloba* cf. *costata*	Uvilla	Tree	★	♦
12	*Coccoloba krugii* x *uvifera*	Grape	Tree	★	♦
13	*Coccoloba microstachya*	Wild Pockhout; Grape	Tree	★	♦
14	*Coccoloba swartzii*	Swartz's Pigeonplum	Tree	★	♦
15	*Coccothrinax barbadensis*	Silver Palm; Thatch Palm	Palm	★	♦
16	*Consolea rubescens*	Sour Prickly Pear; Tree Cactus	Cactus	★	♦
17	*Cordia ricksecker*i	San Bartolome	Tree	★	♦
18	*Cordia sulcata*	Mucilage Manjack; Manjack	Tree	★	♦
19	*Croton astroites*	Wild Marrow	Shrub	★	♦
20	*Croton betulinus*	Beechleaf Croton	Shrub	★	♦
21	*Croton fishlockii* (**Photo 138**)	Fishlock's Croton	Shrub	★	♦
22	*Cynophalla hastata*	Broad-leaved caper tree	Tree	★	♦
23	*Cyperus nanus*	Indian Flatsedge	Sedge	★	♦?
24	*Dendropemon caribaeus*	Four-angle Leechbush	Shrub	★	♦
25	*Digitaria eggersii*	Eggers' Crabgrass	Grass	★	**Not Known**
26	*Erythroxylum brevipes*	Brisselet	Tree	★	♦
27	*Eugenia cordata* var. *cordata*	Lathberry	Tree	★	♦
28	*Eugenia cordata* var. *sintenisii*	Lathberry	Tree	★	♦
29	*Eugenia sessiliflora*	Sessileleaf Stopper	Tree	★	♦

No.	SPECIES	COMMON NAME	PLANT TYPE	BELONGER STATUS	CONSERVATION STATUS
30	*Euphorbia articulata*	Jointed Sandmat; Milk Bush	Shrub	★	♦
31	*Furcraea tuberosa*	Female Karata	Agave	★	♦?
32	*Galactia dubia*	West Indian Milkpea	Vine	★	♦?
33	*Galactia eggersii*	Egger's Milkpea	Vine	★	♦
34	*Ginoria rohrii*	Bastard Gregre	Tree	★	♦
35	*Guilandia ciliata* (**Photo 141**)	Mato; Nicker; Warri	Shrub/Vine	★	♦
36	*Heteropterys purpurea*	Bull Whit/Bull White; Bull Twist	Vine	★	♦
37	*Hohenbergia* cf. *antillana* (**Photo 139**)	Antilles Lacebark	Bromeliad	★	♦
38	*Hohenbergia* sp.	Lacebark	Bromeliad	★	♦
39	*Hylocereus trigonus*	Strawberry Pear; Night-blooming Cactus	Cactus	★	♦
40	*Ipomoea eggersii*	Egger's Morning Glory	Vine	★	♦
41	*Ipomoea steudelii*	Steudel's Morning Glory	Vine	★	♦?
42	*Jacquinia berteroi*	Bois Bande; Black Barch	Shrub	★	♦
43	*Justicia* cf. *mirabiloides*	West Indian Water-willow	Shrub	★	♦
44	*Lepidaploa glabra*	Wild Tobacco	Shrub	★	♦
45	*Lepidaploa sericea*	Longshoot	Shrub	★	♦
46	*Machaonia woodburyana*	Alfillerilo	Shrub	★	♦
47	*Malpighia coccigera* subsp. *coccigera*	Dwarf Holly	Shrub	★	♦
48	*Malpighia infestissima*	Cowhage Cherry	Tree	★	♦?
49	*Malpighia woodburyana*	Woodbury's Stingingbush; Bulldog	Tree	★	♦
50	*Mammillaria nivosa* (**Photo 140**)	Woolly Nipple Cactus	Cactus	★	♦
51	*Maytenus cymosa*	Caribbean Mayten	Tree	★	♦
52	*Maytenus laevigata*	White Cinnamon	Tree	★	♦?
53	*Melocactus intortus*	Turk's Cap	Cactus	★	♦
54	*Metastelma anegadensis*	Wise Wist; Caribbean Swallow-wort	Vine	★	♦
55	*Metastelma decipiens*	Cheeseman's Swallow-wort	Vine	★	♦?
56	*Mimosa ceratonia*	Black Ambret	Vine	★	♦?
57	*Mitracarpus polycladus*	Cana Gorda Girdlepod	Herb	★	♦?
58	*Mosiera xerophytica*	Aridland Stopper	Tree	★	♦
59	*Myriopus microphyllus*	Twining Soldierbush		★	♦

