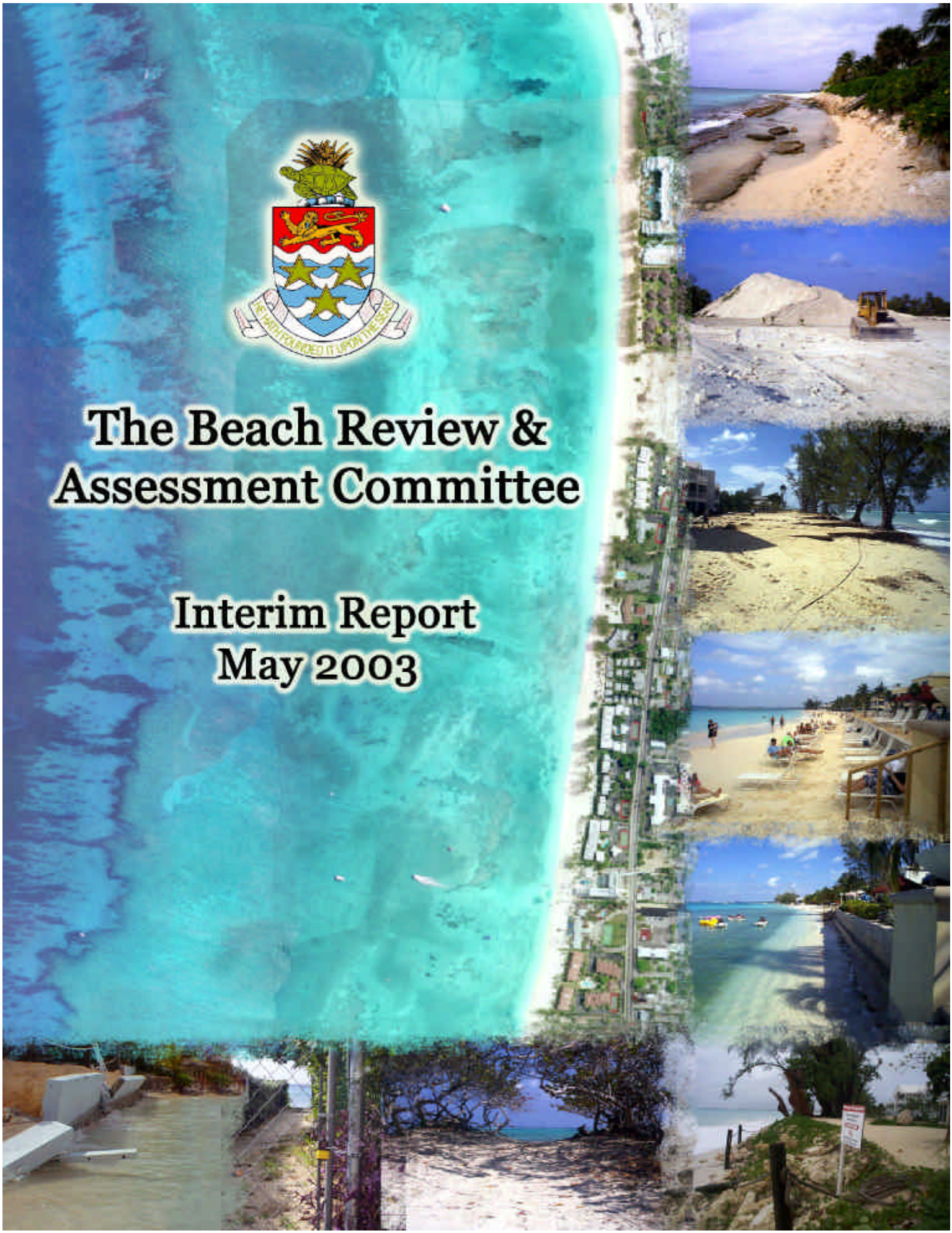

The Beach Review & Assessment Committee

Interim Report
May 2003

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Interim Report Beach Review and Assessment Committee

EXECUTIVE SUMMARY

The following Report, '*Beach Review and Assessment Committee: Interim Report April 2003*' documents the background and major issues primarily influencing Seven Mile Beach and its management with respect to erosion. The Report provides a broad range of recommendations aimed at addressing both immediate erosion concerns and preventing future erosion problems through changes in development and planning policy.

