

PA-ABL-567

AN ENVIRONMENTAL APPRAISAL  
OF  
IMPACTS FROM DREDGE AND FILL  
AND LAND RECLAMATION  
ON  
COASTAL MARINE WATERS AND CORAL REEFS  
OF MAHE, SEYCHELLES

Paul Andre DeGeorges  
Regional Environmental Officer  
USAID/REDSO/ESA  
October 20, 1990

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## 1. INTRODUCTION

Mahe Island is the headquarters for the Government of Seychelles, the major center for tourism and industry and the major center of population. It is a steep sloped granitic island with very little flat lands on which to develop.

As a result in the mid 1980's, a major land reclamation project was undertaken in which approximately 135 hectares of coastal waters were reclaimed between Victoria and Brilliant Point. During the construction phase, nearshore fringing reefs were dredged. The fill from these burrow areas was used to extend the land mass into the sea. This area was used primarily for placement of fishing and commercial ports.

Because of increasing needs for private housing and the ever expanding industrial sector, it is estimated that an additional 96 hectares of reclaimed land will be needed for placement of a dry dock, extension of the sports complex for the next Indian Ocean Games, expansion of the airport, expansion of the industrial estate, sewage works, road construction, housing and social services. This is being planned for 1991 between Providence and the airport (Figure 1).

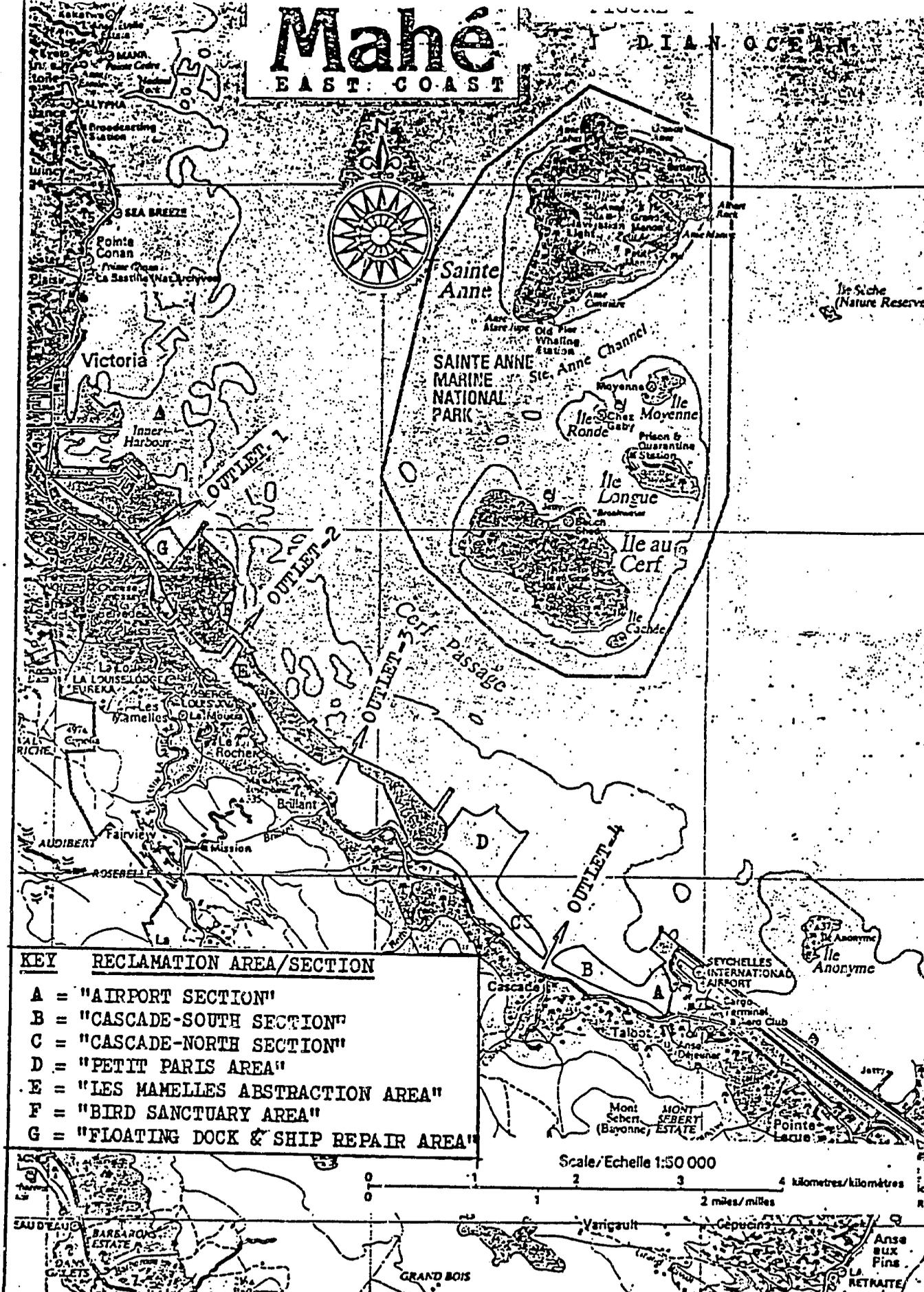
The Seychelles has one of the more comprehensive environmental management plans (1990-2000) the author has seen. Likewise, the major goal of the National Development Plan (1990-1994) is sustainable development that, because of the importance of tourism, depends on integrating this development in balance and harmony with the surrounding natural resources.