No.	SPECIES	COMMON NAME	PLANT TYPE	BELONGER STATUS	CONSERVATION STATUS
60	*Nashia* cf. *inaguensis* (**Photo 142**)	Bahamas Berry; Pineapple Verbena; Moujean Tea	Shrub	★	♦
61	*Neea buxifolia*	Saltwood	Tree	★	♦
62	*Oplonia microphylla*	Thicketwort	Shrub	★	♦
63	*Oplonia spinosa*	Pricklybush	Shrub	★	♦
64	*Ouratea littoralis*	Abey Amarillo	Tree	★	♦
65	*Pithecellobium unguis-cati*	Catclaw Blackbead	Tree	★	♦
66	*Plumeria alba*	Noosegay Tree; Wild Plumeria	Tree	★	♦
67	*Poitea florida*	Wattapama	Tree	★	♦
68	*Psychilis macconnelliae*	Mrs. Macconnell's Psychilis	Orchid	★	♦
69	*Psychotria glabrata*	Browne's Wild Coffee	Shrub	★	♦
70	*Quadrella cynophallophora*	Black Willow	Tree	★	♦
71	*Reynosia guama*	Guama	Tree	★	♦
72	*Rochefortia acanthophora*	Greenheart Ebony	Tree	★	♦
73	*Rondeletia pilosa*	Downy Rondeletia	Tree	★	♦
74	*Ruellia coccinea*	Petunia; Red Petunia	Herb	★	♦?
75	*Sabal causiarum*	Palmetto; Puerto Rico Palmetto; Puerto Rican Hat Palm	Palm	★	♦
76	*Samyda dodecandra*	Wild Guava	Tree	★	♦
77	*Scolosanthus versicolor*	Puerto Rico Devilbush	Shrub	★	♦
78	*Senegalia muricata*	Spineless Wattle	Tree	★	♦
79	*Serjania lucida*	Basketwood; Black Withe	Vine	★	♦
80	*Sideroxylon obovatum*	Breakbill	Tree	★	♦
881	*Smilax coriacea*	White Whyte; Greenbrier	Vine	★	♦
82	*Solanum conocarpum*	Marron bacoba	Shrub	★	♦
83	*Solanum polygamum*	Cakalaka Berry; Cakalaka	Shrub	★	♦
84	*Stenocereus fimbriatus*	Spanish Stenocereus	Cactus	★	♦
85	*Stigmaphyllon emarginatum*	Monarch Amazonvine; Wiss Vine	Vine	★	♦
86	*Stigmaphyllon floribundum*	Wolly Amazonvine	Vine	★	♦
87	*Tabebuia heterophylla*	White Cedar	Tree	★	♦
88	*Tetramicra elegans*	Elegant Wallflower; Elegant Tetramicra	Orchid	★	♦
89	*Tetrazygia angustifolia*	Stinkingfish; Broom-wood	Tree	★	♦

No.	SPECIES	COMMON NAME	PLANT TYPE	BELONGER STATUS	CONSERVATION STATUS
90	*Tetrazygia elaeagnoides*	Krekre	Tree	★	♦
91	*Tillandsia x lineatispica*	None	Bromeliad	★	♦
92	*Tolumnia prionochila*	Toothed-lipped Tolumnia	Orchid	★	♦
93	*Tolumnia variegata*	Variegated Tolumnia; Variegated Oncidium	Orchid	★	♦
94	*Vachellia anegadensis*	Poke-me-boy; Anegada Vachellia	Tree	★	♦
95	*Xylosma buxifolia*	Mucha-gente	Tree	★	♦?
96	*Zanthoxylum thomasianum*	Thomas' Pricklyash	Tree	★	♦
97	*Ziziphus rignonii*	Soana	Tree	★	♦

Further Information for Table 1.

