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TOURISM AND THE ENVIRONMENT
A CASE STUDY OF FRIGATE BAY, ST. KITTS



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The views expressed in this document are those of the Consultants and do not necessarily reflect the views of the United Nations or of any CDCC Member Government.

I. INTRODUCTION

A. Terms of Reference

This report is the result of a study commissioned by the Economic Commission for Latin America and the Caribbean (ECLAC). The terms of reference summarized in the contract agreement with the Island Resources Foundation were: "to carry out a case study on tourism, development and the environment for the ... Frigate Bay area in St. Kitts-Nevis and to formulate guidelines and concrete recommendations on appropriate ways to introduce [an] environmental dimension in the tourism industry, including its related infrastructure"

B. The Study Concept and Methods

Tourism, as an economic enterprise, has a long history in the island states and territories of the Eastern Caribbean. In recent decades -- principally since the second World War and especially since about 1960 -- the small-island nations of the region (which vary widely in size, population, income, levels of development, and natural resource endowment) have pursued tourism-related development in a more calculated, strategic mode, although generally in isolation of each other relative to planning and management concerns. Consequently, the pace, type, style, and scale of tourism and its importance to each national economy have also varied widely in the region. Nevertheless, tourism has emerged as the leading economic sector for the majority of Caribbean Microstates (McElroy, 1984). On the one hand, as Blommestein (1985) has noted:

To a large extent tourism developments have been undertaken by the private sector in response to market demand and largely in the absence of policy guidelines and without the essential inputs of planning and environmental assessments, with governments responding in an ad hoc manner to developments and consequences

On the other hand, by way of contrast, some states have not left the task of tourism development entirely to the private sector. The Barbados, Grenada and Trinidad/Tobago governments own hotels, for example, and the latter operates a hotel management training school. St. Lucia, at Rodney Bay, and the British Virgin Islands Government, at Wickham's Cay, undertook area-specific tourism development schemes. St. Kitts took yet a different approach, creating a government statutory body to develop a major tourism complex -- Frigate Bay -- which is the subject of this study. Some states have

sought regional promotion and marketing strategies; others have resisted this tactic. Most have cooperated in supporting the establishment and operation of a regional institution -- the Caribbean Tourism Research Center in Barbados -- to study this heterogeneous thing called "tourism" and its impacts, promise, and problems.

In any event, the transformation which has occurred as a result of tourism development in the region has been significant, particularly in recent years. In general, it has been demonstrated that tourism is a viable path to economic development, but that by failing to plan adequately, the sustainability of tourism can become threatened.

Tourism planning entails identifying the sector-related assets or resources and developing them through a network of economic activity in such a manner that these resources are not destroyed or result in conflicting uses. In West Indian islands tourism is largely based on a favorable climate, the attraction of coastal and marine resources and other natural, cultural and human assets. But in an often desperate effort to create jobs and earn foreign exchange and due to haste in seeking to satisfy market demand for new tourism destinations and facilities, a significant portion of appropriate planning activity -- especially in the environmental sector -- is either never conducted or is side-stepped for expediency during the implementation phase. Forward and backward linkages between the tourism sector and the national economy are also missing in project design formats.

This Frigate Bay case study forms part of a wider regional study which attempts to analyze the relationships between tourism development and the resource base in three small island nations of the region. The Frigate Bay area provides a particularly good example of a zone dedicated to tourism development, with significant linkages to other tourism areas and to the wider national economy. It is unusual, within the region, as an early prototype blending government strategy and private enterprise -- somewhat akin to but still unlike St. Lucia's Rodney Bay development project or the BVI's landfill scheme at Wickham's Cay.

This case study provides a general history of the Frigate Bay development project, a description of the structure and management practices of the Frigate Bay Development Corporation (FBDC), and a review of the existing physical and natural resources of the Frigate Bay area, including their past, present and proposed uses. It concludes with an extended series of recommendations to improve the management and sustainability of the resources committed to the ongoing tourism development process at Frigate Bay.

II. THE TOURISM SECTOR OF ST. KITTS-NEVIS

A. The National Context

St. Kitts-Nevis, which achieved independent statehood on September 19, 1983, is by Eastern Caribbean standards a small country with (in 1980) a total population of 44,404 (35,104 on St. Kitts), 269 sq kms (or 104 sq mi) of land and a gross domestic product (1980) of US\$43 million.

The total labor force is approximately 20,000 persons. A small but growing light manufacturing sector of 28 firms employed 3,000 persons generating approximately eight percent of GDP (1980). Sugar production (approximately 30,000 lbs. annually) occurs entirely on St. Kitts and occupies 12,000 acres out of 19,000 regarded as agricultural land. Sugar, therefore, dominates the economy and, with its molasses by-product, accounts for 17.5 percent of GDP and 70 percent of total exports (Williams, 1983).

Food crops occupy 3,000 acres, yielding in excess of 200,000 lbs. annually, while 11,000 acres (23 percent of St. Kitts' total land area) are forested. By way of comparison, the Frigate Bay development area covers 850 acres.

Given the secular decline in world sugar prices, the Government's more recent search for increased invisible export earnings, tax revenues, and expanded employment opportunities by enlargement and enhancement of the tourism sector is quite understandable and defensible. Frigate Bay is a pivotal segment of that overall strategy. A current Government document sums it up:

The careful development of Tourism in the State is of vital importance. It is necessary in order to provide a wide variety of services and attraction to the visitor. It is also important in that it provides employment and income to our Nationals while retaining as much as possible of our socio-cultural fabric intact (St. Kitts-Nevis Government, Ministry of Tourism, 1982).

B. The Tourism Sector: An Overview

The tourist industry, which is gaining in economic significance, recorded substantial increases in visitor arrivals in 1984. Numbers of visitors to St. Kitts/Nevis rose by 16

percent in 1984 to nearly 40,000 arrivals (see Table 1). The increase followed three years of essentially no growth (1981-1983) when arrivals were at levels of 34-35,000 annually. This pattern reflects trends in the Caribbean region as a whole. For the final quarter, visitor arrivals by air increased by 38.6 percent over the corresponding quarter of 1983, to 10,312 (Eastern Caribbean Central Bank, 1984). Cruise ship passenger arrivals increased for the year by approximately 49 percent to 34,000. This performance, among the best in the Caribbean, reflects the strong market interest in "new" destinations, especially those which can be reached on a seven-day cruise from southern Florida, Puerto Rico, or the Virgin Islands, which has started to "home port" smaller cruise ships.

Table 1. Visitors* to St. Kitts and Nevis by country of usual residence (source: St. Kitts/Nevis Tourist Board and Beekhuis, 1985).

| Country of Usual Residence | 1983 | % | 1984 | % | Percent Change 1983/1984 |
|----------------------------|---------------|--------------|---------------|--------------|--------------------------|
| U.S.A. | 9,858 | 28.77 | 14,572 | 36.55 | 47.82 |
| U.K. | 2,838 | 8.28 | 3,081 | 7.73 | 8.56 |
| Other/Europe | 453 | 1.32 | 437 | 1.10 | (3.53) |
| Canada | <u>2,056</u> | <u>6.00</u> | <u>2,488</u> | <u>6.24</u> | 21.01 |
| Subtotal | 15,205 | 44.37 | 20,578 | 51.60 | |
| OECS | 3,518 | 10.27 | 4,099 | 10.28 | 16.52 |
| Other CARICOM | 2,231 | 6.51 | 2,107 | 5.29 | (5.56) |
| Other | <u>13,315</u> | <u>38.85</u> | <u>13,082</u> | <u>32.81</u> | (1.75) |
| Subtotal | 19,064 | 55.63 | 19,288 | 48.40 | |
| TOTAL | 34,269 | 100.0 | 39,866 | 100.0 | 16.33 |

*does not include cruise ship passenger arrivals

St. Kitts-Nevis has approximately 718 hotel rooms and another 80 guest rooms, with approximately 528 hotel rooms located on St. Kitts and 190 on Nevis (see Table 2). While most of these rooms are located on the coast, a few are renovated sugar plantation houses or more modern design facilities located at various upland interior sites. Occupancy rates are consistently low (Table 3).

Table 2. St. Kitts and Nevis hotel room totals, 1985
(source: Beekhuis, 1985, and interviews).

| Location/ St. Kitts | Name of Hotel | # Rooms |
|------------------------|-----------------------|-----------|
| Frigate Bay | Frigate Bay Beach | 64 |
| Frigate Bay | Jack Tar Village | 150 |
| Frigate Bay | Island Paradise | 88 |
| Frigate Bay | Leeward Cove | 10 |
| Frigate Bay | Timothy Beach | 10 |
| Frigate Bay | Sun 'n' Sand | <u>34</u> |
| | Frigate Bay Total | 356 |
| S/E Peninsula | Banana Bay Beach | 12 |
| Other | Fairview Inn | 30 |
| Basseterre | Fort Thomas Hotel | 64 |
| Dieppe Bay | Golden Lemon Hotel | 17 |
| Basseterre | Ocean Terrace Inn | 40 |
| Other | Rawlins Plantation | <u>9</u> |
| | ST. KITTS TOTAL | 528 |
| Nevis | Cliff Dwellers | 14 |
| Nevis | Golden Rock | 13 |
| Nevis | Montpelier | 16 |
| Nevis | Nisbet Plantation | 30 |
| Nevis | Old Manor | 10 |
| Nevis | Pinney's Beach | 54 |
| Nevis | Rest Haven Inn | 35 |
| Nevis | Zetland Plantation | <u>18</u> |
| | ST. KITTS/NEVIS TOTAL | 718 |

Both islands offer small but varied destinations and have traditionally served as a tourist market for wealthy older repeat guests. In 1984, approximately US\$13 million in foreign exchange and 14 percent of the country's employment came from tourism. In that same year, the proportion of arrivals from North America and Europe (especially the U.S.) increased significantly. This trend bodes well for hotel occupancy as most visitors from North America and Europe stay in tourist hotels, while many Caribbean visitors stay with friends and relatives. The United States continues to provide over one-third of the total visitor arrivals (Beekhuis, 1985).

Table 3. Room occupancy rate and average length of stay in hotels, 1976-1984, St. Kitts (Source: St. Kitts/Nevis Tourist Board).

| Year | Room Occupancy Rate (percent) | Average Length of Stay (nights) |
|------|-------------------------------|---------------------------------|
| 1976 | 24.2 | 4 |
| 1977 | 23.8 | 4 |
| 1978 | 26.2 | 5 |
| 1979 | 27.0 | 5 |
| 1980 | 28.7 | 5 |
| 1981 | 29.0 | 5 |
| 1982 | 23.2 | 5 |
| 1983 | 19.4 | 4 |
| 1984 | 25.9 | 5 |

The St. Kitts-Nevis Government has concluded that expansion of the tourism sector must play an increasingly important role in its economic diversification strategy. In order for this to occur, however, enough hotel rooms must be constructed to justify increased direct jet airline access. (At present only two international airlines, Pan American and BWIA, serve St. Kitts.) The major focus of the Government initiative will be on Frigate Bay and possibly the Southeast Peninsula beyond the Frigate Bay area, for which an environmental assessment and tourism focussed land use planning effort is already underway.

C. The Significance of the Study Area - Frigate Bay

At present, 67 percent of the hotel rooms on St. Kitts or 49 percent of the national total are located at Frigate Bay. With a proposed addition of 100 rooms at Jack Tar Village (formerly the Royal St. Kitts Hotel) by 1986, those percentages would increase significantly. They reflect the obvious attractiveness that Frigate Bay presented originally to Government leaders and planners in the early 1970's, as offering the only major accessible area with potential for coastal and marine tourism development. As a consequence, the Frigate Bay Development Corporation (FBDC) was launched in 1973 to capitalize on the area's natural resources -- two major beaches and open low hills and flat terrain -- and to capture a share of the Caribbean tourism market for St. Kitts. It is not inconceivable that by 1988, or only 15

years since the Corporation became operational, the Frigate Bay area could well have three-quarters of all the hotel rooms on St. Kitts. This trend will continue until major development begins on the now inaccessible, 4,500 acre Southeast Peninsula, an activity that will require prior completion of a major access road down the Peninsula's "spine".

With a combination of light sandy beaches and recreational areas on both the Atlantic and Caribbean coasts, its proximity to Golden Rock Airport and to the capital of Basseterre, an impressive 18-hole golf course, six hotel or condominium projects with the prospect of others to follow, and significant aesthetic assets, Frigate Bay represents a marketable attraction and keystone to St. Kitts-Nevis' tourism and recreational development planning. It is a well defined zone bounded by hills and coasts and is small enough to be effectively managed. It provides the only major accessible water sports and recreational zone on the St. Kitts coast and is currently heavily utilized by both locals and visitors.

In sum, the Frigate Bay Development area provides a useful model for examining the tourism industry on St. Kitts and its capacity to deal effectively with the management of the environmental resources committed to or impacted by the project. To a high degree, the future of tourism in St. Kitts-Nevis depends heavily on the sustainability of the Frigate Bay development project -- the subject of this case study.

III. THE STUDY AREA - A DESCRIPTION

A. Physical Description

Frigate Bay is located in the Parish of St. George's and more specifically is classified in that section considered as "the rest of St. Georges" (Figure 1). In actual fact it forms the beginning segment of the Southeast Peninsula, although separated from it by Timothy Hill. It is close to the capital city, Basseterre, being approximately 2.5 miles away. Distances from air and sea ports are under four miles, and the paved road system poses no problems in travel to and from these points as the traveler does not have to pass through town.

Climatic conditions are not significantly different from those existing in other areas of the island, but the average rainfall (35") is less than the national average although about the same as the lower Southeast Peninsular area at Cockleshell Bay. The northeast tradewinds blow across the area thus creating a relatively cool environment. The average temperature is 78F (26C) which is typical for the temperatures to be experienced in the lower lands, and the average relative humidity is 74 percent.

The study area is quite similar to its adjacent appendage, the Southeast Peninsula, which is the geologically older section of the island; both are very eroded with little "forest cover" and mostly rounded hills, xerophytic dry scrub woodland vegetation at higher elevations and halophytic vegetation in the lower coastal areas.

The geomorphology of the area is the result of marine shoreline accretion and uplift, combined with erosion from the older volcanic hills surrounding this flat valley-like area. The marine influence resulted in two salt ponds, saline soils and brackish ground water. The geology of the study site, like the entire Southeast Peninsula, is significantly different from that of the central core of the island, which was built up by volcanic action in the more recent Pleistocene era. While the rest of the island has large stretches of black volcanic sand beaches, on the Southeast Peninsula the sand color is less influenced by volcanic deposits and is golden brown to yellow in color, with a significant proportion of coral and algal material.