During the dredge and fill operations of the mid 1980's, very little or no precaution was taken in controlling the sedimentation from dredging, this sediment reaching out as far as the Ste. Anne Marine National Park. Likewise, the rock armour placed along the fill areas was unable to stop the erosion of fine particles into the coastal waters.

Many ecologists on the island believe that this resulted in serious coral reef degradation, coral reefs being relatively intolerant to high sedimentation or colloidal materials in the water column. Heavy sedimentation can smother the corals, making it impossible for the coral polyps to feed and the symbiotic algae (zooanthellae) to photosynthesize. These zooanthellae, which help nourish colonial corals, may also be unable to photosynthesize, if colloidal materials (very fine dissolved matter that never settles out of the water column) block off too much light. The ultimate effect is the death of the coral reef.

# Mahé

EAST COAST



KEY	RECLAMATION AREA/SECTION
A	"AIRPORT SECTION"
B	"CASCADE-SOUTH SECTION"
C	"CASCADE-NORTH SECTION"
D	"PETIT PARIS AREA"
E	"LES MAMELLES ABSTRACTION AREA"
F	"BIRD SANCTUARY AREA"
G	"FLOATING DOCK & SHIP REPAIR AREA"

MINISTRY OF COMMUNITY DEVELOPMENT INDEPENDENCE HOUSE		TELEPHONE: 25333	PROJECT REF.:
CIVIL ENGINEERING SECTION			PREPARED: W.T. CHECKED:
CLIENT: GOVERNMENT OF SEYCHELLES			APPROVED: 5.09.90
PROJECT: EAST COAST DREDGING & RECLAMATION PROJECT - P.-II			
THIS DRAWING: MACRO-LOCATION-MAP & KEY-PLAN		SCALE: 1:50,000	DRAWING NO.: MCD/E/EC.11.1

Because of the Government of Seychelles's commitment to sustainable development is linked to environmental conservation, it was determined that during phase two of land reclamation, every action would be taken to minimize the impacts to the coastal zone, in particular the coral reefs, from both short term activities (dredge and fill) and from long term erosional processes as described above.

Planned mitigative actions are as follows:

\*To mitigate short term impacts from dredge and fill activities a silt screen will be placed around the area to be dredged and around the area to be filled in order to contain sediment from these activities so that it will not drift over coral reefs and grass beds.

\*To mitigate long term impacts from erosion into the coastal waters from the reclaimed land by placing a filter cloth liner at the base of the fill area along the rock armor. This material allows water to pass but not suspended solids.

\*As an emergency step to reduce siltation, reinforcing with rock armour and filter cloth, outlets into the coastal waters from the artificial lagoon created by land reclamation.

\*Initiation of a long term environmental monitoring program, both biological and water quality, to assure that the mitigative measures taken are acceptable and so additional measures can be taken if unforeseen problems are identified.

The cost of this second phase is approximately 22 million Ruppies. The United States Government is putting up approximately 11 million Ruppies. The Regional Environmental Officer (REO) to USAID in East and Southern Africa, was invited to review the proposed land reclamation plans and proposed mitigative measures to assure the environmental soundness of the plans, in order to minimize the risk of long term irreversible impacts on man and the natural environment.

## 2. EXECUTIVE SUMMARY

Although, the evaluator is not an engineer, it appears from all information provided to him, that all reasonable mitigative measures are being taken. The U.S. Government can rest assured that with this environmental appraisal, the proposed mitigative measures and the proposed monitoring program, all reasonable actions that are economically feasible will be taken to safeguard the coastal integrity of Mahe Island and the Ste Anne Marine National Park during the second phase of the land reclamation.