REGION	Symbol Used in Table	# of Species in Profile Islands
British Virgin Island Endemics	★	3
Virgin Island Endemics	★	6
Puerto Rico Bank Endemics	★	14
Greater Antillean Endemics	★	22
West Indian Endemics	★	52

Conservation Status	Symbol Used in Table
Endangered	♦
Threatened	♦
Vulnerable	♦
Stable (Least Concern)	♦

Note:
The conservation status of the species identified in the above table is based on the extensive field research and experience of IRF's biodiversity staff. IRF's methodology for reaching its status determinations does not fully satisfy the global standards of IUCN guidelines, largely because of local data limitations. Nonetheless, we have followed the general precepts of the IUCN approach and, pending additional detailed studies, we are confident these status determinations are congruent with IUCN standards.

True Belongers of Virgin Gorda

Photo 138.
Virgin Gorda Belonger: *Croton fishlockii*.

Photo 141.
Virgin Gorda Belonger: *Guilandia ciliata*.

Photo 139.
Virgin Gorda Belonger: *Hohenbergia cf. antillana*.

Photo 142.
Virgin Gorda Belonger: *Nashia* cf. *inaguensis*.

Photo 140.
Virgin Gorda Belonger: *Mammillaria nivosa*.

9.2.2 Critical Protection Priorities

Native species and their habitats are key biological assets that illustrate the special character of Virgin Gorda and its surrounding islands. However, human-induced activity and especially major tourism-based development have put tremendous pressure on these critical assets. Therefore, the pursuit of better options for the management and protection of these resources should be a top priority for decision-makers in both the public and private sectors. This is why we have identified and highlighted many of these biological assets in this the final section of the *Virgin Gorda Environmental Profile*.

Local BVI (and Virgin Gorda) conditions and decisions present the most direct challenge to species, habitats, landscapes and ecological processes. But global conditions and events associated with climate change and sea level rise are also increasingly adding to the cumulative impacts on Virgin Gorda's resource base. Since humans are the beneficiaries and custodians of these resources, it is the responsibility of the Virgin Gorda community and its government to take positive action to reverse ecological decline and strive for more sustainable use and management of the island's special resources.

If this Profile is truly a "look behind" document (to use a Caribbean expression), then let us look at the loss of just one precious resource as a signpost to guide us as we look ahead. One of Virgin Gorda's most outstanding species, the endemic **Crested Toad** (*P. lemur*), was lost when the mangrove habitats at Spanish Town were dredged to create the Virgin Gorda Yacht Harbour and the marshes at Little Dix Bay were filled for tourism development. Whatever the economic imperatives might have been, these acts were seemingly carried out without a full awareness of the potential loss of one of the world's oldest amphibians, a species so exceptional and rare. It is this benign lack of awareness and understanding that leads to extinction and to the accumulating loss of the ***"genius of the place"*** that is uniquely Virgin Gorda.

9.2.2.1 Plant Species and Habitats of Special Concern

This final section of the Environmental Profile focuses on native species of Virgin Gorda that are of "*special concern.*" However, we note that all native species (whether plant or animal) form an integral part of their ecosystems and ecosystem functions. As such, protection of ecosystems and habitats are also critical to the survival of these species.

When the term "***special concern***" is used, it refers to plants and animals that are currently, or potentially will be, at critical conservation levels as a result of an event or an accumulation of events. These events may have happened over dozens or even hundreds of years although the effects are now being realised. Some events are now being perpetrated and the effects are ongoing, although the eventual outcome may not yet be observable.

The data provided herein on species and habitats of special concern are by no means complete, and further research is needed to determine more precisely (i) the conservation needs of the species and ecosystems highlighted, (ii) the impacts of the threats and how to address them, and (iii) the identify of other potentially threatened species.

A list of plant species of special concern is provided in **Table 37** of this chapter and also in **Table 17** of Chapter 4. **Figure 28** below provides the location and names of some of these rare plants of special concern. These plants were identified during field investigations by the IRF team in October of 2011 and February of 2012; their GPS locations have been recorded.