The Frigate Bay project and study area embraces 850 acres and is bounded by the Atlantic Ocean to the east, the Caribbean Sea to the south, the Conaree Hills to the west

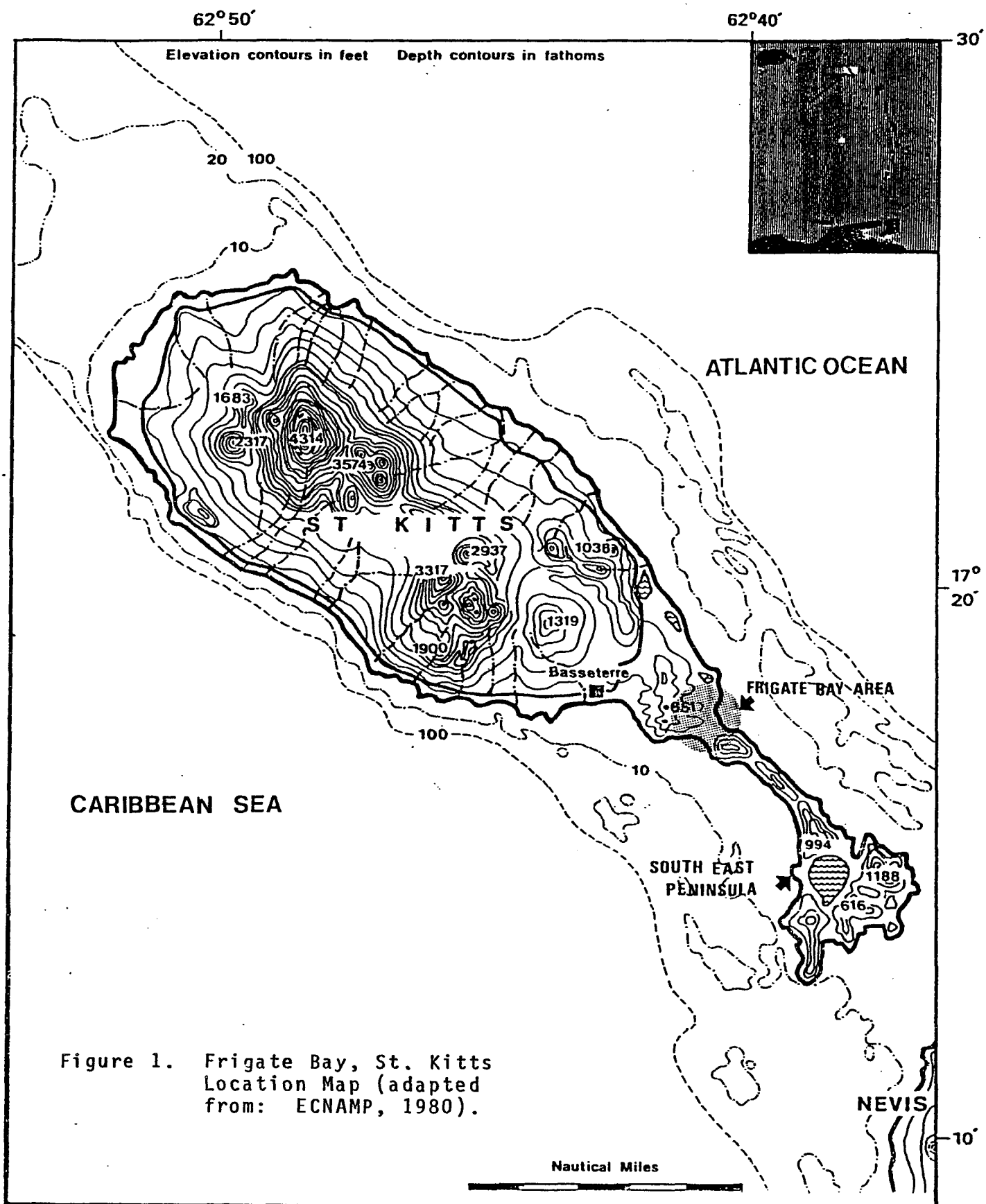


Figure 1. Frigate Bay, St. Kitts
Location Map (adapted
from: ECNAMP, 1980).

and Timothy Hill at the start of the seven mile long Southeast Peninsula (Figure 1). Shaped like a grand double amphitheatre, with natural saline ponds at the northern and southern perimeter and with relatively flat land in between and reasonably gentle slopes to the west, Frigate Bay had a high percentage of buildable or developable land and about one and a quarter miles (2,000 meters) of sandy beaches.

B. Resources and Attractions at Frigate Bay

Beaches. There are two major, high quality beaches in the area, one on the Atlantic side which starts at Cable Bay (near Timothy Hill) and extends northward the entire length of the Frigate Bay to Muddy Point (1,500 meters) and beyond. Its fine sand texture and the light brown color of this wide, gently sloping beach create a natural attraction. The second, shorter (500 meters), steeper beach at South Frigate Bay on the Caribbean side is more accessible and has quieter, shallow waters which are used more often than the Atlantic beach. This beach, however, is more susceptible to storm wave damage and would be cut in two by any dredged entrance to the marina proposed for the salt pond just behind the beach.

Coral Reefs. Extensive coral reef areas close to shore are found mainly on the Atlantic side of Frigate Bay. The reefs are primarily inshore although other reef systems can be found in deeper water several hundred meters offshore and beyond. These create natural habitats for a large variety of marine life, such as conch, lobster, varieties of reef fish and feeding areas for less frequent pelagics such as Spanish Mackerels, Balos, Skipjacks, Bonitos and Jacks. It is important to note that the reefs on the Atlantic side act as a storm wave barrier reducing wave energy and impact on the beach. The fringing reef at Half Moon Bay, just north of Muddy Point, illustrates this point well and is an excellent reef for snorkeling. No detailed marine studies have been conducted in the area.

Sand Berms and Dunes. Another critical environmental feature of the Atlantic coast is the presence of sand berms and dunes. Wind-blown sand has been known to be deposited as dunes as high as twenty feet in some areas and forms a second natural defense barrier behind the beach berm against hurricane and storm wave run-up and over-wash. Over time, salt tolerant (halophytic) vegetation helps stabilize these two sandy sea defense barriers. At least one construction project at Frigate Bay has shown scant respect for the ecological value of the berm-dune system, but in general the

primary berm has been preserved at other project sites along this coast.

Landscape Relief. Land forms within the area are added attractions, especially the rolling westerly hill and valley formations and the Southeast Peninsula's steeper hills which, like a "necklace," form an extended narrow ridge which continues right down to the Great Salt Pond, Nags Head and Mosquito Bluff, only two miles from Nevis across the Narrows (see Figure 1). The scenery viewed from any of the hilltops is most pleasing, and this land form is often used for hiking purposes.

Soils. Soils in this area are generally not ideal for traditional types of agriculture, but limited agricultural activity (i.e., backyard gardening) and domestic horticulture is common. High salinity in soils tends to reduce plant growth in many areas. Owing to accelerated erosion on many hills soil depths are thin, and in some areas rock exposure is evident.

Vegetation. Natural vegetation in the area is generally poor, made up mainly of dry and littoral woodland on the hills and scrub on the hill bases. Vegetation in the developed sections has been changed from arid scrub to cultivated grasses and shade or fruit trees, requiring much irrigation and fertilizer inputs.

Ponds. An interconnecting system linking eight (two natural and six man-made) salt water ponds forms the wetlands to be found in the area. Some of these ponds (which all serve as sediment traps for hillside runoff) were originally mangrove swamps that have been modified into regular ponds, thus changing the wetland habitat. One site receives the effluent from the sewage plant, and the pond system receives pumped Atlantic sea water to assist with the flushing process. Marine life still exists in the ponds including fish which pass (as larvae or juveniles) through the sea water inlet pipes on the Atlantic side of Frigate Bay. Consequently, it is possible to catch a variety of fish types and sizes in the ponds.

Wildlife. By observation of local wildlife enthusiasts, the wildlife population has been decreasing as development increases and as preferred habitats are modified or eliminated, although some sea turtle nesting survives (see following section). The exception is the "ground dove" which has shown a marked increase in population over the years. Deer, mongoose, monkeys, sandpipers (Calidris minutills), the lesser scaup (Aythya affinis), the blue winged teal (Anas discors), the firlous treeduck (Dendrocygna), and the

popular cattle egret (Bubulus ibis) are regular visitors (see also Section IV).

Man-Made Resources. The 18 hole golf course, developed in a proper manner from scratch, stands in distinct contrast to previously existing archaeological and historical sites or features in the area which lie fallow and have not been developed at all. The only exception is the old vernacular estate house, currently used as offices by the Frigate Bay Development Corporation but which might have been restored (to some appropriate time horizon) and used as a show piece museum or interpretive/educational/community center, in possible combination with a sales office. In sum, the historical and cultural resources of Frigate Bay have not been utilized as yet.

Lastly, Frigate Bay never has had any formally designated marine or terrestrial parks, wildlife reserves or protected habitats.

C. The Frigate Bay Development Corporation and Project

1. Background

Thirty years ago Frigate Bay was a privately owned estate which was by and large unproductive commercially. The southerly salt pond was used for small-scale salt mining, the fields and hillsides for animal grazing and the Caribbean beach for local recreation on a permit basis from the owners. The only intact physical structure was the estate house which is now used as the offices of the Frigate Bay Development Corporation.

The land was purchased by the Government of St. Christopher-Nevis in the late 1950's, but certain disputes were not resolved for nearly a decade. Following the preparation of a master plan for Frigate Bay in the early 1970's, the Government established the Frigate Bay Development Corporation (FBDC) and vested the previously acquired Frigate Bay Estate lands in the Corporation "... for the purpose of undertaking and encouraging the development of Frigate Bay (St. Christopher-Nevis Government, 1972). The FBDC was, as a statutory corporate body, solely owned by the Government. No former land owners were equity partners, nor did they express interest in being so involved.

In the original 1972 Frigate Bay development plan, the land was categorized and allocated for five different types of use, based on site capability analysis and other factors.

These land use designations eventually resulted in the following distribution of proposed land uses (see Figure 2):

| | |
|--|------------------|
| - Residential land (some for minimum 1/4 acre lots, others larger) | 220 acres |
| - Commercial land (hotels, condos, etc.) | 285 acres |
| - Service | 30 acres |
| - Golf Course | 180 acres |
| - Green Areas and Other | <u>135 acres</u> |
| TOTAL | 850 acres |

The residential land areas are planned for single family dwellings with four lots per acre maximum, 25 percent building coverage, and the hotel/condominium areas allow 32 rooms maximum per acre. The FBDC was to put in all infrastructure -- roads, telephone, drainage, sewage treatment systems, water supply, and underground electrical service -- and then sell parcels or lots to home owners and hotel/condominium developers. Purchasers of land from the Frigate Bay Development Corporation, whether for commercial or residential purposes, were and still are required to follow the Building Application Guidelines set forth by FBDC. A copy of the most recent Guidelines is attached to this report as Appendix A. These regulations ensure that development proceeds in accordance with the master plan and that all buildings meet minimum standards. Guidelines cover preservation of views, building use, density, setbacks, access, parking, landscaping, on-site drainage, top soil removal, sewage disposal, water supply, and type of building materials to be utilized.

2. Infrastructure Development: Phase I (1973-77)

Beginning in 1973, Frigate Bay's rate of commercial development was relatively slow until recent years. Economic conditions at home and abroad affected the developmental rate, for virtually all commercial developers operating in the Frigate Bay area were foreign investors. Residential development, including some local purchases, continued over the period but did not show any significant acceleration until the turn of the eighties.

During FBDC's first five years of operation, all main roads were cut and surfaced. This included the entrance road to the development (Rd#2), the sections of road between the three roundabouts (Rd#1 and #7) and the section of road running parallel to the Atlantic beach (Rd#6). Passable unpaved roads were provided in selected residential sections (HL and HH). The perimeter electrical lines and water lines

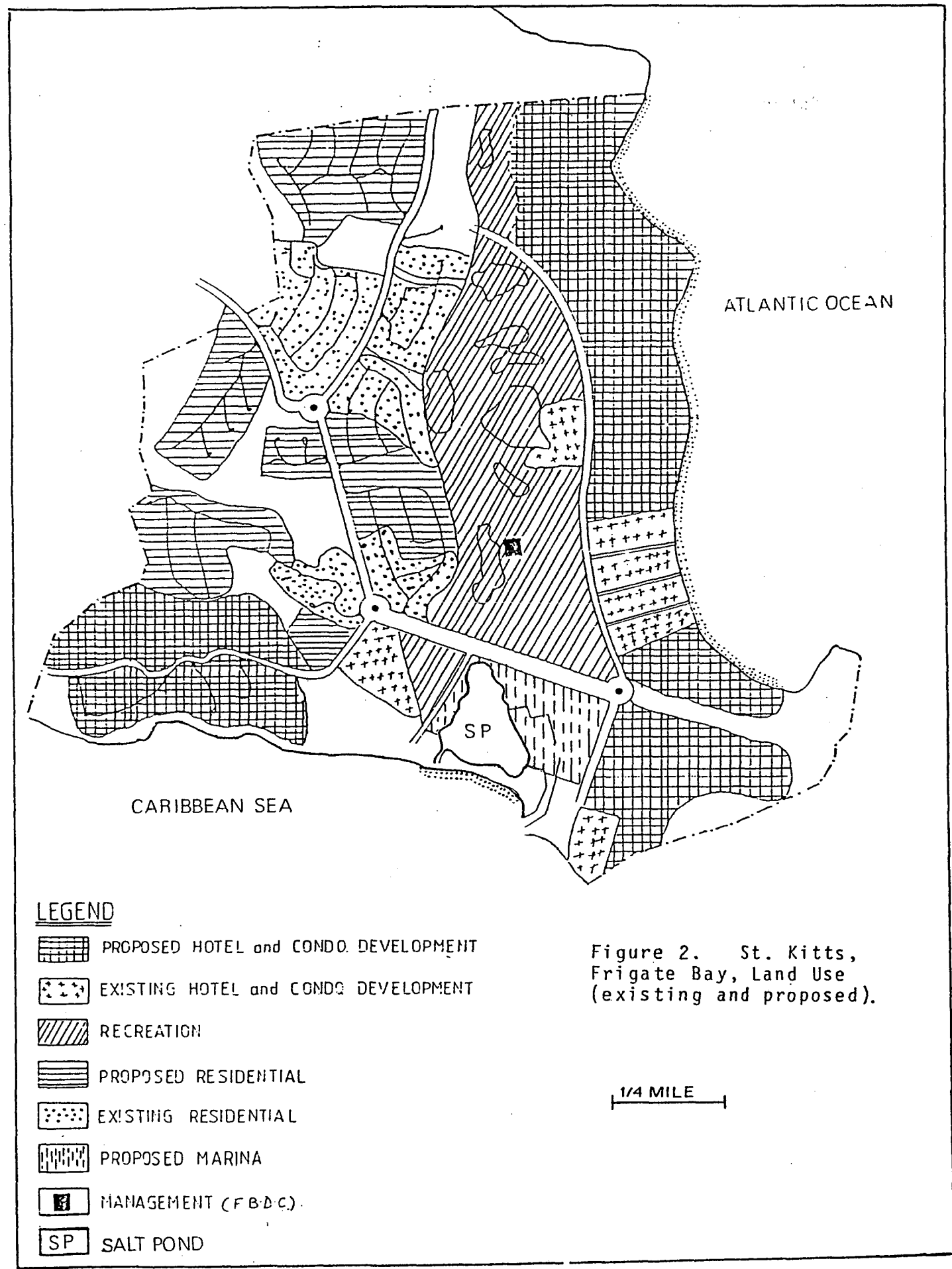


Figure 2. St. Kitts, Frigate Bay, Land Use (existing and proposed).

were installed, and branch water lines and electrical branch lines were provided along the new residential area roads. (See Figure 3.) Storm water drains were constructed at the first and second roundabouts, discharging into a pond system on the flatlands.

Other major activity included the creation of an 18 hole golf course on approximately 165 acres of land. The golf course, which opened in May 1976, has since been developed into one of the three best in the region and provides a manicured park-like core around which all other land use activity is centered. Twelve residential units were started and ten completed by 1977, the end of this period.

Lastly, two major commercial building projects took place during these early years: the first was the Royal St. Kitts Hotel designed originally for 138 rooms with a casino, swimming pool, restaurant and other basic facilities. Two small sewage package plants each with a capacity for 150 persons plus a 20 percent peak overload margin were also installed in the area. The second major commercial project was at Frigate Bay south, the small Anchorage restaurant and bar. Both were owned by the FBDC, and both were architecturally disappointing as "style setting" models.