It is highly recommended that as part of this funding, the U.S. Government alone or in collaboration with another donor (e.g. International Center For Oceanographic Development-Canadian) undertake the following actions:

- a. As soon as possible purchase the minimal equipment necessary to carry out long term environmental monitoring, both biological and water quality in the vicinity of the land reclamation area. This monitoring should begin months before the onset of dredge and fill activities so that a baseline can be obtained as a measure against which impacts can be ascertained that may result from construction activities.
- b. Consider sending the Department of the Environment's Senior Park Ranger for 1-2 months to the Key Largo National Marine Sanctuary, Florida to obtain on the job training in developing a monitoring program and in overall marine park management.
- c. Consider collaborating with U.S. Peace Corps to make development of a coastal zone monitoring program, a major U.S. Government contribution to sustainable development in the Seychelles over the next five years.
- d. Consider requesting the vendor of the siltation cloth to conduct a pilot bench scale study using samples of the fill material to assure that the appropriate mesh cloth is chosen which will allow water to pass but will eliminate or greatly reduce the passage of particulate matter or colloids into the coastal waters of the dredge and fill area.
- e. Send a copy of the final engineering report and the report of the silt screen/filter cloth expert to USAID/REDSO/ESA engineers for their review and approval.

There are other issues that could impact on the coastal zone but which are not directly related to the land reclamation project. The U.S. Government and/or the Seychelles Government may wish to deal with these issues:

a. In the Caribbean, nutrient enrichment of coastal waters from sewage has been found to be one of the biggest causes of coral reef dieoff. It is also a major public health problem and one of the more detrimental causes for deterioration of the tourist industry. An island wide assessment is needed to determine the current state of sewage treatment and disposal in tourist and urban areas so that donor support can be solicited.

b. Because of the closeness to the coastal zone, an entire island needs to be thought of as a coastal zone. The protection of important coral reefs requires a watershed approach that controls all development in watersheds draining onto these reefs. These controls begin at the very top of the island and continue all the way into the nearshore coastal waters that surround the reefs. As part of the Department of Planning's activities, there should be close collaboration with the Department of the Environment's proposed "Coastal and Marine Environment Baseline Study" to identify important coral reef habitat in need of protection so that appropriate actions can be taken to minimize the impacts of landbased pollution on the reefs associated with watershed development (e.g. development of tourism, urbanization, industrialization and agriculture).

A copy of a report has been left with the U.S. Embassy for distribution to government authorities that describes possible solutions and how the failure to deal with these latter issues has resulted in the collapse of the coral reef ecosystem in the Western Atlantic and the Florida Keys. Based upon the information in this report, strong consideration should be given to reassessing the value of preliminary treatment with an extended ocean outfall in favor of oxidation ponds and what would likely be a short outfall, as stated in the 1990-94 National Development Plan, Section 5.1.3, "Comprehensive and Integrated Approach to Planning and Development. Based upon the Caribbean experience, if oceanographic conditions are adequate, this is the most appropriate and cost effective solution to both ecological and public health concerns in the tropics.

A film of all coral reef surveys and of environmental issues associated with the existing and proposed land reclamation has been left behind with the U.S. Embassy to be copied and distributed to the Government of the Seychelles.

### 3. FIELD ACTIVITIES

The site visit to the Seychelles was conducted from October 18-20, 1990. On day one a meeting was held with members of the Departments of Planning and the Environment including:

\*Belinda Micock, Assistant Director of Planning, Ministry of Community Development

\*Nirmal Jivan Shah, Biologist/Ecologist, Director of Conservation and National Parks, Department of Environment

\*Elaria Smith, Conservation Officer, Dept. of the Environment

\*Waldemar Tilly, Chief Engineer, Ministry Of Community Development

\*George Romilly, Legal Consultant, Department of Environment

A review of environmental and engineering issues associated with the land reclamation/rock armour project were discussed with this team. This included a discussion of proposed measures using silt screen and filter cloth to mitigate short and long term sedimentation from land reclamation into the marine environment. In the afternoon, a site visit was made with Ms. Micock and Mr. Tilly to existing and proposed land reclamation sites.

Day two was spent in the field with Ms. Smith and Joel Souyave, Senior Park Ranger, assessing coral reefs that were or could be impacted from land reclamation against other reefs believed to be minimally impacted by the environment.

Day three was spent meeting with Patrick Lablache, Director General, Ministry Of Community Development, to discuss survey findings, editing film of field observations and in producing a draft report.

#### 4. RESULTS AND DISCUSSIONS

4.1 Proposed Use Of Silt Screen And Filter Cloth To Minimize Deterioration Of The Coastal Zone From Long And Short Term Sedimentation Associated With Dredge And Fill Activities. A specialist in this area will be arriving shortly to advise the Government of the Seychelles on the exact procedures and on the choice of materials to provide the best results.