Vegetation habitats (communities) of special concern are provided in **Table 38** with their general location presented on **Figure 28**. Equally important but not highlighted on **Figure 28** are the identifications and locations of Virgin Gorda's salt ponds and fringing mangroves. These are provided as **Figure 16** and **Figure 17** of Chapter 4, and also described in **Table 27** of that chapter.

Table 38.
Habitats and areas of *Special Conservation Concern* for Virgin Gorda and neighbouring islands.

ENDANGERED | THREATENED

Habitat and Areas	Status	Concerns
WETLANDS (*including salt ponds and fringing mangroves*) Figures 16, 17, and Table 27, Chapter 4		Severely threatened by coastal development.
MAJOR GHUTS (*riparian systems*) Figure 4 and Table 4, Chapter 1		Threatened by land development and road construction.
DRY FORESTS AND WOODLANDS Location E, Figure 28		Threatened by real-estate and commercial tourism development, as well as road construction.
SEASONAL FORESTS AND WOODLANDS WEST AND NORTHWEST OF GORDA PEAK Location D, Figure 28		Threatened by land development and road construction.
COASTAL DUNES AND BEACHES Location #6, Figure 28		Threatened by coastal development.
NATIVE GRASSLANDS Locations H and F and #4, Figure 28		Threatened by land/commercial/tourism development, road construction, feral and free-roaming livestock, invasive non-native grasses, and herbaceous plants.
BOULDER FIELDS Locations I and #5 in Figure 28		At risk from expansion of Spanish Town and from land/commercial/tourism development; also from non-native plant species.
OFFSHORE ISLANDS Locations A, B, and C, Figure 28		Because of their size and exposure, most offshore islands are at risk from invasive flora and from feral and free-roaming livestock.