3. Phase II Development (1978-1982)

During this period, primary infrastructural activities continued and were extended to new areas within the development. Additional roads were cut but left unpaved in six areas. Electrical, water and telephone lines were provided to several new areas, but the building construction did not keep pace. Leeward Cove was the only development of its type to be built, although fifteen new residential units were built.

4. Phase III Development (1983-1985)

The infrastructural situation improved to the point where, in addition to the main road network being paved, most subdivisions now have proper access roads although many remain unpaved. Electrically, one half of the area benefits from an underground grid. The primary electrical power is three phase 11KV with over ten step-down transformers appropriately located throughout the area. Secondary power is also three phase but it carries 415 volts.

Water for the area is obtained from wells outside of the study area and pumped into three concrete reservoirs, each with a holding capacity of 300,000 imperial gallons. A 12 inch water main is installed along Road #1. A six inch pipe

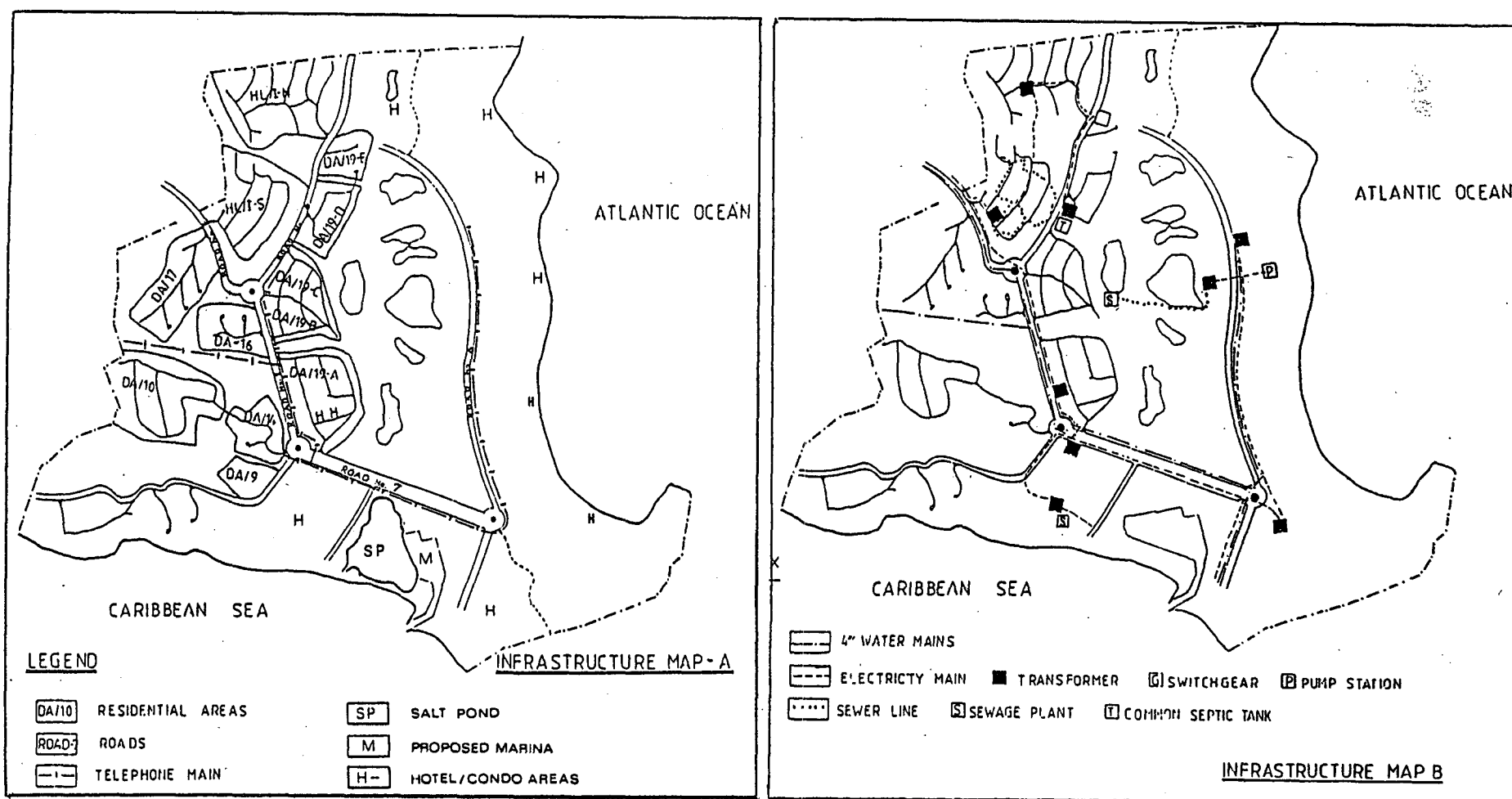


Figure 3. Frigate Bay Development Area, St. Kitts - Infrastructure Maps.

continues from this point along Roads 6 and 7, and this serves the main hotel and commercial areas. The golf course receives its water supply from a nine inch pipe that passes along Road #4. It does not pay for water. Telephone lines are installed in underground cables to the extent of the electrical line system.

Sewage treatment in the residential areas is accomplished by the use of holding tanks which overflow to soak pits. The Royal St. Kitts Hotel is served by a small extended aeration sewage treatment plant which discharges its treated effluent into the nearby pond. A second unit of a similar size to the first one was installed, but has not yet gone on line. Frigate Bay Beach Hotel installed a 500 person capacity sewage plant which discharges into a seep field adjacent to the beach west of the Anchorage Restaurant.

During this period, the Frigate Bay development project experienced a construction "boom." It was also the period when the Corporation sold the Royal St. Kitts Hotel, following a disastrous fire that destroyed the central service area, including the dining room and reception area. The hotel has since been reconstructed and reopened privately. The Anchorage Restaurant was also sold to a long-standing occupant. The sale of the Royal St. Kitts shifted the responsibility for golf course management from the hotel operation back to the FBDC, which still owns the golf course.

The following projects were completed during this period:

- Frigate Bay Beach Hotel = 64 rooms
- Sun and Sands = 34 rooms
- Timothy Beach Hotel = 4 rooms completed and 6 rooms incomplete
- Island Paradise = 40 rooms
- Golden Sands Condominiums = 24 rooms for the first phase which are still incomplete
- Rebuilding the Royal St. Kitts Hotel's central building and construction of the Cabana, which is the hotel's beach recreation center.

A total of nineteen residential homes were built, and FBDC made some progress with additional service road and electrical installations.

5. Proposed Projects, 1985-1989

The major project proposed by the FBDC for implementation during this period is a comprehensive sewage system, to

satisfy demand to the year 2000, which is estimated to cost approximately US\$8 million, partly funded by the Canadian International Development Agency (CIDA).

The second existing 500 person capacity sewage plant which now lies idle will be brought into operation as a temporary measure to service the proposed 100 room expansion of the Jack Tar Village (former Royal St. Kitts Hotel). This project will cost in the range of approximately EC\$25,000 and is a prerequisite for further short-term hotel development on the Atlantic coast. Both plants will run at near full load until the major sewage plant comes on stream in 1987 or 1988.

The developers of Island Paradise (one of the condominium developments) plan to expand by building an additional 66 rooms on a three acre plot of land adjacent to the existing development which, in itself, will have another four buildings (each with four rooms) by the end of this year. This will bring the total to 88 rooms by the end of 1985 and to 154 rooms by the end of the next major phase.

Residential and infrastructural development are expected to proceed at the current rate.

D. FBDC Structure and Management Practices

1. The Board

According to the Frigate Bay Development Corporation Act (1972), the Corporation is under the direction of a Board of Directors composed of a Chairman, a Vice Chairman and not more than seven other members, as the Minister may from time to time determine. The Minister of Tourism has continued to take responsibility for the Corporation since its inception. It is he who appoints the members of the Corporation for a term of two years and the Chairman and Vice Chairman for a term of three years. Reappointment is allowed at the Minister's discretion. For the twelve-year life of the Corporation, the Minister of Tourism has always served as Chairman and has shown no inclination to pass these duties on to anyone else. This creates a rather uncomfortable situation in that the Chairman of the FBDC is therefore responsible to himself as Minister.

The choice of Board Members is entirely in the hands of the Minister, generally with advice and approval from other cabinet colleagues. At present the Board comprises seven persons, including the Minister, a Vice Chairman who is otherwise employed by Government, and the Managing Director who

is also appointed by the Minister. The Attorney General and another public servant also sit on the Board. The other two are the only Board members who can be considered independent, private-sector persons, not likely to be unduly influenced by political considerations.

The act also provides that, in the administration of its affairs, the Corporation may be assisted by such persons in the public service of the State as the Minister may designate for the purpose. Such a function is presently carried out by a technical advisory committee consisting entirely of certain technicians employed in the public sector. (See Figure 4.)

2. FBDC Support Staff

The staff totals approximately 55 persons including a field and maintenance staff of about 35 persons, which has grown by 25 percent since taking over the management of the eighteen-hole golf course two years ago. Not included in this total are the golf caddies who operate on a free-lance basis. The golf pro and two assistants were acquired by the FBDC following the sale of the Royal St. Kitts Hotel. The position of Engineer has never been filled, although efforts have been underway recently to do so.

3. Income Sources

There are two main income-generating activities undertaken by the FBDC on an ongoing basis. The sale of commercial and residential land represents about 80 percent of gross income, and the rental of equipment accounts for the remaining 20 percent. Golf course maintenance occupies most of the staff time and loses approximately EC\$60,000 annually. This does not include the cost of watering the course as no water bills have been received for the 60 million gallons used annually.

4. Costs

Gross land sales fell by 50 percent in 1984, to approximately EC\$1 million from EC\$2 million in 1983. No commercial sales were recorded in 1984. Administrative and maintenance expenses rose from EC\$0.7 million in 1983 to EC\$1.1 million in 1984, mainly as a result of unpaid equipment rentals (valuing over EC\$250,000) to Government, which are accounted as a donation from the Corporation. In effect, the "free" government water actually costs EC\$250,000. The Corporation registered a net loss of approximately EC\$200,000 in 1984.

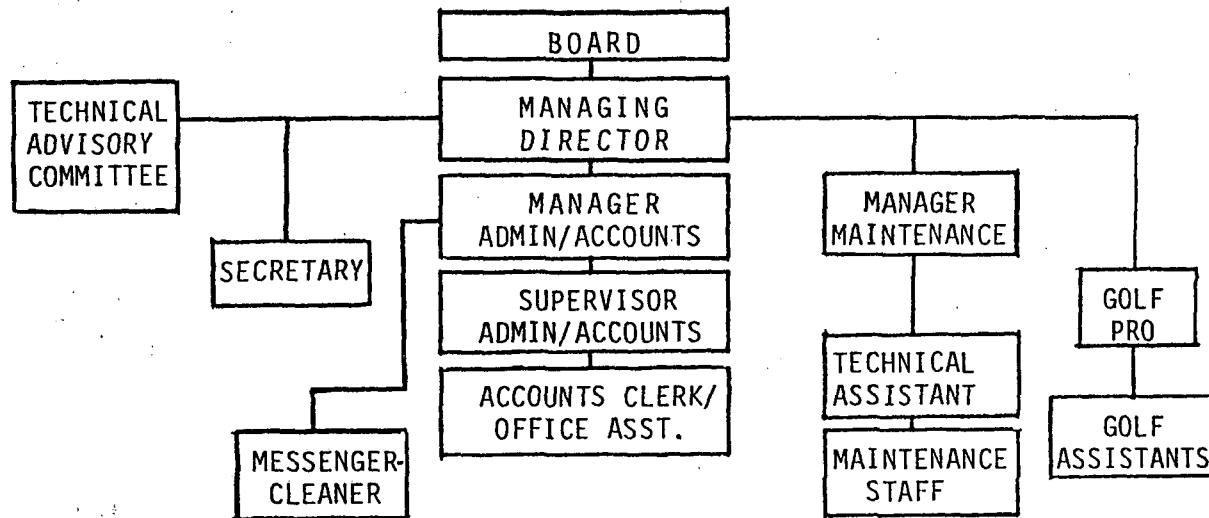


Figure 4. Organizational structure of Frigate Bay Development Corporation.

This state of affairs does not worry the Managing Director, who reports that the cash flow situation is adequate to see the Corporation through this period of sales decline. The priority for the short-term is the result of a decision to bring the basic infrastructure up to market requirements before undertaking a promotional campaign in the long-term. However, with approximately 60 percent of available land now sold, there is less than 30 percent of the required infrastructure in place.

The Corporation's marketing efforts consist mainly of the promotional campaigns of the St. Kitts-Nevis Tourist Board. The current managing director feels that the emphasis at present must be on upgrading the management of the existing Frigate Bay area before undertaking any major advertising and sales campaign, locally or internationally (W. Liburd, personal communication). Whether this "management upgrading" mission will incorporate new environmental management strategies designed to enhance the marketability of Frigate Bay's tourism product remains to be seen.

IV. RESOURCES, USER IMPACTS AND ENVIRONMENTAL CHANGES

A. Shallow Marine Habitats

1. Mapping

Figure 5 shows the shallow marine habitats adjacent to Frigate Bay based on aerial photos flown in 1968, as adjusted by two site surveys for the current study. Both physical and biological processes since that time will have lead to changes in distribution of the more dynamic bottom types (e.g., the proportions of open sand and seagrass beds), but the picture is satisfactory for present purposes. Two areas of particular interest were examined in some detail by study investigators -- the regions immediately offshore from the northwest end of Frigate Bay South and from the Royal St. Kitts beach facility on Frigate Bay North.

2. Frigate Bay South.

The area off Frigate Bay South, while it appears heavily visited by both local and tourist snorkelers, is offshore from the Frigate Bay sewer outfall. Seaward of the near-shore band of ripple-marked open sand, with scattered, exposed dead sand dollars and mollusc shells, there are patchy beds of dense seagrass. These beds are predominantly manatee grass (Syringodium filiforme), but typically contain some turtle grass (Thalassia testudinum) and variable amounts of macroalgae (Halimeda, Caulerpa, Avrainvillea). The seagrasses are not heavily overgrown with epiphytic algae and appear generally healthy. The manatee grass is expanding into adjacent areas of barren sand. The empty shells of recently harvested queen conch (Strombus gigas) can be seen every few meters, but large living conch are rare, at least in these shallow areas.