Basically, the silt screen will function very similarly to the screens used to contain petroleum spills. An impervious polyester vinyl non-permeable turbidity curtain will be suspended from floats and anchored with chain. It will be from 1.5 to 4.0 meters deep depending on the conditions.

The consultant will have to advise them on how to get rid of the suspended matter and water trapped by this curtain (either around the area being dredged and/or the land being reclaimed).

A filter cloth will be placed at the base and along the outer edge of the rock armourment in order to control erosion into the coastal waters from reclaimed land. It is advised that the consultant who is coming, be prepared to bring filter cloth of varying pore sizes to determine what size will provide maximum filtration of water with minimum filtration of suspended matter and colloidal materials.

Because the author of this environmental assessment is not an engineer, it was decided that Mr. Tilly would send the final engineering documents to USAID/REDSO engineers for their review from the standpoint of engineering soundness.

4.2 The Impacts Of Dredge/Fill Activities and Land Reclamation On Coral Reef Health. A brief one day survey of coral reefs around Mahe was undertaken. The author was accompanied by Joel Souyave-Senior Park Ranger, Ms. Smith-Conservation Officer and Charles Seitz-Visiting Environmental Planner Peace Corps. The following reefs were surveyed (Figure 2):

\*Baie Ternay National Park (Sites 1 & 2) and Reef Off Of Auberge Club Des Seychelles (Site 3) as examples of minimally impacted coral reefs.

\*Fringing Coral Reefs In The Vicinity Of The Victoria Sewage Outfall (Site 4) and Off Of Brilliant Point (Site 5) As Examples Of Highly Degraded Coral Reefs From Which Fill Material Will Be Collected.

\*Coral Reefs From Ste Anne Marine National Park (Ile Cachee (Site 6) and Ile Moyenne (Site 7) as examples of coral reefs that may have been impacted from dredging activities.