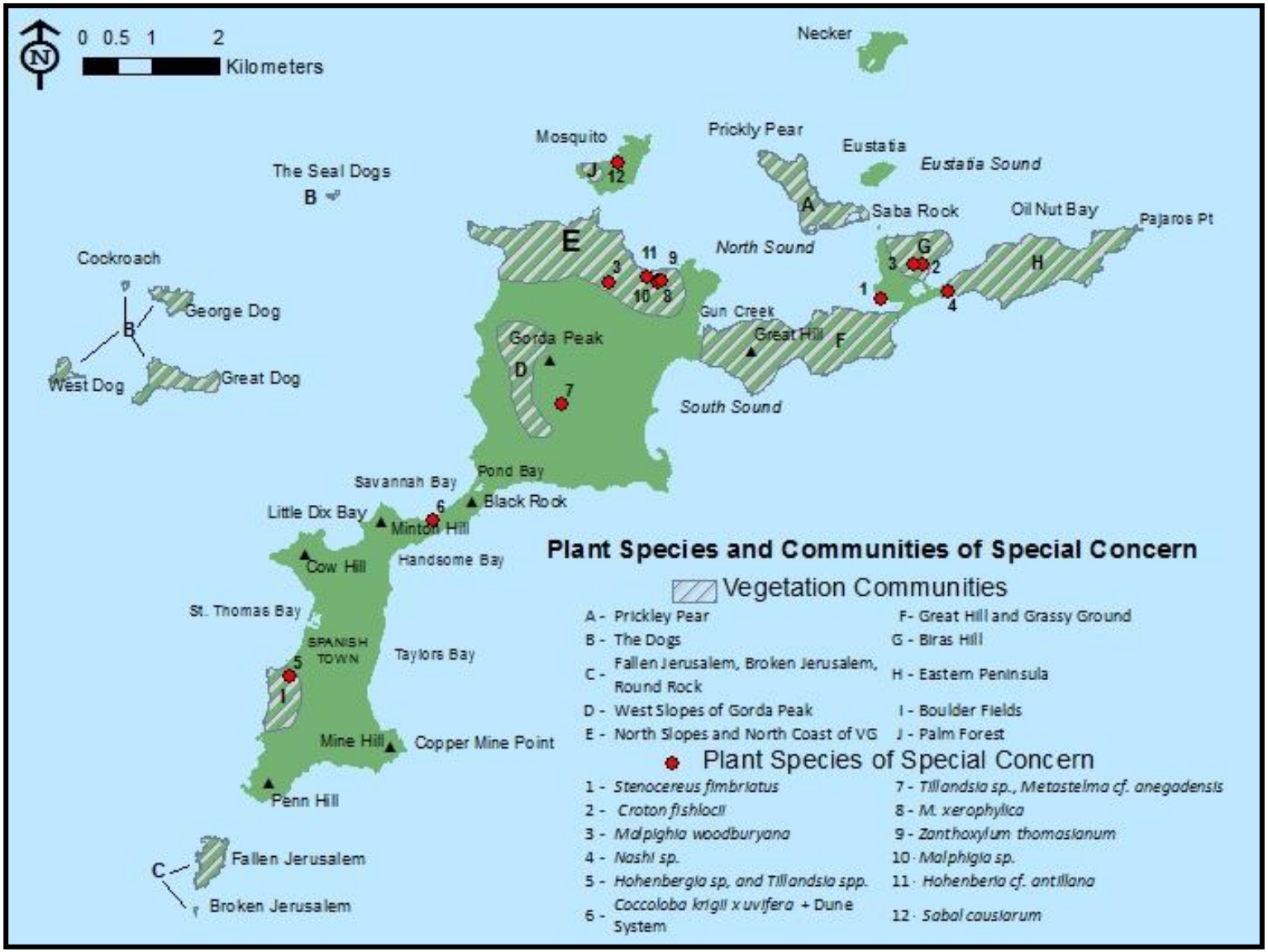


Figure 28.
Plant species and vegetation communities of *Special Concern* for Virgin Gorda and its offshore islands.