The Report has been submitted as an interim report because the Committee recognised that many of the issues that were affecting beaches other than Seven Mile Beach were equally important but had not yet been considered by the Committee. Given the timeframe and urgency for required action on Seven Mile Beach it was felt that an Interim Report would allow the Committee, and ultimately the Government, to address priority issues in this area including restoration of beaches in heavily eroded sections.

Following the submission of this Interim Report the Committee will then continue to address additional beaches and beach management issues in the Cayman Islands in accordance with the original Terms of Reference. These additional recommendations will make up the final report that will be incorporated into the **Strategic Beach Management Plan** outlined in the Interim Report.

The recommendations outlined in the Interim Report encompass a broad range of beach management issues, strategies and priorities. While all of the recommendations are important it is clear that those dealing with restoration of eroded sections of Seven Mile Beach, particularly the Southern section from Crescent Point to the Sovereign, are considered immediate priorities that should be implemented in the shortest possible timeframe.

The following summary represents the major recommendations outlined in the Interim Report grouped together in three key priority groupings:

> ***High Priority Short Term Solutions*** represent recommendations that must be implemented and possibly completed within 2-6 months of adoption of the Interim Report. Immediate action in these areas will not necessarily provide a long-term solution to erosion problems, but will temporarily alleviate problematic erosion conditions and more importantly will demonstrate clear intention on Government's behalf to tackle this difficult problem.
>
> ***High Priority Long Term Solutions*** represent recommendations that should be implemented within 2 – 12 months of adoption of the Interim Report and that will have a long-term impact on erosion issues. These recommendations represent changes in development and planning policies that will directly benefit beach management.

Intermediate Priority Long Term Solutions represent recommendations that should be implemented within 12 months of adoption of the Interim Report and that will have a long-term impact on erosion issues.

MAJOR RECOMMENDATION AND PRIORITY GROUPINGS:

High Priority – Short Term Solution (2 - 6 Months).

1. Removal of specifically identified and inappropriately sited rock and rubble obstructions along Seven Mile Beach (Reference page: 18).

2. Conduct an immediate trial for Government initiated Spot Nourishment of heavily eroded sections of Seven Mile Beach utilising sand sources stockpiled on the island from previous construction projects. (Reference page: 27). Conduct an 'Engineering Feasibility Study' in preparation for a beach nourishment program during the next major erosion event and as a central component of the Strategic Beach Management Plan. (Reference page: 27 and 34)

High Priority - Long Term Solution (2 - 12 Months).

1. Establishment of a 'Strategic Beach Management Plan.'(Reference page: 18)
2. Establishment of the Historic Vegetation Line using suitable archived aerial photography as the benchmark for determining setbacks on all beaches. (Reference page: 19)
3. A Coastal Setback Category Map, that will detail site-specific setback distances, should be generated for all coastlines on Grand Cayman (beginning with Seven Mile Beach) as well as the Sister Islands. (Reference page: 19)
4. Immediately implement a policy of Opportunistic Nourishment (return of stockpiled beach sand from previously approved development and any sand removed from the beach ridge during the construction of new foundations, seawalls and pools). (Reference page: 27)
5. Establishment of a permanent Beach Management Fund with an initial deposit by Government in the 2003/4 financial year and in subsequent years from private and Government funding mechanisms to be determined at a later stage. (Reference page: 35)
6. Amendment of Development and Planning Regulations and/or CPA policies such that all repair of coastal structures damaged by storms and hurricanes shall require planning permission in accordance with established policies and recommendations. (Reference page: 38)

Intermediate Priority – Long-term Solution. (12 Months)

1. Amendment of Planning Regulations to include a requirement that Heavy Vehicle Access is maintained to the Seven Mile Beach between future buildings considered for Planning

approval to allow heavy equipment access to the beach in the event of a major beach restoration effort. (Reference page: 34)