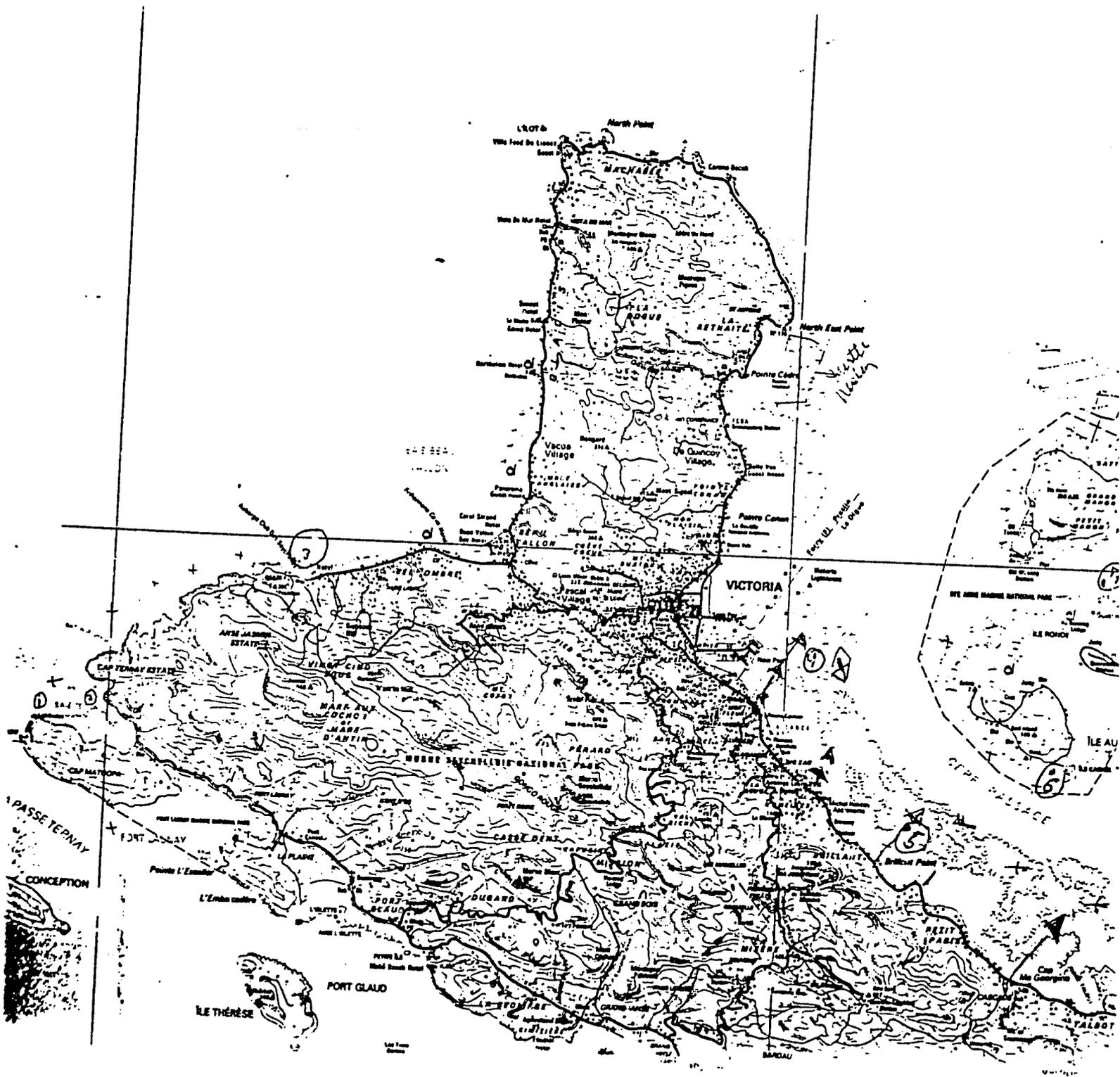


Figure 2. Underwater Sampling Sites To Identify Percent Live Coral Cover, October 19, 1990, Mahe, The Seychelles.

Although, time was limiting and only a very small area of each coral reef was surveyed, an attempt was made to estimate the percent live versus dead coral cover in order to determine the overall health of the coral reef. A 25 foot chain marked every 5 feet was stretched out over a typical section of the reef. At least three times on each reef, a one foot square quadrant was placed along the chain and an estimate of percent dead coral was made. The entire length of the chain and each quadrant was filmed on video. Slides were also taken. At the end of this sequence, a 360 degree panoramic view was filmed and an overall impression of the health of the reef was made. These observations were discussed upon resurfacing between the senior park ranger and the author. Potential causes of degradation were also discussed.

A summary of observations is contained in the accompanying table. Basically, except for the first site at Baie Ternay, all sites appear to be suffering from some degradation. This statement must be qualified by the fact that with the exception of the highly degraded nearshore fringing reefs, the coral reefs observed during this survey, even with some signs of degradation are healthier than most reefs that one would find today in the Caribbean or Florida Keys.

The exact cause for this degradation is purely speculative and can not be ascertained without a strong water quality based monitoring program. Other than the heavily degraded nearshore fringing reefs, it is not evident that siltation from dredging is the major cause of this degradation.

The heavy cover of Sargassum spp. algae smothering these nearshore fringing corals and that seen beginning to fill in spaces between the horny projections of the Acropora/Porites corals at the two sites on St Anne Marine National Park, could be indicative of nutrient pollution associated with improperly treated and disposed waste between Victoria and the airport. For instance from the permanent resident population of Victoria alone (23,000 people), it can be estimated that this is equivalent to fertilizing the nearshore coastal waters with 38-39,000 fifty pound bags of 20/10/10 (NPK) fertilizer as a result of human waste disposal. If all of these nutrients are available for algae production depending on the limiting nutrient between 7-13 million pounds dry weight of algae could be produced per year in Victoria's nearshore coastal waters (See Attachment). Looked at in this light, it is no wonder that epiphytic algae could out compete and over grow corals that have evolved to rapidly recycle nutrients in nutrient poor tropical waters. The importance of monitoring for nutrient pollution can not be overstated.

If siltation is the major cause of degradation there is no quantitative data to determine what has been more devastating, sediment from dredging activities or sediment from land runoff during heavy storms.

UNDERWATER OBSERVATIONS

OF

CORAL REEF HEALTH

MAHE, SEYCHELLES, OCTOBER 19, 1990

<u>SITE</u>	<u>OBSERVATIONS</u>
1. Baie Tourney National Park, Near Lighthouse At Mouth:	Large granite boulders dominated by different species of <u>Acropora</u> spp. 100 percent live coral cover, excellent diversity of fish. Maximum depth 50 feet, 15 minutes. Visibility 100 feet.
2. Baie Tourney National Park, 1 km off of National Youth Service Camp:	Coral Reef showing minimal signs of stress with 20-30% dead coral, most likely cause due to pollution coming from NYS Camp that has been in existence for about 10 years. Twelve feet depth, 20 minutes. Water quality data needed to better understand cause of reef degradation. Visibility 50-100 feet.
3. Auberge Club De Seychelles 100 meters off shore:	Coral reef in excellent condition, 5% dead coral. Minimal negative impact from hotel, perennial river in populated watershed. Maximum depth 18 feet, 15 minutes. Visibility 50-100 feet
4. One Kilometer Offshore from Victoria Sewage Treatment Plant, In Vicinity Of Outfall:	95 % of coral on fringing reef dead covered in <u>Sargassum</u> spp. Remaining dominant coral "boulder like," appears to be species of <u>Porites</u> spp. ?? Minimal sedimentation observed on coral although visibility only about 3 feet. Water column full of colloidal material and suspended solids. Water quality data needed to better understand. Maximum depth 8 feet 15 minutes