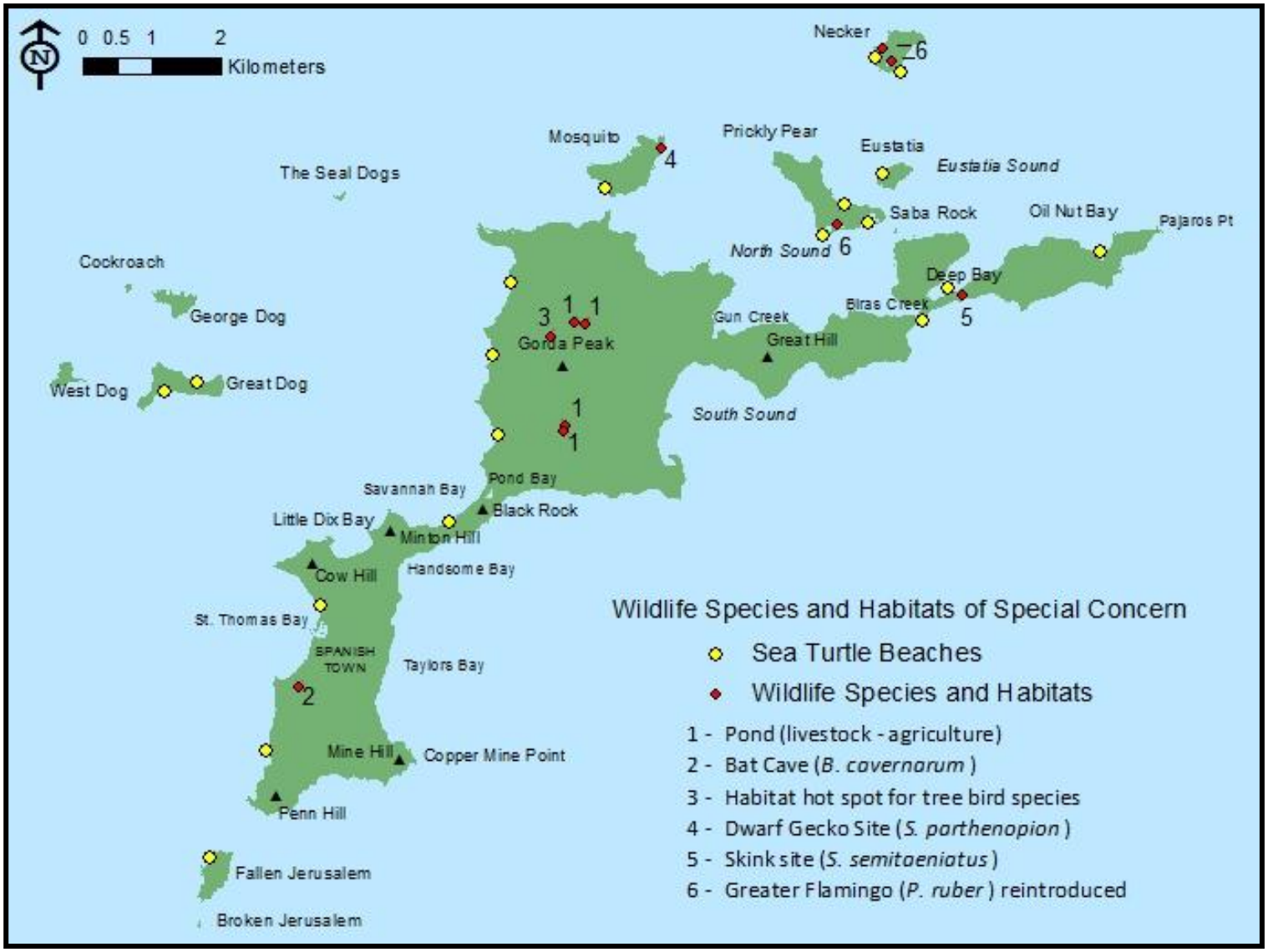


Figure 29.
Wildlife species and habitats of *Special Concern* for Virgin Gorda and its offshore islands.

9.2.2.2 Wildlife Species and Habitats of Special Concern

A list of the native fauna of special concern is provided in **Table 26** (Chapter 4). **Figure 29** of this chapter displays the locations of some of these species of special concern documented during the field surveys carried out by the IRF profile team in October of 2011 and February of 2012. The number of sites and species are likely to increase with future surveys.

A few selective habitats of special concern for fauna are also highlighted on **Figure 29**. Not included but nevertheless covered in the biodiversity chapter (Chapter 4) are salt ponds and fringing mangroves (see **Figures 16** and **17**). These habitats provide critical foraging and nesting opportunities for a great number of faunal species of special concern.

To determine the status of faunal species and habitats (and also plant species and habitats detailed in Section 9.2.2.1), the Foundation's biodiversity team conducted field assessments, consulted local, regional, and international experts, and scrutinised available documentation from other researchers and the results from earlier IRF studies in the environmental profile islands.

9.2.2.3 Future Protection Priorities

As has been noted through this *Virgin Gorda Environmental Profile*, there are many areas on Virgin Gorda and its neighbouring islands that require careful resource management and protection in order for ecosystems and ecological services, natural aesthetics, historical values, and biodiversity to be sustained.

Table 39 provides a summation of information on those areas with multiple parameters of significance or value on the environmental profile islands. These have been identified as priorities by the profile research team.

The cross-referenced format demonstrates that most of the areas and sites included have multiple significance, and therefore judicious management and protection of these areas may be important not only to Virgin Gorda but to the long-term sustainable development of the British Virgin Islands as well.

Photo 143.
The biodiversity-rich dry forest and woodland of the northern slopes of Virgin Gorda looking toward Blunder Bay from above Leverick Bay. These habitats and landscapes are threatened by road construction, land development and feral goats.

Table 39.
Virgin Gorda and its neighbouring islands with multiple parameters of value or significance.