The reef community developed on submerged bands of beachrock (marking ancient shorelines) is depauperate, but probably interesting to the novice snorkeler as there are some attractive fish present such as juvenile angelfish (Pomacanthus sp.) and small numbers of large soft corals and sponges. About 20 percent of the beachrock framework is covered with living coral, and most of the stony corals are low encrusting forms. There is little vertical relief to provide visual interest or habitat diversity for fish or other organisms. The air photos indicate that reefs with more extensive coral development are located somewhat further offshore, but these are probably beyond the range of novice snorkelers swimming out from the beach. While damage by the recent Hurricane Klaus and the intrinsic low relief

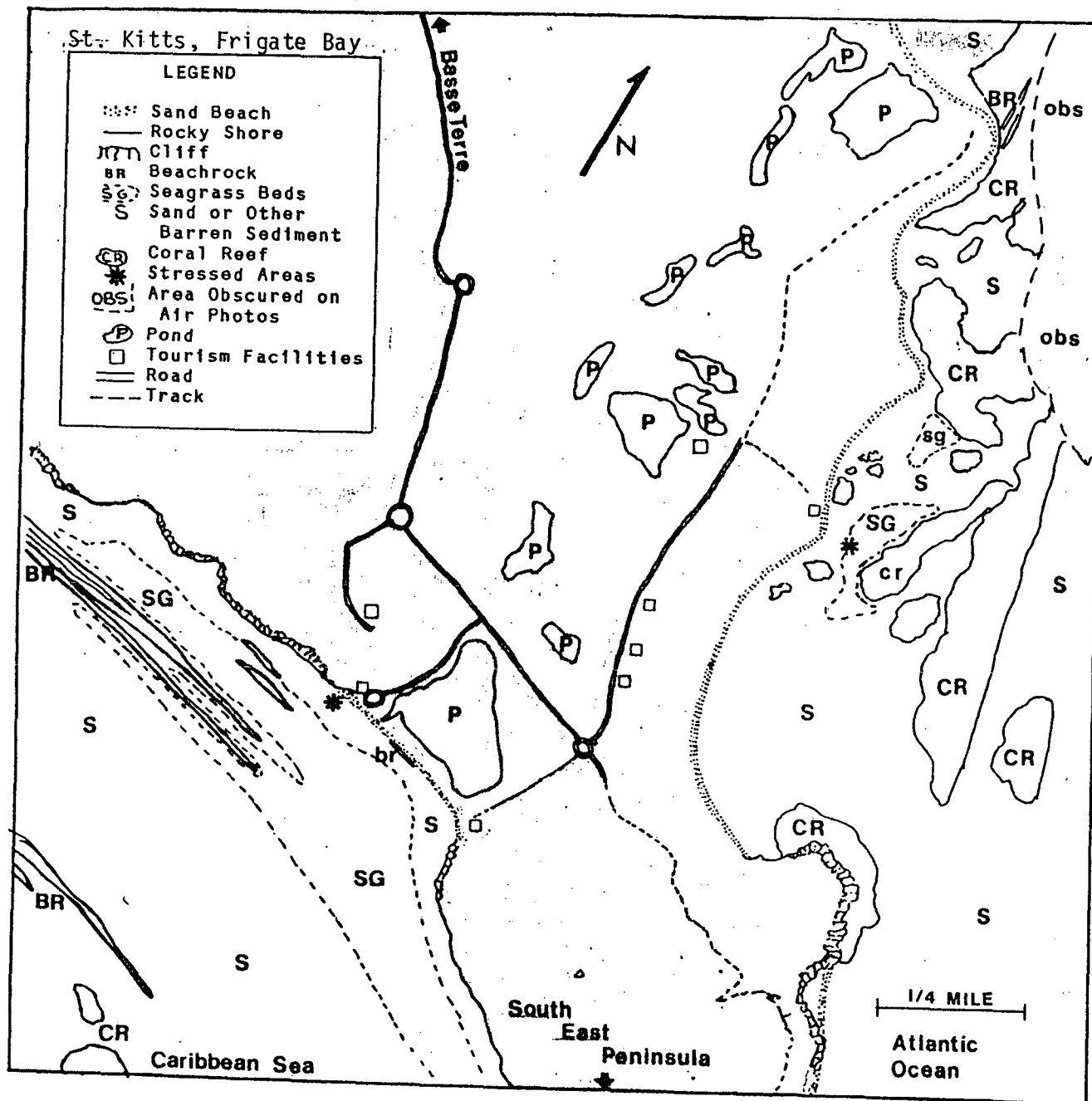


Figure 5. St. Kitts Frigate Bay area, coastal and marine features. Data from DOS 1968 aerial photographs and 1985 field work by W. Rainey, Island Resources Foundation.

of the beachrock framework likely contribute to fairly low fish numbers and diversity, visitor impact by exploitation (suggested by the stand on the beach advertising speargun rentals) could certainly make the limited community less interesting to future observers. There are, however, no blatantly visible effects attributable to the sewage percolating through the beach a few tens of meters away -- at least at present.

3. Frigate Bay North

Immediately offshore from the restaurant/recreational facility on the Atlantic shore, there is a wide band of ripple-marked sand, interrupted just north of the point in front of the restaurant by a patch reef in the surf zone. This reef is evident in the 1968 air photos, and overall appearances suggest a long-term trend of the beach advancing slowly seaward (Figure 6) over the patch reef (with periodic retreats from major storms). The reef is subject to considerable wave action, scour and sedimentation. The framework has about a 10 percent cover of living hard or soft coral, the rest being covered with encrusting calcareous algae or a fleshy algal turf. There are a few colonies of elkhorn coral (Acropora palmata), but most stony corals are low, sediment-tolerant forms. There were some large surgeonfish grazing on the reef, but most fish noted were small damselfish or parrotfish. The water is clear and shallow; so despite the limited diversity, the reef should be interesting to novice snorkelers.

At the seaward margin of the open sand there are vigorously expanding patches of shoal grass (Halodule wrightii), some of which have very heavy overgrowths of epiphytic algae. Seaward at slightly greater depths (3-4 m), the seagrass patches are a mixture of manatee grass, shoal grass and macroalgae. Here again the patches appear to be erosional remnants from earlier storm damage which are expanding slowly into adjacent areas of barren sediment. Continuing seaward in depths of 4-6 m, the conditions change considerably. The established beds of manatee grass are covered with a thick layer of long hair-like epiphytic green algae which is continuous over substantial areas. The dense algal layer blocks out light, and manatee grass below it is dying back in all of the (relatively small) area examined (Figure 6). There are few leaves on the grass rhizomes, and on the margins of grass patches the barren but living rhizomes are eroding out of the sediment over a substantial proportion of the area.

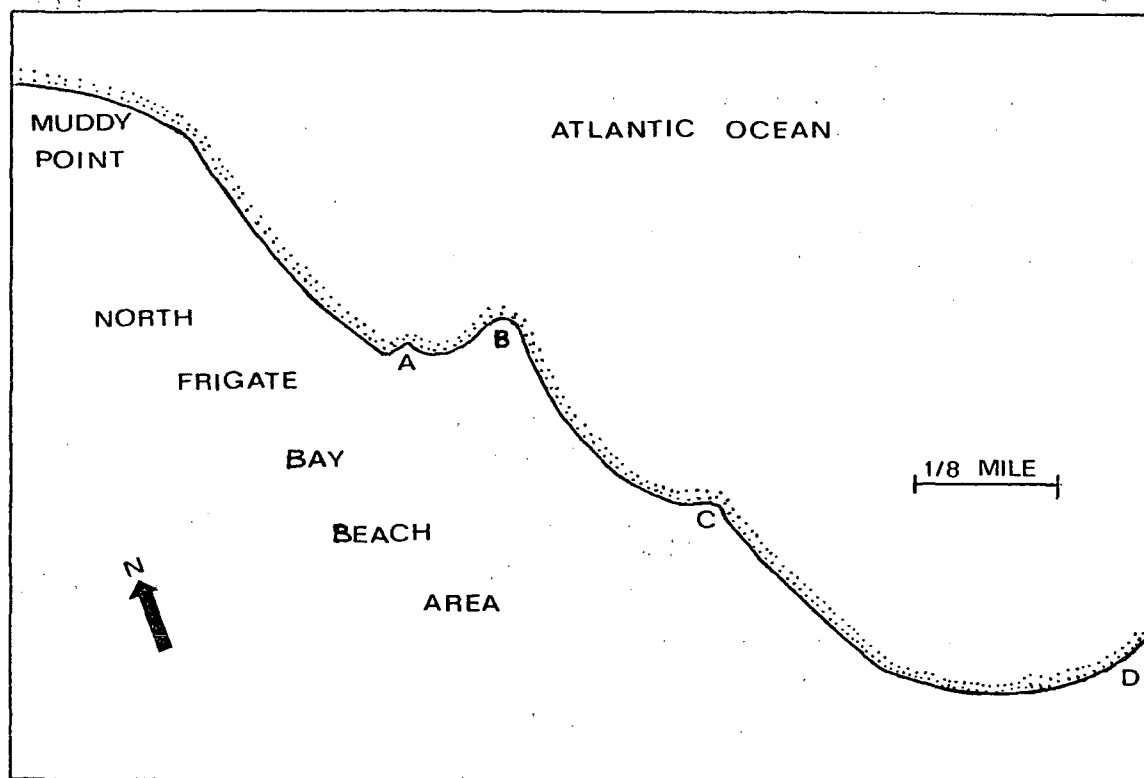


Figure 6. North Frigate Bay shoreline migration. Based on a comparison of 1962 and 1982 aerial photographs. Points A and B are accreting (moving seaward), and Point C is eroding with sand build-up at D likely.

There are scattered observations of temporary filamentous algal blooms around several Caribbean islands, but the extent of damage to the seagrass here is quite unusual. This situation is cause for concern, not only for the ecological impact of the loss of the seagrass beds as habitat, but because seagrasses play a significant role in trapping and stabilizing nearshore sediments. Decreased seagrass area will likely lead to increased sediment movement in subsequent storms, with consequent changes in the nearshore bottom profile and perhaps changes in the beaches.

The immediate cause of the luxuriant growth of epiphytic algae is uncertain but one possibility is a local increase in concentrations of dissolved nutrients. An obvious source for increased nutrients in the "lagoonal" waters between the reefs and the beach is increased nutrient concentrations in groundwater percolating seaward through the beach. Increased groundwater nutrient levels would result from domes-

tic waste discharges, fertilizers for the golf course and plantings, and general runoff from developed areas within the watershed. Though the connection is somewhat speculative, the quality of the beaches is sufficiently important to the viability of tourism development that a more thorough evaluation of the extent of damage to the seagrasses (and perhaps the reefs seaward of them which were not surveyed), groundwater nutrient levels, and shallow marine circulation is in order.

In front of the restaurant a large buried plastic pipe emerges from the beach and extends offshore across a patch reef. This is the intake for seawater pumped to the inland ponds of the Frigate Bay complex. Long broken sections of similar pipe scattered on the bottom nearby make it clear that this intake has been damaged and repaired after major storms. The broken pipe should be removed.

B. Beaches

1. Introduction

The extensive, light-colored sand beaches of Frigate Bay are one of the area's major tourism assets, and, therefore, the long-term maintenance of the beach areas deserves serious consideration in development planning. Much more than other aspects of the landscape, beaches are dynamic systems, changing form in response to seasonal shifts in wind and wave regimes. These processes are usually cyclic, but progressive alteration such as headland erosion, rare natural events, such as major storms, or some human activities may alter a beach in ways which are permanent or which persist over many years. The dynamic system extends beyond the open beach itself to include dunes behind, the sandy shallow nearshore, the reefs offshore, and the freshwater streams which carry upland sand to the sea. Alterations to any of these components may ultimately affect the form, or indeed, the continued existence of the beach.

2. Previous Surveys.

Deane, et al. (1973) examined the beaches on both the Atlantic and Caribbean shores of Frigate Bay in the interval 1970-73. Their beach classification for the three sites examined is given in Table 4). Cambers (1983) surveyed coastal erosion and sand resources in St. Kitts-Nevis and reported no evidence of substantial erosion on either Frigate Bay North or South in the interval 1946-68 and only local erosion on Frigate Bay North from sand mining in the interval 1968-1983. Specifically, in the latter case, removal of

Table 4. Beach classification for Frigate Bay, St. Kitts (adapted from Deane, et al., 1973).

| LOCATION | EXPOSURE | Color | SEDIMENT Grain Size | Type | STABILITY |
|-------------------------|--|-----------------------|---|--|-------------------|
| | | | | | |
| Frigate Bay South | Leeward coast, exposed | Very pale brown | Well-sorted, fine/medium sand | Mineral with less than 40% shell-coral sand | Stable |
| South of Muddy Point | Windward coast, exposed | Very pale brown | Moderately well-sorted, fine/medium sand | Shell-coral sand with less than 40% igneous minerals | Slight erosion |
| Frigate Bay North | Windward coast, a crescentic- shaped beach, partially pro- tected by a headland, reef | Very pale brown | Well-sorted, fine/medium sand | Shell-coral sand with less than 40% algal fragments | Stable |

large amounts of sand from the beach in 1983 resulted in undermining of the Royal St. Kitts beachfront restaurant/recreation building. In a recent resurvey for UNESCO (Cambers, 1985), she observed significant erosion along the west coast of St. Kitts as a result of Hurricane Klaus in 1984. This included Frigate Bay South where an entire pocket beach at the western headland disappeared. Also, she reports that December 1984 removal of vegetation in front of the Royal St. Kitts Hotel led to considerable sand loss. She considered Frigate Bay particularly sensitive to sand mining or vegetation removal because low elevation enhances the risk of flooding, and the wind funneling through this low area increases the risk of wind erosion of dunes when the vegetation is disturbed.

3. Case Study Field Survey (October 1985): Caribbean Shore

Frigate Bay South beach is the primary tourist attraction on the Caribbean shore. It abuts rocky hillsides at its eastern and western ends and is backed by a large salt pond. At the western end there is a paved road leading to the Anchorage Restaurant and an informal parking area used by beachgoers. On a leveled platform slightly above the eastern end of the beach on the hillside is the Timothy Beach Resorts building. Two units there appear to be occupied; the others are unfinished. This facility is served by two unpaved sandy tracks which lead onto the beach berm. Several local fishing boats are beached here, and signs offer boating services.

The beach is currently widest (Figure 7A) toward the western end (up to 10 m from the water's edge to the permanent vegetation line) and narrowest in the center (about 3 m). Activity on the beach is concentrated at the eastern and western ends, not only because of ready access but because exposed beachrock (Figure 7B) in the zone of wave runup and in nearshore shallow waters makes swimming less appealing. The seaward face of the beach is relatively steep, but it appears to be stable or advancing slightly at present. A slight erosional scarp and some exposed roots in the remaining clumps of seagrass near the center of the beach (Figure 8A) make it clear that the beach was cut back to the permanent vegetation line recently (presumably during Hurricane Klaus), but has extended seaward slightly since then. At the far eastern end of the beach exposed roots of mature mahoe trees (*Thespesia populnea*) and an undercut scarp in the soil indicate that erosion was severe here and recovery since limited. The beach sand itself has a salt and pepper appearance, resulting from a mixture of dark grains of largely crystalline igneous minerals with lighter colored



Figure 7A. Frigate Bay from northwest end. Timothy Hill and Timothy Beach Resort in background. The car park and restaurant are behind the grove of trees.



Figure 7B. Recently exposed beachrock in the swash zone and nearshore close to the center of Frigate Bay beach.

grains which include both igneous minerals (largely silicate glass) and marine carbonate particles (shell, coral and algal fragments).

The dune form and beach vegetation have been considerably modified by man. All of the woody beach and dune vegetation except for limited portions of the seaward fringe of seagrape has been removed. The dune area (no higher than 1 m above the berm) is now covered with low grass and scattered planted coconut palms. Immediately in back of the beach, there is a vehicle track which leads to the eastern access road. An artificial outflow channel for the salt pond (Figure 8B) which was cut through the beach has been closed by longshore movement of sand. In addition to human activity there were several dogs near the beach chasing shorebirds in the early morning. Digging under the remaining patches of seagrape suggest that any turtle nests laid on the beach which avoided human depredation would likely be taken by dogs.

The pocket beach on the northwest headland of Frigate Bay South has not recovered from the effects of Hurricane Klaus (noted by Cambers, 1985). The beach is an 8-12 foot wide band of largely igneous pebbles, cobbles and boulders with little sand thinly veneered over bedrock (Figure 9A). Coral heads up to several feet in diameter on the beach attest to the intensity of wave action experienced here in the recent past. A thin layer of dune sand partially stabilized by vegetation extends up the hill (itself a rockslide) behind the beach to perhaps a 50 foot elevation. The dune sand is being eroded down slope by freshwater runoff and slumping and is largely carried away by wave action. The sand remaining on the beach among the cobbles is the small fraction of coarse material left after winnowing by wave action. The dune sand is out of equilibrium with the current level of wave energy at the beach, and erosion can be expected to continue until little or no sand remains in the zone of wave runup. At the western headland of the pocket beach there are vegetation-stabilized lobes of dune sand perched above vertical rocky cliffs, also indicating a formerly more extensive beach. The bottom close to shore off this beach and cliffs is covered with large boulders, so it has no appeal as a bathing area, but footprints indicate a few visitors still find their way along the shore.