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UNDERWATER OBSERVATIONS (Cont.)

OF

CORAL REEF HEALTH

MAHE, SEYCHELLES, OCTOBER 19, 1990

SITE

OBSERVATIONS

5. Brilliant Point, Off Lagoon Outlet, just off of and before Runway Lights: 40% Sargassum spp. cover, 40% silt covered dead coral and 10-15% live coral, dominated by same coral species as off sewage plant. Visibility same as off sewage treatment plant. Maximum depth 10 feet, 15 minutes
6. Ile Cachee: 70% live coral, 30% dead coral. Acropora spp. corals dominant. Most of dead coral on top of reef where Turbinaria spp. algae begins to dominate and percent dead coral increases. Most of reef slopes living. While coral appears mostly alive, beginning to see epiphytic algae growing in interstitial areas. This could be the beginning of reef degeneration. Reef needs monitoring both biologically and water quality. Fish life excellent. Visibility 50-100 feet.
7. Ile Moyenne, St. Anne Channel: Exact conditions difficult to generalize. Slopes, dropping off to a sandy bottom at about 40 feet of depth, are made up of coral talus. At shallower depths 10-15 feet and shallower area dominated by coral, Acropora spp. While coral appears mostly alive, beginning to see epiphytic algae growing in interstitial areas. This could be the beginning of reef degeneration. Reef needs monitoring both biologically and water quality. Shallows (5 feet depth and less) dominated by extensive beds of Turbinaria spp. algae. Fish life excellent. Visibility 50-100 feet

The above possibilities are purely speculative in nature and are that much more of a reason to help the Department of the Environment obtain equipment necessary to carry out a biological/water quality based program along the coast. This is a major priority as outlined in their Environmental Management Strategy, 1990-2000. It should be remembered that similar surveys were what spawned the beginning of the US Environmental Protection Agency in the United States. This type of monitoring was undertaken for similar reasons, to better understand the health of our lakes, rivers and streams, many of which had become extremely eutrophic from human, industrial and agricultural pollution.

Consideration should be given to sending the Senior Park Ranger for two months of on the job training in monitoring and marine park management at the Key Largo National Marine Sanctuary, operated by personnel from the National Oceanographic And Atmospheric Administration. Both the author and Ms. Smith have had contact with personnel from this marine park and they are open and available to conduct such training. This is the individual who will be overseeing the work of the Peace Corps Volunteers who will be arriving in 1991 to work in parks and natural resources management.

It is expected that many of the 114 outer islands in the Seychelles contain virgin coral reef habitat. Not only because of their importance with regard to biological diversity, but because of their importance to island ecology, fishing and to tourism, the Seychelles may have the unique opportunity to protect its reefs based upon its philosophy of sustainable development. Based upon what is happening to the world's tropical coastal zones, this may be one of the few areas left in the world where healthy stands of coral reef exist over such a large area.

It should be noted that the identification of Indian Ocean corals is very difficult due to polymorphism. That is to say under different environmental conditions the same species of coral can take on a number of different forms. Through a combination of underwater photography of live coral and bleached samples of the photographed coral a reference collection can be established to aid in the development of a monitoring program. Dr. Terry Done from the Australia Institute of Marine Science, through UNESCO, has been helping Mauritius and Kenya establish such collections and train personnel. This should be considered by the Department of the Environment.

Importance Of Coastal Zone Monitoring To The Future Of Shelles's Coral Reefs. As discussed above there are a number of potential causes for the observed coral reef degradation (e.g. sedimentation from dredge and fill/land reclamation, erosion from perennial streams, sewage, boat and diver damage), which can only be ascertained with a properly designed coral reef monitoring program. This program should include both water quality and coral reef monitoring.