2. Developers and residents shall be encouraged to use native beach vegetation to assist beach stabilisation both before and after storm events. (Reference page: 37)
3. Amendment of Section 31 of the Development and Planning Law (1999 Revision) to prevent the practice of sand removal from all beaches. (Reference page: 37)
4. The Committee strongly recommends that the current Department of Environment and Lands and Survey Department Beach Monitoring Programme is continued and information and data collected in this programme is incorporated into specific Beach Management Plans as part of the Strategic Beach Management Plan. (Reference page: 39)

1. INTRODUCTION

In January 2003 Honourable W. McKeeva Bush OBE, JP, Leader of Government Business and Minister of Tourism, Environment, Development and Commerce, established the Beach Review and Assessment Committee (BRAC) with the primary objective to review, recommend and implement an appropriate plan of action to address the issue of beach erosion.

2. THE TERMS OF REFERENCE.

The Committee was provided with the following Terms of Reference (TOR) that were expanded and agreed to in the early stages of the process to include additional items felt relevant by the Committee.

1. Assess all available information and make recommendations on policies and strategies for the long-term management and preservation of Seven Mile Beach and all beaches of the Cayman Islands. In this regard, consideration should be given but not limited to:
    I. The need for nourishment or other solutions.
    II. Development of appropriate coastal setbacks.
    III. Recommendations on native beach vegetation, and for the redevelopment / repair of coastal and inland structures / buildings damaged through wave action.
    IV. Policies and recommendations to preserve access, visual and physical, to the beach.
2. Development of a Contingency Plan detailing planned actions in the event of a significant erosion event on Seven Mile Beach.
3. Prepare a Report for the Ministry Tourism, Environment, Development and Commerce by March 28th 2003 which will be tabled in the Legislative Assembly.

3. THE COMMITTEE

The appointed Committee was composed of the following members:

• Hon. McKeeva Bush	Minister, Tour. Env. Dev & Com.	Chairman
• Gina Ebanks-Petrie	Director of Environment	Co Chairman
• Tim Austin	Assistant Director, R&A. D.O.E.	Secretary
• J. Robert Bodden	Beach Preservation Committee	Member
• Mr. Bryan Bothwell		Member
• Clark Buchanan	Director, Lands and Survey	Member
• Captain Chuckie Ebanks	Cayman National Watersports Association	Member
• Captain Eugene Ebanks		Member
• Kenneth Ebanks	Director of Planning	Member
• Kem Jackson		Member
• Derrington (Bo) Miller	North Coast Tourism Council	Member
• Pearse Murphy	C.I.Soc. Architects, Surveyors &.Engineers.	Member
• Bob Soto		Member
• Wil Pineau	CEO, Chamber of Commerce	Member
• Pat Ulett	Asst. Secretary, TED&C	Member

Consultants to the Committee

- Dr. Richard Seymour – Head, Ocean Engineering Group, Scripps Institution of Oceanography (see qualifications page 44).
- Mr. Ralph Clark, PE - Bureau of Beaches and Wetland Resources, Florida Department of Environmental Protection (see qualifications page 52).

Invited Presentations:

- D.L. Holmberg, Holmberg Technologies Inc. (see qualifications page 48).
- John McKenzie and Burns Rutty presenting ProTec Tube.

4. SUMMARY OF MAJOR RECOMMENDATIONS

The following summary outlines the major recommendations of the Beach Review and Assessment Committee by April 2003. The recommendations are presented in the order in which they appear in the document and the order does not reflect their priority for action or implementation. The more detailed recommendations can be found in the body of the report with rationale and examples provided were appropriate. Timelines and priorities are discussed in the Executive Summary of this document.

1. **Establishment of a 'Strategic Beach Management Plan'. (Reference page: 18).**

2. **Removal of specifically identified and inappropriately sited rock and rubble obstructions along Seven Mile Beach. (Reference page: 18).**

3. **Establishment of the Historic Vegetation Line using suitable archived aerial photography as the benchmark for determining setbacks on all beaches. (Reference page: 19).**

4. **A Coastal Setback Category Map, that will detail site-specific setback distances, should be generated for all coastlines on Grand Cayman (beginning with Seven Mile Beach) as well as the Sister Islands. (Reference page: 19).**