4. October 1985 Survey: Potatoe Bay

Further northwest on the undeveloped Caribbean shore of the Frigate Bay property is Potatoe Bay. The watershed for this bay appears to be lightly-used grazing land undergoing conversion to thorn scrub. An indistinct foot path leads west



Figure 8A. Frigate Bay beach looking east from near center of beach. Beach vegetation is largely removed with only patches of seagrass left. Planted coconut palms and mowed grass behind this seaward fringe. Timothy Hill in background.



Figure 8B. Widgeon grass (*Ruppia maritima*) accumulated by wind in closed artificial outlet channel for pond behind Frigate Bay beach.

parallel to the coast toward a small, seemingly abandoned house; there is little evidence of current human activity other than cattle grazing. The center of beach in the western cove of Potatoe Bay is a veneer of largely igneous sand over a sea level bench cut in unconsolidated sediment, but the loose beach material grades into cobbles and boulders toward each headland. The center of the beach is 3-5 m wide to the foot of a cliff of unconsolidated sediment 6-10 m high. There is no dune development.

Shrubby vegetation growing on the cliff face shows that the rate of shoreline retreat is not rapid, but the roots of manchineel trees in a gut close to the eastern headland of the cove were recently exposed by wave action (perhaps during Hurricane Klaus). The eastern side of the cove is a steep rocky slope undercut by wave action; the western side is a low point with cobble beach. The cove bottom appears to be covered with igneous boulders. Though the upland areas offer an attractive view of the coast, this beach has little to offer the typical beachgoer.

5. October 1985 Survey: Frigate Bay North

Except for its southernmost segment which includes a rocky headland, the entire eastern shore of the Frigate Bay Development Corporation property is a continuous, light-colored sand beach backed by low, vegetated dunes. The northern portion of this beach is protected from the full force of Atlantic swells by a fringing reef. The southernmost beach segment is not so sheltered and has a steeper beach profile and higher dunes (Figure 9B).

At Muddy Point, just north of the northern Frigate Bay Development Corporation property line, the beach berm is about 13 m wide and less than 1 m high near the seaward edge. It grades irregularly into a vegetation-stabilized dune 1-1.5 m higher than the berm. The woody vegetation on the seaward edge of the dune is seagrape which is replaced by croton, wind-sheared manchineel and buttonwood behind the dune crest. On the lower sandy soil behind the dune there is thorn scrub in which columnar cactus (Cephalocereus royeri) is prominent. At the rear margin of the dunes a sandy vehicle track parallels the beach and provides direct access to Muddy Point from the hotel areas to the south.

The beaches on the point and immediately to the south show no evidence of recent erosion, but there is an erosional scarp in the center of the beach in Halfmoon Bay to the north. Beachrock lineations in the shallow water north of the point subparallel to the current shoreline offer testament to changes in beach position. The sand at Muddy Point



Figure 9A. Eroded pocket beach northwest of Frigate Bay.



Figure 9B. South along the beach from St. Christopher Beach Club and Casino; note vegetation-stabilized dune extending up lower slope of Timothy Hill and erosional channels through that dune.

is fine-textured and appears to be a roughly equal mixture of marine carbonates and igneous material. Large numbers of human and dog tracks are evident on the beach. Right at the point, an area roughly 10 X 16 X 1 m was excavated through the berm and dune with heavy equipment (Figure 10A). At the rear of this excavation a mound of sand is pushed up (where the vegetated dune would have been). This mound (which is alongside the vehicle track leading back to the main road) shows evidence of more recent sand extraction with hand implements.

The rear margin of the dunes between Muddy Point and the Royal St. Kitts beach facility show evidence of extensive sand mining, though the dune height is so low (typically about 1 m) that the total volume of sand removed is not enormous (Figure 10B). The water table is at the ground surface in the low lying land behind the dunes, placing a lower limit on convenient sand excavation with hand tools. Although sand mining is nominally illegal, multiple fresh excavations indicate that it continues (Figure 11A). One popular site with a borrow area roughly 30 X 30 X 1.5 m is slightly north of the Royal St. Kitts beach restaurant. In addition to a considerable depth of sand, it is screened from unwanted onlookers by a stand of manchineel trees. On 26 October a large truck with several workers shoveling sand was encountered here. Their response to observation suggested they were well aware the activity was illegal (Figure 11B).

6. October 1985 Survey: Royal St. Kitts Hotel Beach Facility

Although this beach was originally similar in overall aspects to Muddy Point, it has been more heavily modified and receives much heavier visitor use. Close to the restaurant/recreational building, the woody dune vegetation has been removed from the beach inland to the vehicle track paralleling the shore, and the dune has been leveled. North of the building the seaward fringe of seagrass is locally intact, but areas to the rear have been cleared and leveled and are now covered with salt tolerant vines. Irregular remnants of earthmoving operations (pits and mounds of sand) further north now support a continuous cover of herbaceous vegetation, with some seedlings of woody vegetation. South from the building the seaward fringe of seagrass on the primary dune persists but is locally broken by openings which provide vehicle access to the beach. Several sets of deeply indented vehicle tracks cross the dune and continue north along the water's edge toward a cluster of hauled-out fishing boats.

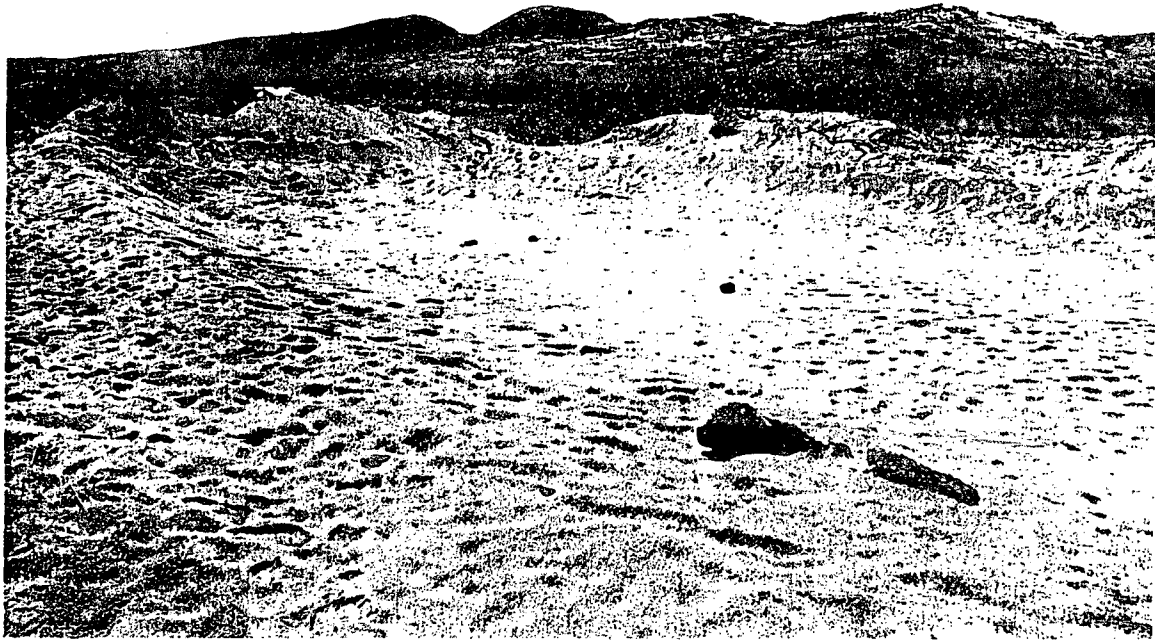


Figure 10A. Substantial excavation with heavy equipment through dune extending on to berm at Muddy Point (possibly an attempt to restore a dune after earlier sand removal).



Figure 10B. South of Muddy Point; sand borrow at rear edge of dune; note typical back beach vegetation on dune and sedge on water saturated soil below; water table is the base level for manual sand extraction.



Figure 11A. Immediately south of Muddy Point along rear margin of dune. One of many sand borrow sites.



Figure 11B. Extensive clandestine sand excavation area and dump site. This site is close to the Royal St. Kitts Hotel beach facilities, but is hidden by vegetation; truck observed taking sand here on 26 October, 1985.

Seaward of the restaurant building the beach is about 25 m wide, and there are numerous semi-permanent thatch umbrellas over tables and beach chairs. Rake marks show that the small amount of seagrass and other marine debris deposited on the beach is removed in the immediate vicinity of the building. The sand is fine and yellow, but qualitative microscopic examination revealed it contains about equal parts of marine carbonates and igneous material. The slope of the beach in the zone of wave runup is low, and the beach is currently advancing seaward at this location. Immediately to south of the restaurant the berm is about 1.2 m high and grades irregularly into a dune 3-4 m high. At the first point north along the shore from the building, the beach is considerably narrower (5-7 m). In the arc of beach south of the restaurant, leading to Leeward Cove and the other developments (the northern portion of Frigate Bay North), there is a clear 0.6 m scarp indicating recent erosion of the berm, but the beach has advanced seaward 5-7 m since that event.

7. October 1985 Survey: St. Christopher Beach Club and Casino

This is the southernmost development (albeit inactive) along the Atlantic shore. The incomplete buildings are close to the road paralleling the beach, but the entire site between the buildings and the back of the primary dune is cleared and leveled. The leveled area is now completely covered with a dense mat of vines and grasses except for a more recent, large and barren excavation (perhaps for sand extraction) behind the primary dune. The woody vegetation cover on the dune itself is largely continuous seagrape with patches of Suriana maritima on the seaward face. A 0.6 m scarp just seaward of the face of the dune indicates the beach was cut back severely, relatively recently, but it has advanced seaward about 8 m since that time. The seaward margin of the berm is slightly cusped and gently sloping (4-5 degrees) in the zone of wave runup.

As noted earlier, the primary dune height is somewhat greater near the southernmost end of the beach, and lobes of wind-driven sand extend at least 16 m up the slope of Timothy Hill. This fan of sand, now heavily vegetated, is being dissected locally by runoff from the hillside above. Evidence of small-scale sand mining in low elevation, back beach portions of this undeveloped section are extensive, and the extraction continues.

8. Beach Use

On 25 October at 6:45 AM at the northwest end of Frigate Bay

South adjacent to the Anchorage Restaurant there were six vehicles parked with 25 people (including 3-5 tourists) on the beach or in the water. By 7:10 AM the local residents had left leaving only the tourists. At 2:00 PM there were approximately ten people in this area including one or two engaged in renting sailboards and instructing in their use. At the same time at the eastern end of the beach there were about twenty people, some sunbathing, others sailboarding and several attending a temporary building (Figure 12A) which rented equipment. Tourists from the Royal St. Kitts Hotel were shuttled back and forth from this site by a small jitney.

At the Royal St. Kitts beach facility on Frigate Bay North, local residents and tourists were swimming, snorkeling and using the recreational facilities in the building. Tourist foot and bicycle traffic between the beach facility and the Royal St. Kitts Hotel was considerable (perhaps 20/hour averaged over several brief midday observation periods on three different days). Most of the local residents arrived by car. Several small groups of tourists were seen walking the beach between the Royal St. Kitts facility and the developments to the south (Figure 12B).

The traditional location for beach picnics and outings continues to be the Caribbean beach. This area is often congested and heavily littered on a public holiday. Crude estimates suggest that as many as 3,000 persons visit Frigate Bay on a public holiday. The number of vehicles, including lorries and vans, is conservatively estimated at 200. This brings pressure on limited beach and parking space, especially on the Caribbean side. The lack of clearly defined parking spaces leads to congestion of vehicles, increases the possibility of vehicular accidents, and injures the sand-stabilizing natural vegetation.

9. Beach Access

The Frigate Bay Development Corporation has systematically made adequate provisions for public access to all beaches adjacent to the development. Clearly marked public rights of way -- cleared pathways wide enough for a vehicle running from the public vehicular road to the beach -- are sited at intermittent locations between various beach front hotel and condominium properties. Adequate specified parking areas, back from the beach, however, have not yet been provided for.



Figure 12A. Stand on northwest end of Frigate Bay beach with sign offering to rent diving gear, including spearguns.



Figure 12B. Royal St. Kitts Hotel beach facility looking south with facility in view (note heavy vehicle tracks on beach).

C. Sewage Treatment

1. The Master Plan

When completed, the 850 acre community of hotels, condominiums, residential areas, marina, restaurants and public buildings will all be connected by proper intercept and force mains to a large central sewage treatment plant. This will be a costly undertaking and probably will require a deep water ocean outfall for the effluent unless it is sufficiently treated to be used as grey water for golf course irrigation.

The Building Guidelines (see Appendix A, page 4, section 12) quite clearly state that "... in areas where it is possible for a building or a development to connect to the Frigate Bay Development Corporation's sewage mains, such connection must be made." In the early stages of the project development where such connection to FBDC sewage mains is not yet possible, any condominium or hotel is required to make provisions for its own on site sewage disposal with a view to eventual connection to the FBDC sewage mains when they are installed. Individual smaller buildings such as residences must install a two-chambered septic tank and soakaway or leach-field for final disposal of any effluent.

Obviously, the sewage disposal requirements of the Frigate Bay project area are a function of the level of development, i.e., the number of buildings requiring "hook up," and this will change over time. An approach suitable for early low-load dispersed siting stages will require modification as densities, occupation levels and loading increase and core areas develop. At present, FBDC is approaching a transition point in this matter of keeping the sewage treatment plant, process and capital costs in balance with the level of development, discharge load and absorptive capacity of the environment to process an expanding volume of effluent. Certainly, by 1990 FBDC will have to modify its present system, but (as described below) it is working well enough to warrant careful evaluation for inclusion in any new approach (as opposed to complete abandonment in favor of a large scale, centralized, high-tech mechanical process, with significant life-cycle energy and maintenance requirements).

2. Sewage Waste Management: The Interim Plan for the Core Area

The designers and engineers who formulated the existing interim or first stage sewage management plan for Frigate Bay were both ingenious and practical -- combining several small-scale, high-tech package treatment plants with a mod-

ified low-tech sewage lagoon approach. They also took advantage of the presence of two existing salt ponds, the need for additional man-made ponds in the golf course fairways as "hazards" (and for aesthetic reasons), the need for ponds as drainage sumps in the low lying central areas, plus the availability of unlimited volumes of sea water to accelerate water flow through the complex eight pond system which receives partially treated sewage from FBDC's two central sewage treatment plants situated at the southern edge of the most westerly pond (see Figure 3).

3. Present Operations

Frigate Bay Beach Hotel (Figure 13A and 3B) has a package sewage treatment plant installed (Figure 13B) and operating (with no obvious odors) on the hillside southwest of the hotel. The effluent departs by gravity through a PVC line running along the surface on the shoulder of the hill, then drops into a 6-8 foot high clayey mound (presumably dredge spoil) near the northwest end of Frigate Bay South, adjacent to the windsurfing equipment concession. Luxuriant vegetation makes it difficult to see whether there is any distributary pipe, but effluent emerges as a visibly flowing seep at the foot of the clay mound, flows seaward in a shallow, heavily-vegetated trench and percolates into the sand at the landward margin of the beach. The effluent is (October 1985) clear and odorless. Immediately adjacent portions of the beach are heavily used for recreational purposes by both tourists and local persons.