Water quality monitoring should include regular sampling at identified sites of:

- \*Oxygen/Temperature
- \*Salinity/Conductivity
- \*Light Penetration via Secchi Disk
- \*Turbidity of both filtered (Colloidal Matter) and Unfiltered water samples.
- \*Total Suspended Solids
- \*Phosphate/Nitrate Series
- \*Total Coliform/Fecal Coliform Bacteria

Sampling should be at the surface, mid depth and just off the bottom unless the site is so shallow that a lesser number of samples can be collected and still provide a representative opinion about the state of the water quality. Sampling should be scheduled for regular monthly field trips. During peak rain storms or during unusual activities (e.g. dredge and fill operations), sampling should take place more frequently.

Permanently marked transects should be established and regular photographic/video reef surveys should be conducted and related to water quality in order to ascertain the health of the reef and what if anything may be resulting in changes. Such monitoring will allow mitigative measures to be planned well in advance of a crisis situation.

The Peace Corps is in the process of making environmental activities one of its priorities and since the Department of the Environment also sees coastal environmental monitoring as its priority, consideration should be given in helping this marriage take place along with some financial support for equipment supplies. The Regional Environmental Advisor is available to work with Peace Corps and the Department of the Environment to identify the needed equipment and supplies. He has at his disposal, many scientific and field supply catalogs.

One final observation to be noted, is that in the contractual requirements noted in the DeSilva report ("Assessment Of Impact Of Recent Dredging And Reclamation Activities In East Coast Mahe, Seychelles On The Ste. Anne Marine National Park," April 1986). There is a requirement "...that return water shall at all times be reasonably free of sediments. The maximum allowable concentration shall not exceed 30 grams per liter." When the REO raised a question about this he was told that this was a typo and that it should be 30 milligrams per liter. It is not evident how the author came to such a conclusion, regardless of the concentration.

The USEPA's criteria for suspended and settleable solids in marine waters is that they should not reduce the depth of the compensation point for photosynthetic activity (e.g. Secchi Disk Depth or the 1% Light Level) by more than 10 % from the seasonally established norm for aquatic life. In this case, if baseline Secchi Disk readings can be obtained before construction begins, then the Secchi Disk Depth in areas of important coral reef habitat can be considered the norm and then they should not be decreased by more than 10% due to dredge and fill or land reclamation activities.

Secchi Disk readings are easy to take. If one is not readily available, it can be easily fabricated until a commercial grade disk can be purchased.

4.4 The Potential Impact On Coastal Erosion From Collecting Fill Material From The Degraded Nearshore Fringing Reefs. Living coral reefs play a major role in providing sand for beaches as they are biologically broken down over time. Coral reefs also protect the mainland and the beaches by acting as buffers against storm and wave action. Normally, when fringing reefs are removed, (e.g. physically to open channels for boat traffic or dynamited for fishing, dieoff and collapse from landbased pollution), coastal erosion becomes a problem. Peter is robbed to pay Paul as groins, jetties and breakwalls modify the literal movement of sand, saving the beaches in one area and accelerating erosion in other areas.

This concern was discussed with both Mr. Tilly and Mr. Lablache. Mr. Lablache assured me that he was aware of this issue. Blue prints were shown the author which indicate that dredge spoil is to be collected from the inner most edges of the degraded nearshore fringing reefs. The outer areas of these reefs will be left alone to protect the coast line. Mr. Lablache is in the process of hiring construction supervisors to assure that such contractual requirements are carried out.

METHODOLOGY AND ASSUMPTIONS USED TO ESTIMATE

THE POTENTIAL EFFECTS OF HUMAN WASTE

FROM VICTORIA, MAHE

TO ENRICH THE NEARSHORE WATERS WITH NUTRIENTS AND ALGAE

1. Typical Human Wastes

lb/capita/day

TSS 0.162  
BOD 0.160  
Total Nitrogen as N 0.047  
Total Phosphorus as PO<sub>4</sub> 0.029 x 0.326 = 0.01 as P

Source: USEPA. March 1973. Water quality criteria 1972.  
USEPA. EPA-R3-73-033. 594p.

2. Total Man Days Per Year In Victoria

Permanent Residents	Man Days/Year
23,000	8,395,000

3. The total pounds of Total Nitrogen and Phosphorus produced in Victoria from human sewage is:

lb of Phosphorus/Year	lb of Total Nitrogen/Year
83,950 as P	394565 as N

4. Typical Tropical Fertilizer consists of the following active ingredients:

a. 20% as Nitrogen

b. 10% as P<sub>2</sub>O<sub>5</sub>

5. Molecular Weight of P<sub>2</sub>O<sub>5</sub> = (30.97) x (2) + 15.99 x 5 =  
61.94 + 79.95 = 141.89

6. The percent by weight of P in P<sub>2</sub>O<sub>5</sub> is 61.94/141.89 = 44 %

7. The percent by weight in a bag of fertilizer of "P" is  
10% x 44% = 4.4 %

8. Therefore in a 50 pound sack of fertilizer there is:

a.  $(0.20) \times (50) = 10 \text{ lb of N}$

b.  $(0.044) \times (50) = 2.2 \text{ lb of P}$

9. If 83950 lb of total phosphorus as P is produced by human waste from Victoria per year this is equivalent to:

$83950/2.2 = 38,159$  fifty pound sacks of fertilizer being dumped into the nearshore waters around Victoria each year, assuming that the current system of treatment and disposal of sewage does not adequately remove nutrients.