Sites, Habitats, and Vegetation Communities	Parameters of Value or Significance														
	Natural Hazard Protection	History and Archaeology	Landscape Scenic Aesthetic	Recreational	Marine	Protected Areas and Reserves	Climate Change and Sea Level Rise Amelioration	Beach	Watershed Management	Wetlands	Science and Research	Biodiversity	Fisheries	Economic	CONSERVATION STATUS
VIRGIN GORDA															
Boulder Fields				A, B, C								❀		1, 5	VULNERABLE
Copper Mine				A, B, C								❀		1, 5	VULNERABLE
East End Peninsula				A, B, C, D, F								❀ ❀		1, 3, 4, 7	THREATENED
Gorda Peak				A, B, C								❀ ❀		1, 5	VULNERABLE
Gorda Peak West Slopes				A, B, C, D								❀ ❀		1, 5	THREATENED
Leverick Bay Blunder Bay				A, B, C, D, F								❀ ❀		1, 3, 4, 6, 7	THREATENED
Nail Bay to Long Bay				A, B, C, D, F								❀ ❀		1, 3, 4, 7	ENDANGERED
North Sound				A, B, C, D, F								❀ ❀		1, 3, 4, 6, 7	THREATENED
Savannah Bay Pond Bay				A, B, C, D, F								❀ ❀		1, 5, 7	VULNERABLE
South Sound				A, B, C, D, F								❀ ❀		2, 4, 7	THREATENED
The Baths				A, B, C, D								❀		1,5, 6	VULNERABLE
NEIGHBOURING ISLANDS															
Broken Jerusalem				A, B, C, D, F								❀ ❀		1, 7	VULNERABLE
Eustatia Island				A, B, C, D								❀ ❀		1, 3, 4, 7	VULNERABLE
Fallen Jerusalem				A, B, C, D, F								❀ ❀		1, 7	VULNERABLE
Mosquito Island				A, B, C, D								❀ ❀		1, 4, 7	VULNERABLE
Necker Island				A, B, C, D								❀ ❀		1, 3, 4, 5, 7	VULNERABLE
Prickly Pear Island				A, B, C, D, F								❀ ❀		1, 5,6, 7	THREATENED
Round Rock				A, B, C, D, F								❀ ❀		1, 7	STABLE
Saba Rock				B, C, D										1, 3, 5	VULNERABLE

Sites, Habitats, and Vegetation Communities	Parameters of Value or Significance														
	Natural Hazard Protection	History and Archaeology	Landscape Scenic Aesthetic	Recreational	Marine	Protected Areas and Reserves	Climate Change and Sea Level Rise Amelioration	Beach	Watershed Management	Wetlands	Science and Research	Biodiversity	Fisheries	Economic	CONSERVATION STATUS
The Dogs (6 islands)				A, B, C, D, F										1, 7	STABLE
HABITATS															
Beaches				A, B, C, D, F										1, 3, 5, 7	ENDANGERED
Boulder Fields				A, B, C											VULNERABLE
Caves															ENDANGERED
Coral Reefs and Seagrass Beds				A, B, C, D, F										1, 5, 7	ENDANGERED
Forests, Woodlands, Shrublands, Grasslands, Rocky Coasts				A, B, C											ENDANGERED
Ghuts				A, B, C											ENDANGERED
Mangroves, Marshes and Salt Ponds				A, B, C										1, 3, 5	ENDANGEREED
VEGETATION COMMUNITIES															
Boulder Fields				A, B, C											VULNERABLE
Coastal Hedge															ENDANGERED
Drought-deciduous Forest															ENDANGERED
Gallery Semi-deciduous Forest															ENDANGERED
Mixed Dry Shrubland															ENDANGERED
Native Grasslands															ENDANGERED
Natural Beach				A, B, C										1, 3, 5, 7	ENDANGERED
Rock Pavement															ENDANGERED
Sclerophyllous Evergreen Shrubland															ENDANGERED
Seagrasses, Sandy Bottom				C, D, F										1, 3, 5, 7	ENDANGERED
Semi-deciduous Forest															THREATENED
Semi-deciduous Woodland															ENDANGERED
Wetlands				A, B, C										1, 5, 7	ENDANGERED

TABLE 39 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

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 s*table* 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.

Note that in the Table, most environmental profile islands, including private ones, are considered at least vulnerable due the inherent risks from natural hazards and the consequent impacts that damage from such hazards may cause, particularly related to the tourism economy.

Habitats and Ecosystems

The habitats and ecosystems listed in this Table are broadly defined and encompass most of the systems found on Virgin Gorda and its nearby islands, though not all.