The Royal St. Kitts Hotel is connected at the present time to two small FBDC (see Figure 3B) package treatment plants (Figure 14A and 14B), only one of which is in use. The effluent is discharged by gravity into a buried pipe that cannot be readily traced on the surface. However, approximately 25 m northwest, there is a surface seep on the margin of the golf course which drains downhill into a stormwater collecting pond filled with luxuriant freshwater vegetation. A floating mat of algae in the small seep suggests the seepage has a high nutrient level, a characteristic of sewage effluent from all primary and (to a lesser degree) secondary treatment plants. Sea water is pumped from the Atlantic side (the intake is just east of the Royal St. Kitts Hotel beach facility) into the pond adjacent to the Royal St. Kitts and then gravity feeds it south and north through the pond and interconnecting sluiceway, culvert and drainage ditch system to the two original salt ponds adjacent to the sea -- one at Muddy Point in the north and the other behind Frigate Bay beach in the south. Both ponds have artificial outlet "spillways" through the berm to the sea for "flooding

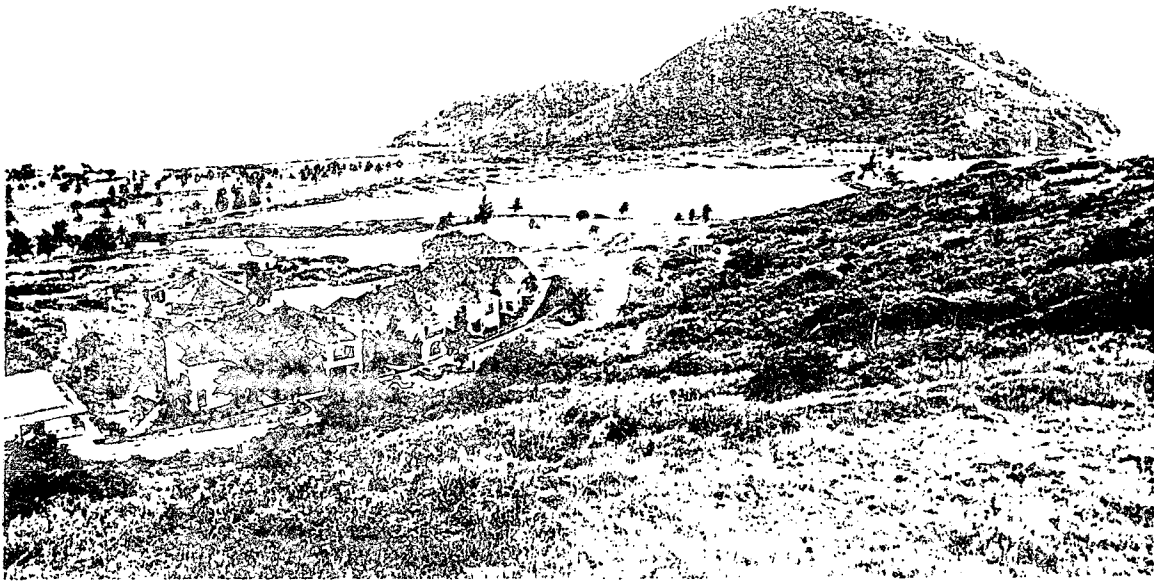


Figure 13A. Frigate Bay Beach Hotel looking southeast and east.

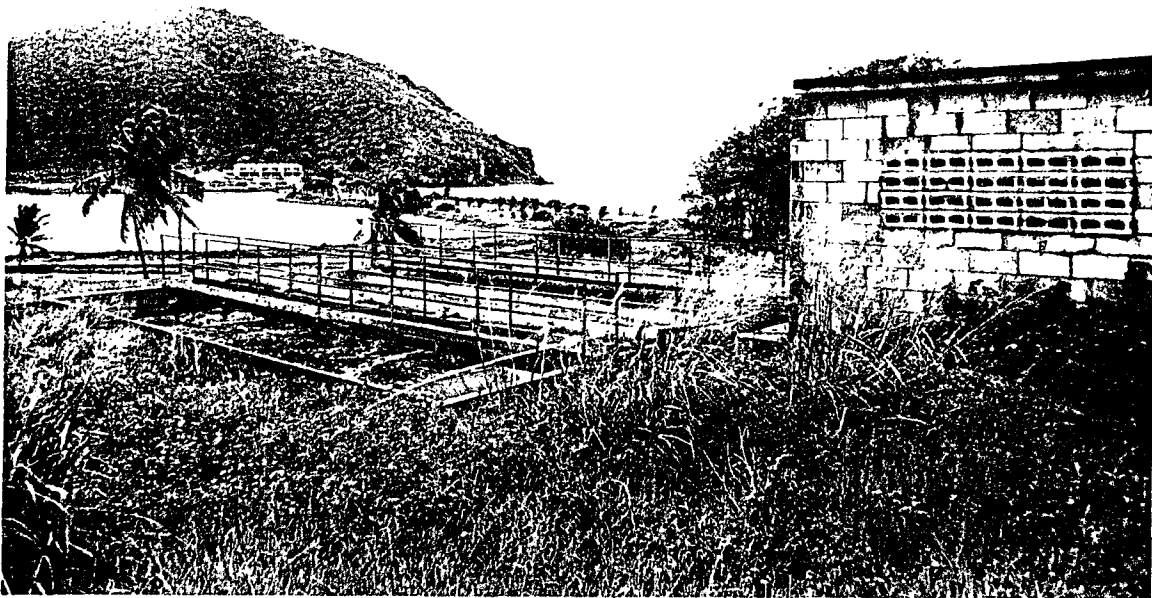


Figure 13B. Sewage treatment plant for Frigate Bay Beach Hotel.

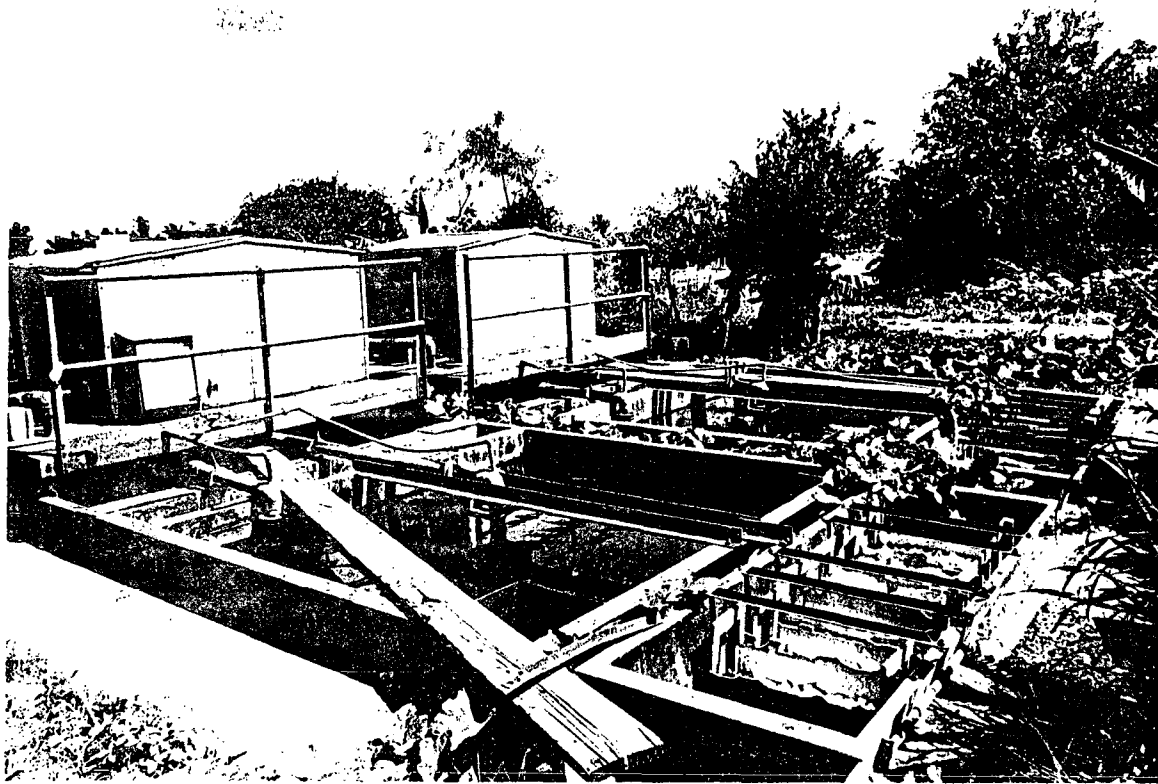


Figure 14A. Royal St. Kitts Hotel sewage treatment plant, immediately west of hotel and adjacent to pond. Inoperative plant with full tanks.

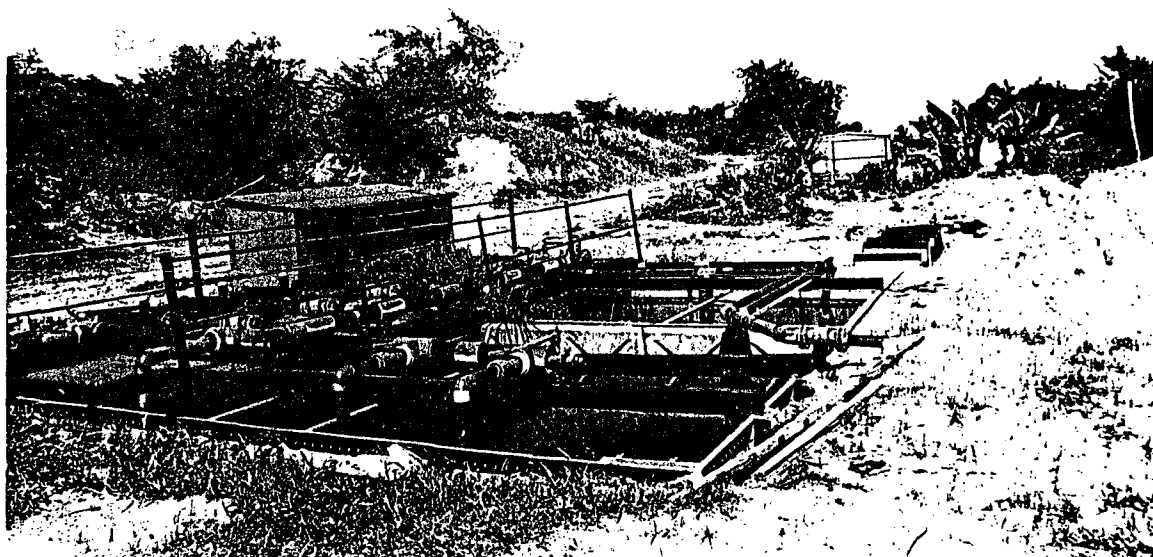


Figure 14B. Royal St. Kitts Hotel sewage treatment plant, currently in operation.

level" discharge. Normally the discharge is by percolation/seepage through the sand berm.

D. Ponds and Surface Drainage

The system of eight inter-linked ponds (two natural and six artificial) serves many purposes, as noted above, but its primary function is to act as a sump for both sheet surface and sub-surface drainage from the more elevated slopes to the west. Runoff volumes are increasing under the impact of vegetation removal (for building sites and road construction), more paved surfaces and more channelization of excess rainfall runoff via road gutters, storm drains, culverts and sluiceways.

Following the heavy rains of October 1985 the water table was very close to the surface in the lowland portions of the project, particularly north of the Royal St. Kitts Hotel. At the foot of the rocky slope west of Muddy Pond there was extensive ponding of rain and runoff water on the margins of the golf course, not far from existing man-made ponds (see Figure 15A).

Either inadequate drainage design and locally slow percolation through the soil had trapped the water there temporarily, or more likely the temporary surface ponds and the larger, deeper permanent ponds were at the same level. There was no evident flow in the temporary drainage ditches cut from the northern golf course ponds to Muddy Pond and adjacent flooded mangrove areas. Growth of the salt-tolerant terrestrial plant "survival weed" (Sesuvium portulacastrum) in the bottom of now flooded ditches indicates that water levels were recently 0.2-0.4 m lower. In the southern portions of the project area, however, there is sufficient head to produce considerable water flow through the concrete sluiceway from the southernmost pond on the golf course to the pond behind Frigate Bay South on the Caribbean side (Figure 15B).

In addition to rain and runoff from adjacent hillside drainages, the ground water reservoir also receives seawater pumped into the pond behind the Royal St. Kitts Hotel, the grey water from all development within the basin, and the domestic sewage (processed to varying degrees) from all commercial and residential developments except the Frigate Bay Beach Hotel. Thus, even if there are no problems with effluent treatment, considerable amounts of mineral nutrients are very likely moving into the groundwater. If persistent agricultural chemicals (fertilizers, pesticides, and herbicides) are used in golf course and residential landscape



Figure 15A. From elevated rocky hill immediately west of Muddy Point (near Frigate Bay northern property line). Note housing on adjacent hillside, Royal St. Kitts Hotel in background and ponding of rain and runoff water on margins of golf course below homes.



Figure 15B. Outflow from artificial pond immediately upstream from pond backing on Frigate Bay beach; Frigate Bay Development Corporation offices on opposite side of pond.

maintenance, they may be present as well in the groundwater and ponds and seeping seaward into coastal waters.

The waters in all the semi-natural and artificial ponds are quite turbid, but fiddler crabs are abundant on their margins, and wading birds forage there. The most common aquatic plant in the open ponds receiving some seawater is widgeon grass (Ruppia maritima).

E. Energy and Electrical Systems

Little attention has been given to energy conservation strategies by the Frigate Bay Development Corporation. Solar water heating systems and energy saving architectural designs and equipment operation practices are noted by their general absence; and only the sewage system design gets high marks for low energy consumption. There is no reason, for example, why some of the sea water pumping could not be done using windmills and wind power, saving the cost of electricity.

Although electric power within Frigate Bay is supplied by underground lines, incidental observations revealed some seemingly hazardous "temporary" installations which may have been in place for some time. Power to the sewage treatment plant of the Frigate Bay Beach Hotel is apparently supplied by two insulated lines laid free over the ground and vegetation with no protection (or warning signs). Similar wiring (presumed to be electric power rather than telephone lines) runs to the Anchorage Restaurant at Frigate Bay South beach. These lines are at least locally supported off the ground, but visible tape patches give little confidence that a curious child or animal might not be at risk.

F. Solid Waste and Litter

Solid waste disposal is not a critical problem within the residential areas because containers are required of owners (see Appendix A) and garbage trucks take away waste once per week for emplacement at the Conaree dump (which is, unfortunately, not well run as a sanitary land fill site). The commercial operations at Frigate Bay, however, are expected to dispose of their own waste. From observation of the authors, it is clear that some hotels are guilty of dumping their garbage onto unused, undeveloped lands along the Atlantic coast and especially at Muddy Pond (see Figure 16). Not only is this practice unsightly and damages the mangroves, but it is also unhealthy as it encourages population



Figure 16. Construction debris and golf supplies discarded next to spoil piles on salt flats east of Muddy Pond.

growth of rodents and disease carrying insects. This provides an obvious user conflict that requires FBDC action.

Beach littering has increased with the expanded popular use (especially on public holidays) of the Frigate Bay recreational areas, but this could be managed with improved beach maintenance and cleaning and reduced with a public education program. The FBDC does not have a formal waste disposal and litter control plan. As population densities and use levels increase, it will need one.

G. Land Use and Value

At the turn of the 1970's, the land use patterns of the Frigate Bay area began to shift, from primary use for animal grazing, salt mining and as a natural habitat for migratory birds to a focus on clearing land for infrastructure placement, followed by site preparation and hotel and residential construction. The immediate effect was a decrease in land available for livestock grazing and a destruction of migratory bird habitats. Populations of both livestock and wildlife have declined steadily since, and the decrease has accelerated during the past six years.