10. If 394565 lb of Total Nitrogen is produced by human waste from Victoria per year this is equivalent to:

$394565/10 = 39,457$  fifty pound sacks of fertilizer being dumped into the nearshore waters of Victoria per year.

11. If all of the total nitrogen (TN) were available to be converted to algae and TN makes up 5% by dry weight of algae (Olson and Burgess, 1967) then  $(394,565/.05) 7,891,300$  pounds dry weight of algae could be produced per year if nitrogen were the limiting factor.

12. If all of the total phosphorus (TP) were available to be converted to algae and TP makes up 0.6% by dry weight of algae (Olson and Burgess, 1967) then  $(83,950/0.006) 13,991,666$  pounds dry weight of algae could be produced per year if phosphorus were the limiting factor.

Olson, T.A. and F.J. Burgess. Editors. 1967. Pollution and marine ecology. Interscience Publishers, a division of John Wiley and Sons. Source page 167, 363p.

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November 27, 1990

MEMORANDUM

To :Andy Anderson, Econ/Political Officer, U.S.  
Embassy/Victoria, The Seychelles

Thru :Bob Rose, USAID/REDSO/ENG

From :Paul Andre *J. DeGeorge*, USAID/REDSO/REO

Concerning: Coral Reef Survey Of Mahe and The St. Anne Marine Park  
With Regard To Land Reclamation Around Victoria, Mahe.

Attached is a coral reef survey undertaken for the Government of the Seychelles and the U.S. Embassy/Victoria to assess the current health of the coral reef in the area, and the environmental soundness of the current plans to reclaim land between the capitol of Victoria and the airport.

This environmental appraisal recommends that as part of this funding, the U.S. Government alone or in collaboration with another donor (e.g. International Center For Oceanographic Development-Canadian) undertake the following actions:

- a. As soon as possible purchase the minimal equipment necessary to carry out long term environmental monitoring, both biological and water quality in the vicinity of the land reclamation area. This monitoring should begin months before the onset of dredge and fill activities so that a baseline can be obtained as a measure against which impacts can be ascertained that may result from construction activities.
- b. Consider sending the Department of the Environment's Senior Park Ranger for 1-2 months to the Key Largo National Marine Sanctuary, Florida to obtain on the job training in developing a monitoring program and in overall marine park management.
- c. Consider collaborating with U.S. Peace Corps to make development of a coastal zone monitoring program, a major U.S. Government contribution to sustainable development in the Seychelles over the next five years.

d. Consider requesting the vendor of the siltation cloth to conduct a pilot bench scale study using samples of the fill material to assure that the appropriate mesh cloth is chosen which will allow water to pass but will eliminate or greatly reduce the passage of particulate matter or colloids into the coastal waters of the dredge and fill area.

e. Send a copy of the final engineering report and the report of the silt screen/filter cloth expert to USAID/REDSO/ESA engineers for their review and approval.

If the above mitigative measures can be realized, both the REO and the REDSO Engineering staff feel comfortable that every effort will have been taken to protect the Seychelles' fragile and economically important coastal zone during the second phase of the land reclamation project.

The REO looks forward to future collaboration with the Government of the Seychelles, the U.S. Embassy and U.S. Peace Corps to see this program realized.

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## CONTACTS

1. Andy Anderson, Econ/Political Officer, U.S. Embassy/Victoria
2. Marlene Beck, Peace Corps Directress, The Seychelles
3. Belinda Micock, Assistant Director of Planning, Ministry of Community Development
4. Nirmal Jivan Shah, Biologist/Ecologist, Director of Conservation and National Parks, Department of Environment
5. Elaria Smith, Conservation Officer, Dept. of the Environment
6. Waldemar Tilly, Chief Engineer, Ministry Of Community Development
7. George Romilly, Legal Consultant, Department of Environment
8. Patrick Lablache, Director General, Ministry Of Community Development
9. Charles Seitz, Environmental Planner, U.S. Peace Corps.