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Online Biodiversity Resources

Bathead (Information on bats of the Lesser Antilles):
http://www.bathead.com/

caribherb West Indian Amphibians and Reptiles:
http://www.caribherp.org/

Database on Islands Invasive Species Eradications:
http://eradicationsdb.fos.auckland.ac.nz/

eBird (Global tools for birders, critical data for science)**:**
http://ebird.org/content/ebird (requires you to sign up as a member)

Flora of the West Indies:
http://botany.si.edu/antilles/WestIndies/index.htm

Plants of St. Lucia (focus is primarily St. Lucia but with great photos and many shared species)**:**
http://www.saintlucianplants.com/

Plants of the Eastern Caribbean (focus is the Lesser Antilles but with great photos and many shared species)**:**
http://ecflora.cavehill.uwi.edu/

UK Territories Online Herbarium:
http://www.kew.org/science-research-data/directory/projects/SppSpecDatabaseUKOT.htm

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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. Her 40 years of Caribbean experience have focused on institutional development, NGOs, public policy, financial management, and—most recently—Caribbean philanthropy law.

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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 a regional 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 is the principal scientist for the biodiversity components of the BVI Environmental Profile Programme. For the *Virgin Gorda Environmental Profile*, Mr. Lindsay is the lead author of Chapter 4 (Terrestrial Biodiversity) and co-author of Chapter 9 (Directions for the Future).

The president of Island Resources Foundation, **Bruce Potter**, is an expert on small island sustainable development and the principal architect of the Foundation's capabilities in environmental information management. Mr. Potter has 40 years of experience—in both the public and private sectors—in international development, economic development planning, information system design and implementation, project management, and institutional development.

Mr. Potter was a member of the IRF profile team for eight Eastern Caribbean Environmental Profiles, providing economic profiles for several of the targeted islands. He serves as the information technology manager for the BVI Environmental Profile Programme and is the moderator of the project's blog site initiated for the *Virgin Gorda Environmental Profile*.

Lloyd Gardner is president of the Foundation for Development Planning. An environmental planner from Jamaica and now resident of the U.S. Virgin Islands, he has more than 30 years of experience in environmental management throughout the Caribbean. He participated in the preparation of the Jamaica Country Environmental Profile, authored the National Environmental Management Strategy for Montserrat and has conducted reviews of national environmental strategies for several countries Mr. Gardner was a member of IRF's Sandy Cay project team for over four years, with specific responsibility for preparing the *British Virgin Islands Protected Areas System Plan, 2007-2017*.

For the *Virgin Gorda Environmental Profile*, Mr. Gardner authored Chapter 8 (Protected Areas and Resource Conservation).

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 several proposed development projects in the BVI. Mr. Petrovic was a member of the IRF profile team that prepared the *Jost Van Dyke Environmental Profile*.

For the *Virgin Gorda Environmental Profile*, Mr. Petrovic prepared Chapter 5 (Coastal and Marine Resources).

Cynthia Rolli is an environmental and mitigation planning consultant with considerable BVI experience in all phases of environmental impact assessment, disaster mitigation and planning, and GIS applications. Ms. Rolli was instrumental in drafting the earliest EIA guidelines for the BVI Territory. She has 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 *Virgin Gorda 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 *Virgin Gorda Environmental Profile*.

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 is 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 Environmental Profile*.

For the Virgin Gorda Environmental Profile, Dr. Kent is the author of Chapter 6 (Historical Heritage Resources) and a contributor to Chapter 1 (Introduction to the Profile Islands), where he provided an overview of the historical development of Virgin Gorda.

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 nine years ago, Ms. McDevitt worked for the City of Cape Town, developing strategies to reduce litter, illegal dumping, and waste in landfills.

For the *Virgin Gorda Environmental Profile*, Ms. McDevitt was co-author of Chapter 7 (Pollution Threats), with responsibility for the solid waste management sub-section.

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 the environmental education officer of the BVI National Parks Trust and as fisheries officer with the BVI Department of Conservation and Fisheries.

Dr. Carlos Ramos-Scharrón, IRF's senior scientist, is a recognised expert on watershed management in the northeastern Caribbean, where he has carried out research studies on erosion and sediment control processes for over a decade, primarily in Puerto Rico, the U.S. and British Virgin Islands, and Antigua. His doctoral dissertation from Colorado State University was based on extensive monitoring at dozens of erosion-prone sites on the island of St. John in the U.S. Virgin Islands.

For the *Virgin Gorda Environmental Profile*, Dr. Ramos-Scharrón was a contributor to Chapter 7 (Pollution Threats), specifically, to the section dealing with the impacts of road construction on erosion and sedimentation.