Some open space remains in the form of the golf course and ponds, and some damaged areas are being planted as part of individual landscaping programs implemented by site owners - both commercial and residential. However, developments along the beach front are of greatest concern as, on occasion, sand berms have been removed under the misguided notion of "improving" the beach by removal of vegetation, leveling dune tops and cutting direct beach access paths through the dunes.

It is estimated that at present (1985) no fewer than 500 persons and as many as 4,000 could be present in the area at any given moment. This has escalated the demand for basic services of water, electricity, telephone, waste disposal and parking. There is a special problem concerning water, for, with swimming pools being constructed and more people using the area, the demand on the available water supply has increased rapidly. Although no figures are available, it seems likely that the water supply situation could become problematic in the near future when the overnight and residential populations are expected to reach as many as 11,000 persons for any given period of time. Since present St. Kitts aquifers are approaching maximum extraction rates, it is good that a CIDA funded water supply assessment is currently underway for the island.

The change in land use has had an impact on land value which has risen steadily over the years. Land sold by the quarter acre for residential use is valued based on the location of the land and whether the buyer is a national or non-national; the cost to the latter is higher. Prior to 1975 land was approximately EC\$0.66/sq.ft. Between 1975 and 1980 land valued at EC\$2.00-2.70/sq.ft., and since 1980 land values have risen to EC\$3.00-\$4.00/sq.ft. Prior to 1981 commercial land was valued at US\$20,000 per acre, while the current price of such land at Frigate Bay is US\$50,000/acre, with five acres as the minimum plot size. This has had an upward pull on land prices in other areas of the island outside of the Frigate Bay complex.

H. Conclusion

If one approaches the preceding review of user impact on key features of the Frigate Bay resource base from a management perspective, one critical point stands out. Some identifiable person is responsible for (that is, is in charge of) the sewage treatment plant, marketing, roads, the electrical system, the golf course, even the corporate headquarters building. In each case, the "assigned person" in charge knows "how it works" and how to "fix" it if there are problems. Assignments and lines of authority and responsibilities are clear.

But reflect on the natural features listed in this section -- beaches, mangroves, dunes and dune vegetation, wildlife, reefs, seagrass beds, the ponds (as living systems), and water quality. In not a single case is anyone "in charge" or responsible, with specific assignments to know "how it works" and how to "fix it" when it does not -- or even how to know when something is not quite right and getting worse.

In effect, man-made features are planned for, looked after and managed, but natural features are taken for granted as free, useable resources. But the resource base is not static -- it is dynamic and it is not "free" because when something is withdrawn (i.e., used) from a given resource account in the "resource portfolio," the balance left earns less, grows slower, has less liquidity and is closer to an over-draft situation.

The FBDC has not managed its environmental resources as efficiently as it has its other responsibilities. There are no environmental disasters lurking in scrub or underwater at the Frigate Bay development site. But there are environmental problems, and they require attention if the ambience and environmental quality and sustainability of Frigate Bay

are to be maintained. FBDC will lose the competitive edge it enjoys by having a well managed, quality product as compared to other island destinations if these issues are not addressed.

In recent months, the United Nations World Commission on Environment and Development confirmed that the experience of the past decade had demonstrated that:

(1) The benefits generated by environmental measures in developing countries, including the damage costs avoided, have generally been greater than their costs.

(2) The macro-economic effects of environmental policies (where implemented) on investment, productivity and trade have been relatively minor and in some cases positive.

(3) More jobs have been created by environmental measures than have been lost.

(4) While the benefits [of environmental management policies] for industry have varied, many industries such as tourism have developed a variety of positive benefits and a more efficient plant and product that as time goes by becomes more economic and competitive.

Other countries are listening to the signals and taking action to ensure the environmental sustainability of their development initiatives. Perhaps the Frigate Bay Development Corporation on St. Kitts should be listening too.

V. RECOMMENDATIONS

Despite a basically sound conceptual design and a comparatively orderly (although slower than anticipated) growth rate, the Frigate Bay development project appears to be on the verge of encountering a relatively broad spectrum of environmental problems which, if not addressed, will escalate in significance over time, negatively affecting marketing strategies, raising administrative costs, reducing future management options, and eventually placing the entire venture at risk.

Some key parts or elements of the dynamic natural/physical resource base or system, which is the capital stock or St. Kitts investment in the Frigate Bay Development Corporation, are showing obvious signs of stress -- if not overload -- and no one seems to be taking notice or to be aware of the visible signals and their subsequent impact. But an ounce of prevention is still worth a pound of cure, and now is the time to apply remedial strategies.

The central problem is not technical but jurisdictional, i.e., no one is in charge of environmental change and impact or of monitoring system interaction, maintenance, and enhancement. In some cases action is needed by the Frigate Bay Development Corporation, in others by Government with more ministries working in concert; in many instances the required action will involve both, plus the hotel owners and other interested parties such as residents and resource users (e.g., hunters, fishermen, divers, and swimmers). A few, because of their complexity, will require technically and scientifically skilled input. Many can be handled locally and require only administrative action, clear and specific assignment of responsibility, a very modest allocation of funds or logistic support, and conscientious follow-up or enforcement as appropriate. In a few instances, minor changes in existing legislation or regulations may be necessary. In the few cases where technical and scientific counsel is required external funding is available if requested by Government, the Frigate Bay Development Corporation or even local citizen groups or non-governmental organizations.

1. Management/Administrative (Frigate Bay Development Corporation)

It is recommended that:

(a) A marketing plan be developed which will among other things, target land sales in the short and medium terms. This will move the FBDC from being reactive or

responsive to being assertive in the market place. It should cushion against drastic declines in sales from one year to the next and enable effective forward planning.

In support of this marketing plan other required actions dealing with historical and cultural resources, environmental policy, the Southeast Peninsula road project, Timothy Hill peak, and wildlife are dealt with below.

(b) A long-term business plan be developed which will address the future of the Corporation and identify possible alternatives or options for income generation. The basic question of what happens "when there is no land left for sale" must be examined. For example, the Corporation could identify services to commercial operations which can be provided for a fee. Examples of such services include landscape maintenance, sewage treatment, pest control, heavy equipment rental, tours, marketing, staff training, purchasing, and security. Alternatively, it could sponsor the establishment of private sector, small businesses to carry out such services (possibly with non-cash equity involvement) and extract a fee or gross receipts tax (or equivalent) as revenue to FBDC.

(c) Regulations according to section 25 (1) (i) be put in place to give full legal authority and control to the Corporation over matters relating to "the laying out and subdivision of land for building purposes, the erection, construction and alteration of buildings and structures, the class and design of buildings or structures to be erected on any specified part of the development area, and the use to which any land, building or structure may be put."

(d) The Board of Directors of the Corporation should no longer be chaired by the Minister of Tourism. This directly limits the effectiveness and creativity of the Board and the Managing Director.

(e) The vacant position of Manager/Maintenance be filled by a qualified engineer who will release some of the time of the Managing Director for planning and marketing. This person should chair the technical advisory committee and be responsible for all technical aspects of managing the study area.

Further, the FBDC "engineer" will need a full-time environmental assistant, with academic training in the natural sciences or environmental management and some experience in dealing with ponds, wildlife, mangroves, halophytic vegetation, eutrophication, coastal beach/reef systems, and possibly sewage. Task assignments should include planning, monitoring, data collection, environmental education, remedial project supervision, and impact assessment input to the technical committee.

(f) The management of the golf course be directed towards a profitable, dynamic operation with increased use of the course by local, regional and international golfers. The Corporation cannot afford to continue to heavily subsidize the cost of operations indefinitely. Any subsidy must be carefully built into land sales and/or other revenue areas in the overall management of the Corporation. Alternatively, the golf course operation could be leased to a private operator, but FBDC should retain management control of the ponds and explicitly restrict and control the uses of pesticides, herbicides, fungicides and chemical fertilizers (especially phosphates).

(g) A large attractive sign be placed at the entrance of the study area welcoming visitors to Frigate Bay and directing them to the FBDC for information. Additional discreet, well-designed, uniform signs and markers are needed at historical sites such as Fort Tyson, for key wildlife/natural areas like the mangrove system and the ponds (which should be named), and for restricted habitats such as the dune vegetation. Such information should not simply post "Keep Off" warnings but should explain why restrictions are important, possibly naming the plant species involved as an educational device.

2. Management/Environmental (Frigate Bay Development Corporation and Government)

Study team recommendations include the following areas of concern.

(a) **Data Collection.** A comprehensive data collection program should be implemented in the project area to provide up-to-date quantitative and qualitative information on beach sand and dune vegetation removal, pesticide use, rainfall data, coastal changes, wildlife populations, mangrove systems, pond levels and algae growth, coral reefs, turtle nesting, sea grass beds, volumes and effects of treated sewage effluent, and water and power usage and future demands. The environmental data project should be designed so that most basic information is collected on a routine, ongoing, and sequential basis by various maintenance staff personnel, but accumulated data should be centrally maintained. At present the "institutional memory" of FBDC has a very minimal environmental baseline.

Some cooperative arrangement for additive input could be arranged with units of Government, such as fisheries, forestry, planning, and agriculture.

(b) **Beaches and Dunes.** An active campaign to stop sand mining and vegetation removal should be required in

order to preserve existing beaches. A large part of such an effort is a matter of public education, and, in this case as well as for other of the recommendations, the target audience includes management and staff of the hotels in addition to the general public. Posting notices in illegal sand mining areas, radio and television spots, simple newspaper articles would be helpful in raising the general level of understanding about the consequences of sand removal.

The overall costs of such an operation would not be great. Given the activity observed during this project, even desultory observation by a guard on a hilltop with binoculars over a few weekends would allow a few formal warnings to be issued. Public announcement plus word of mouth on the monitoring should have a decided effect. If problems continue, a well publicized formal prosecution (even if the penalty is nominal) would also be effective.

The suggestions of Deane, et al. (1973) and Cambers (1983) for identifying, specifying, and using alternative sources of fine aggregate (sand) should be reviewed and pursued. Cambers (1983) recommended that all beach and dune sand removal be stopped except at Belle Tete, where accumulation is active. Deane, et al. addressed the mining of terrestrial volcanics of the Mansion series for fine aggregate. Other sources for aggregate exist, and the Development Corporation needs to protect its investment by conserving the beaches which are a major tourist attraction and a critical storm barrier.

While there may be some beach dune areas from which sand could be harvested without serious risk, until such time as a sand resource management plan is in place, further sand removal from the Frigate Bay area should be prohibited. Corporation staff must be vigilant and prepared to prosecute offenders when necessary, and the cooperation of appropriate Government officials will be essential.

(c) **Beach Vegetation.** Site preparation on the Atlantic coast should avoid destruction of the primary sand berm, and any vegetation removal should be replaced with buildings or other vegetation compatible with the arid and saline environment. Natural vegetation should only be cleared when absolutely necessary for buildings and facilities, and prompt re-vegetation of damaged areas should be required at all sites once the construction phase is over.

(d) **Solid Waste Control.** An effective public education program (to include facility management, staff and construction personnel) regarding the disposal of slow-degrading solid waste should be implemented. There does not appear to be a problem with organic garbage, but persistent litter (construction material, air conditioner parts, golf cart fragments, golf bags, etc.) is widespread and obvious,

particularly in the undeveloped but not unused northern areas of Frigate Bay. (See also the section on mangrove wetlands.)

Littering can be discouraged through the use of warning signs and the practical location of neat, unobtrusive garbage bins along the popular picnic areas. Garbage disposal by commercial operators should be monitored closely for abuse. Anyone found dumping garbage in unauthorized areas should be prosecuted by the Corporation, which, as stated above, also needs to increase public awareness about the severity of this problem.

(e) **Parking.** Designated parking areas should be clearly marked at existing beach, recreation and picnic sites. At least one additional picnic area should be opened at the Atlantic Beach to avoid the congestion which occurs at the Caribbean Beach during public holidays and to eliminate damage to the golf course by the overspill. Present helter-skelter parking patterns are rapidly destroying the sand-stabilizing vegetation.

(f) **Marine Habitats.** Non-consumptive uses of near-shore habitats within the Development area should be encouraged. Close to the major beaches the reefs are not particularly diverse and can rapidly become less so, if fish, lobster, corals, etc. are taken by a significant proportion of the visitors. (For example, novice spearfishermen tend to shoot at anything that moves). This concern may be a matter for fishery regulation (i.e., establishment of a special restricted zone), but the Frigate Bay Development Corporation can take a significant first step by eliminating rental of spearguns at concessions within their jurisdictional area and making available to hotel guests and staff posters or other literature which encourage observation and conservation of nearshore marine habitats. Many countries (for example, the Seychelles, Sudan, the Bahamas) have found it necessary to restrict spearfishing to preserve reef communities.

Groundwater hydrology and nutrient levels, nearshore marine nutrient levels and circulation patterns, and the condition of seagrass beds and reefs adjacent to the project area should be investigated, especially along the north shore where evidence of progressive damage to seagrass was found. Continuing decline in the grass beds will increase the likelihood of beach erosion during storms. The areal extent of damage to the grassbeds is not known, but it would be best to investigate and take corrective action, if possible, while there are still viable natural remnants of grass throughout the area.

Corrective action may entail completion of a development-wide sewage system with an offshore marine outfall.

(g) Wildlife Habitat Preservation and Enhancement.

Simple modifications to the existing artificial ponds on the golf course could increase their value as wildlife habitats and mitigate damage done to the pre-existing natural ponds during the early stages of the development.

Constructing small artificial islands in the center of the larger golf course ponds (with elevation at least one foot above the maximum expected water levels in the ponds) would provide excellent overnight refuges for migrating birds. Even relatively small piles of boulders (10 x 12 feet) are likely to harbor a hundred shorebirds overnight. Larger, lighter colored sandy islands prepared from pond bottoms might well be used for nesting by terns, waders and shorebirds. The critical point is that the mini-islands must be placed in sufficiently deep water so they are rarely if ever connected to the adjacent land. This would prevent access by people and predators such as rats, mongoose, and feral cats and dogs. The birds on these refuges would increase the visual interest of the ponds. Some islands might be partially vegetated by hand planting red mangrove seeds on the periphery and or broadcasting black mangrove seeds, but others should be left bare for terns which are now driven from their normal nesting habitats on the beaches and other open sandy areas by dogs, people and vehicular traffic.

In any modification of existing ponds, their wildlife value can be enhanced by providing gently sloping rather than near vertical margins. Sandy shallows at the pond margins are major foraging areas for shorebirds and waders.

(h) Mangrove Wetlands. The obvious prevailing local perspective on the remaining mangrove wetlands on the northern fringe of the development should be shifted from one of a wasteland and dumping ground to one of damaged wildlife habitat whose enhancement would diversify the tourism values of the project. Muddy Pond is one of the few red mangrove wetlands on St. Kitts. Masses of discarded debris from the golf course operation and the hotels should be removed; and, based on a survey of the hydrology, vegetation and wildlife, a management plan should be drawn up. This need not be an elaborate undertaking.

(i) Wildlife. According to a credible source, several agouti (*Dasyprocta* sp.) have been sighted on the margins of the Frigate Bay golf course. This is a remarkable finding as this animal has generally been considered to have become extinct early in the colonial history of St. Kitts. Agouti are large rodents unfamiliar to most visitors to the West Indies (indeed, probably to most Kittitians) and could be a focus in any publications or presentations addressing environmental values of the Frigate Bay complex. Since this

animal is an element of the Kittitian natural heritage which seems to have barely escaped destruction, any activities likely to affect it, e.g., spreading poison bait for rats, use of herbicides, or allowing packs of dogs to roam freely should be reviewed.

(j) **Sea Turtle Nesting.** The beaches in the Frigate Bay development area, particularly Frigate Bay North and South, are known locally as turtle nesting beaches. Because of continuing regional declines in sea turtle populations, the governments of most Eastern Caribbean islands are moving to place a five year moratorium on turtle harvesting. As part of general efforts to enhance appreciation of the environmental values of the Frigate Bay area by local residents and visitors, information (brochures, posters) on the biology of sea turtles, their threatened status as a local resource, and local fishery regulations should be made available. General educational posters on sea turtles are available free or at nominal cost from several sources, including Environmental Research Projects (ERP), presently working with the Fisheries Division of the Ministry of Agriculture on St. Kitts.

Facilities in the Frigate Bay complex could additionally enhance the survival of sea turtles by:

(i) Educating visitors concerning the presence of turtle tracks on the beaches, requesting that such observations be reported and helping to maintain records on nesting.

(ii) Making it clear to dive concessionaires and their customers that no turtles are to be taken from the reefs.

(iii) Prohibiting the sale of turtle curios or other turtle products (e.g., turtle shell, steaks) in shops or restaurants.

(iv) Training hotel security personnel to monitor beaches, especially in early morning hours during nesting season.

(v) Minimizing artificial light reaching beaches by redirecting or baffling lights or screening with vegetation. Bright lights visible from the beach tend to drive nesting female turtles away. The lights also attract hatchlings emerging from the nest so that they may move inland away from the sea. The hatchlings then typically are eaten by predators or die from desiccation on the next day. Methods for reducing lighting impact are treated in Raymond (1984).

(k) **Recreational Uses.** Greater effort should be made to phase out the grazing of cattle in the Frigate Bay area to prevent further damage to the golf course by the animals. Horse riding on the Atlantic Beach is resulting in piles of feces being deposited on the shore. Designated riding areas away from the beach should be identified, suitably marked paths laid out, and an appropriate brochure and map defining the rules and riding areas should be prepared. Another kind of riding -- "joy-riding" with four-wheel drive vehicles along the beach and over the berm/dune areas by "jeep jockies" -- should be absolutely prohibited as it damages the beach vegetation and destroys the ambience of a tranquil beach setting.

(l) **Historical/Cultural Features.** The Frigate Bay area has a variety of historically and culturally significant resources which are neither protected, used or being developed as part of the Frigate Bay Development Corporation's project or marketing theme. Examples include the Fort Tyson site, the vernacular estate building (currently occupied by the FBDC), the old "salt works," archaeological sites, estate histories, or the name "Frigate Bay" itself. As another example, the 1753 Baker map shows James Gordon, Daniel Mathen, Jonathan Spooner, Tobias Galway, and Isaac DuPuy as estate owners at Frigate Bay. Who were these former owners? Perhaps they could be identified and ponds or roads named after them, in an attempt to make use of Frigate Bay's historical antecedents and thereby to better convey a sense of place. The development of an historical/cultural resource management plan for Frigate Bay is therefore recommended.

(m) **Timothy Hill Development.** In view of the prospective development of (a) the Southeast Peninsula road and (b) St. Kitts-Nevis National Park or National Trust enabling legislation, and given the superior scenic value of Timothy Hill, consideration should be given by FBDC to developing the peak and hill (above the 500 foot contour line) as a public scenic overlook/recreation area/park with a carefully designed access road, car park, viewing platforms, refreshment concessions and a rain shelter/interpretive center.

(n) **Government Action.** The task of the Frigate Bay Development Corporation in addressing localized environmental issues and acting upon the preceding recommendations will be greatly facilitated by, and in some cases will require, a parallel set of decisions by the Government of St. Christopher-Nevis to develop and implement an environmental policy and environmental resource management program for the state. In the same way, there is a tourism development plan and strategy, St. Kitts needs to develop an environmental plan and strategy -- one that cuts across traditional ministerial lines and reflects the pervasive complex-

ity and diversity of the inter-related components that make up the "environment" and infuse all environmental issues, such as those outlined above.

3. Conclusions

The Frigate Bay Development Corporation is not entirely unaware that action is needed along the lines of these recommendations. But neither has it established any plan or priorities for action on these matters, and -- at least for the natural environmental support system of the entire Frigate Bay development enterprise -- time is running out. More and more costly technical interventions will be needed in future years to make up or compensate for declining natural inputs that are "free" as long as the system works and is used within its limitations.

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FRIGATE BAY DEVELOPMENT CORPORATION BUILDING GUIDELINES

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1961, 2, 1963

CONFIDENTIAL - SECURITY INFORMATION

Each application submitted shall be considered on its "merits" and for the advancement of citizens only.

Please send to address at the office of the Corporation on Friday Day. Copies to be made of 10000 may be obtained on application to the Managing Director.

These conditions are being maintained in the following manner:

1. Qualifying Item

The proposed findings shall not be used for any other purpose than that specified herein and are subject to audit or other, non-legally approved, verification of the findings by the Institute for Management Services, Inc.

2. Additions and Alterations

in which no other persons are indicated.

2. Building Details

Smoking density within residential areas will be restricted to four cars per block, with a five car block not exceeding 150 of the cars per block. Only one smoking car is permitted on each lot.

3.8. Density for Sandpiper and Other Group that Does/Do not

- (a) minimum number of units - 10 per acre
- (b) minimum number of bedrooms - 31 per acre
- (c) minimum site coverage - 40% (this includes all buildings within the site)
- (d) minimum number of stories - 3
- (e) minimum distance between buildings - 20' for 4 story buildings

111 Carling cross floor area 10110 (P.A.B.) -

- Benefits for Individual Residential Levees/ponds
- | | | | |
|-----|--|---|------|
| (a) | Estimated number of units per acre | - | 6 |
| (b) | Estimated number of units per lot | - | 1 |
| (c) | Estimated elite coverage | - | 23% |
| (d) | Estimated number of storages on the flat areas | - | 1 |
| (e) | Estimated number of storages on the slopes | - | 1 |
| (f) | Estimated gross (floor area ratio (F.A.R.)) on flat area | - | 0.10 |
| (g) | Estimated gross floor area (F.A.R.) on the slopes | - | 0.50 |
- and sloping areas are determined by the Corporation.

5.3

Wages for 1990

- | | | |
|-----|-------------------------------------|--------|
| 141 | Estimated number of copies per unit | • 30 |
| 142 | Estimated number of units per case | • 40 |
| 143 | Estimated case weight - 400 lbs | |
| 144 | Estimated volume of storage | • 1.0 |
| 145 | Estimated cases stored 4750 cases | 17.4.1 |

9-11-68

Building owners will be notified as to the districts that will be affected between the existing and the boundaries containing the site. In all cases building data is not taken enough to prevent a loss to the count of any area, view or the greatest loss to adjacent buildings.

2- ~~SECRET~~

[illegible]

4. Books and papers.

The Corporation may determine the subjects of access from the card to the lists, buildings, fences, walls or hedges and also are allowed claim to be an road owners or road sections must be assigned and constructed in a company and may also determine the time of operation on the roads, or operating from the road.

See Parking

Provision for the parking of at least two cars within the individual lot boundaries must be made. One of the two parking spaces should have a roof covering and a paved flooring.

12. Sewage Disposal
In areas where it is possible for a building or a development to connect to the Frigate Bay Development Corporation sewage main, such connection must be made.
In addition to an individual building having a two-chambered septic tank it is necessary to provide a soakaway or a distribution field for final disposal of the effluent.
For condominium developments, there must be connections to the Frigate Bay Development Corporation's sewage mains. In the event that such a connection is not presently possible, the development must make provisions for its own on-site sewage disposal with a view to eventual connection to the sewage mains.

13. Solid Waste Disposal
Every household, tenant, hotel/condominium building or apartment building owners/operators shall be responsible for providing his/her own garbage bins with suitable covers, which must be suitably protected against being knocked over. Provision should be made for a concealed bin storage area or areas and for access for the removal of garbage.

14. Building Material
The materials proposed for external finishes to all buildings should be of a nature and type that will not rapidly deteriorate, or require constant maintenance, nor should they, for any other reason, present an unclean or untidy appearance. Some materials that will not be accepted for external use on individual residential units, or condominium or on hotels are: galvanneal sheets, bamboo, untreated timber.

15. Elevation Control
Dwellings will be subject to control in regards to the external appearance; that is elevations and the materials proposed for the external finishes. The Corporation will make the final decision as to whether or not the external appearance of a building or buildings is/are to an acceptable standard, and will make recommendations when it is not, in order to bring it up to such a standard.

16. Roof Slope
It is recommended that roof slopes be no less than 30°. Any roof with a slope less than 30° will be in danger of being torn off in the event of a hurricane.
Roofs of zero slopes should be of reinforced concrete only.

17. Minimum Room Sizes
Bedrooms - 90 sq ft excluding cupboard space
Bathrooms - 36 sq ft
Kitchen - 60 sq ft
11. Fire Fighting Provision
Condominium and hotel developments should make provision for fire fighting by providing one fire extinguisher per unit or providing a sprinkler system for the entire building with a sprinkler outlet for every 50 sq ft. A fire hose system with a reel is also acceptable.
Building must be 100' or less from a street, road or driveway providing access for fire fighting equipment.
Interior staircases shall be separately enclosed with material that is able to withstand one hour of fire.
On second storey, the maximum distance of travel from an exit door of a room or space to a stairway is 100'.
On the third floor, the maximum distance of travel from an exit of a room or space to an exterior door is 120' and the maximum distance of travel from a stairway to an exterior exit door is 50'.
Developers are required to include fire hydrants in their development at every 100' and the minimum water line size should be 4" in diameter.

Topsoil Removal
The removal of topsoil during site preparation should be carefully monitored. Topsoil removal causes an increase in water runoff which leads to soil loss. As a result, soil should only be removed from those areas that will have building activity during the first phase of a development whether it be a single building or a group of buildings. Sitework information should be submitted in detailed note form or presented in drawing form.
18. Room Heights
Habitable spaces shall have a floor to ceiling height of not less than 8'-6", non-habitable spaces shall have a floor to ceiling height of not less than 7'-0".

19. Stair Widths
Stair widths within individual units should be no less than 3'-0" clear between handrails or between handrail and opposite wall surface. The rise and tread of the stairs shall total 17½". The minimum rise shall be 6" and minimum tread shall be 9½". Stairs used in common areas should have a minimum width of 4'-6".

20. Cisterns
Dwelling houses must provide a cistern with a capacity of 750 gallons or 120 cubic feet.
Commercial development must have at least two days' water supply storage.

21. Ventilation
All habitable spaces should be provided with ventilation in accordance with either of the following:
1. Natural ventilation through openable parts of windows or other openings in exterior walls that face legal open spaces, or through openable parts of skylights, providing total clear ventilation area not less than 3% of the total floor area of each habitable space;
or
2. Mechanical ventilation providing at least two air changes per hour either of outdoor air or a mixture of outdoor and recirculated air in such a proportion that a mixture of one air change per hour shall be outdoor air.
3. Kitchens, bathrooms and toilets can be provided with natural ventilation as described in the above section or with mechanical ventilation exhausting not less than 150 cubic feet per minute (cfm) discharging directly to the exterior.
- | S P A C E | Min. Openable Space |
|---|---|
| Kitchens, bathrooms, toilets or shower rooms connected to or in habitable space | 3 sq ft |
| Bathrooms, toilets or shower rooms used by public or employees | 1 sq ft per M.C. and minimum of 3 sq ft |

22. Natural Light

Habitable spaces should be provided with natural light through one or more windows, skylights, transparent or translucent panels or a combination of all these, that face directly on a legal open space. The amount of light should be equivalent to that transmitted through clear glass equal in area to 10% of the floor area of the habitable space.

Kitchens, bathrooms and toilets can be provided with artificial lighting equipment or be provided with natural light.

No part of any habitable space shall be more than four (4) times its clear height distant from the lighting opening.

23. Development Notes and Descriptive Notes

23.1. Development Notes

Each development proposal shall have development notes that will accompany three (3) sets of plans that will be submitted to the Private Bay Development Corporation. For individual building units, forms which should be used to present the development notes will be available at the Corporation's offices. Group unit developments are required to present development notes in text. Development notes shall include information on the following:-

(a) Individual Unit Development

- i. Name of development
- ii. Name, address and telephone number/s of owner/s and date
- iii. Total area of the proposed development
- iv. Area of unit
- v. Site of space
- vi. Site coverage
- vii. Total floor space
- viii. Number of storeys
- ix. Phasing considerations
- x. Approximate cost of building
- xi. Expected commencement date
- xii. Date of application

(b) Group Unit Development

- i. Name of development
- ii. Name, address and telephone number/s of owner/s and date
- iii. Total area of the proposed development
- iv. Breakdown of land uses and land area under various uses
- v. Types and sizes of units and number of units
- vi. Site coverage
- vii. Total floor space
- viii. Phasing considerations
- ix. Number of storeys
- x. Approximate cost of building
- xi. Expected commencement date
- xii. Date of application

23.2. Descriptive Notes

Descriptive notes shall accompany drawings. These are compulsory for both individual unit and group unit developments. The following descriptive notes will be needed for individual unit construction:-

- i. Structural system
- ii. Concrete and masonry
- iii. Steel work
- iv. Roofing
- v. Doors and windows
- vi. Flooring
- vii. Electrical system
- viii. Drainage system
- ix. Sewage disposal system
- x. Special works

The following descriptive notes are required for group unit developments:-

- i. Structural system
- ii. Site work
- iii. Concrete and masonry
- iv. Steel work
- v. Roofing
- vi. Flooring
- vii. Doors and windows
- viii. Toilet and kitchen accessories
- ix. Electrical system
- x. Drainage system
- xi. Road and foot path system
- xii. Sewage disposal system
- xiii. Landscaping
- xiv. Telephone system
- xv. Special works

24. Infrastructure Plans

For all types of proposed group unit developments, infrastructural plans shall be prepared and should give an overall picture of the various infrastructural layouts.

Plans are required for the following:

1. Topography
2. Roads
3. Electricity
4. Water
5. Sewage
6. Drainage
7. Telephone

Infrastructural plans shall be of the same scale as that of the site plan.

25. Required Plans

The drawings submitted to the Corporation must include:

25.1. Location Plan

Scale not less than 1:5000 showing position of lot in relation to the immediate area or the surrounding development.

25.2. Site Plan

On a scale not less than 1" = 100' show:

- (a) Boundary lines and dimensions along with all pertinent data regarding the lot;
- (b) Building/s location, required setbacks, clearing lines, levels on the building/s, dimensions of building/s or other features and in dotted lines the layout of any planned additions;
- (c) All utility lines on the property and connections to street utilities for water and electricity;
- (d) All existing physical features whether to remain or to be removed;
- (e) Fences, structural retaining walls, walkways and pools;
- (f) Storm drainage on both paved and unpaved areas, water catchment and drains;
- (g) Sewerage disposal: location of proposed system;
- (h) Finished ground elevations;
- (i) Access to building/s from road;
- (j) Wind direction;
- (k) Parking provision;
- (l) Legend showing all symbols and construction materials to be used on the site;
- (m) Name of designer, location of building/s etc;
- (n) North point;
- (o) All other relevant information.

25.3. Floor Plan - A horizontal section cut 4'-0" above the floor level.

On a scale of 1/4" = 1'-0" give:

- (a) A description of the use and overall dimensions of each room including staircases, emergency escape routes;
- (b) Levels of various floors;
- (c) North point;
- (d) Built-in cabinets, shelves, closets, medicine cabinets;
- (e) Location and dimensions of all openings including windows and doors showing door swings, numbering doors and windows by type;