5. **Conduct an immediate trial for Government initiated Spot Nourishment of heavily eroded sections of Seven Mile Beach utilising sand sources stockpiled on the island from previous construction projects. (Reference page: 27). Conduct an 'Engineering Feasibility Study' in preparation for a beach nourishment program during the next major erosion event and as a central component of the Strategic Beach Management Plan. (Reference page: 27 and 34).**

6. **Immediately implement a policy of Opportunistic Nourishment (return of stock-piled beach sand from previously approved development and any sand removed from the beach ridge during the construction of new foundations, seawalls and pools). (Reference page: 27).**

7. **Amendment of Planning Regulations to include a requirement that Heavy Vehicle Access is maintained to the Seven Mile Beach between future buildings considered for Planning approval to allow heavy equipment access to the beach in the event of a major beach restoration effort. (Reference page: 34).**

8. **Establishment of a permanent Beach Management Fund with an initial deposit by Government in the 2003/4 financial year and in subsequent years from private and Government funding mechanisms to be determined at a later stage. (Reference page: 35).**

9. Developers and residents shall be encouraged to use native beach vegetation to assist beach stabilisation both before and after storm events. (Reference page: 37).

10. Amendment of Section 31 of the Development and Planning Law (1999 Revision) to prevent the practice of sand removal from all beaches. (Reference page: 37).

11. Amendment of Development and Planning Regulations and/or CPA policies such that all repair of coastal structures damaged by storms and hurricanes shall require planning permission in accordance with established policies and recommendations. (Reference page: 38).

12. The Committee strongly recommends that the current Department of Environment and Lands and Survey Beach Monitoring Programme is continued and information and data collected in this programme is incorporated into specific Beach Management Plans as part of the Strategic Beach Management Plan. (Reference page: 39).

5. OVERVIEW OF BEACH REVIEW AND ASSESSMENT COMMITTEE PROGRESS TO DATE

The work of the Committee to date has focused on Seven Mile Beach due to the urgent need to address issues in this location. This report, therefore, primarily deals with Seven Mile Beach although some general recommendations apply to all beaches of the Cayman Islands. A summary of the **main** recommendations has been outlined in Section 4, but **all** recommendations of the Committee are highlighted in bold text throughout the body of the report.

January 15th – May 9th 2003

15th January 2003: Appointment of Committee by Honourable W. McKeeva Bush, Leader of Government Business and Minister of Tourism, Environment, Development and Commerce

17th January 2003: First meeting of BRAC at the Government Administration Building Conference Room.

24th January 2003: Public meeting of BRAC and invited beach front property owners at the Marriott Hotel. Approximately 100 people in attendance. Stakeholders informed of BRAC Terms of Reference, shown PowerPoint presentation of current issues and monitoring programs and invited to comment on issues they felt were important.

29th January –5th February 2003. Dr. Richard Seymour brought to Grand Cayman from Scripps Institute to assess Seven Mile Beach and explore recommendations and options with BRAC. Dr. Seymour to remain as BRAC advisor.

31st January 2003. Second BRAC meeting at Department of Environment. Dr. Richard Seymour makes presentation to Committee and extensive question and answer period follows.

3rd February 2003: Meeting between BRAC and Citizens Beach Committee at DOE Conference Room. Dr. Seymour invited to give presentation on Characteristics of Seven Mile Beach and Recommendations for Options. Extensive discussion followed.

14th February 2003: Third BRAC meeting at Department of Environment. John Mackenzie and Burns Rutty give a presentation and information on the ProTecTube erosion control structures as an option for stabilization and erosion control on Seven Mile Beach.

21st February 2003: Extraordinary meeting between BRAC and the Cayman Islands Tourism Association organized by Marlene Bodden on behalf of condominium managers.

28th February 2003: Fourth BRAC meeting at the Department of Environment. Presentation of Dr. Richard Seymour's 'Options for the Maintenance and Enhancement of Seven Mile Beach.'

5th March – 11th March 2003: Dick Holmberg of Holmberg Technologies Inc. invited to Grand Cayman at the request of BRAC to provide input and additional alternatives for erosion control.

6th March 2003: Dick Holmberg gives a presentation to BRAC outlining his product of 'Undercurrent Stablilizers' as method of assisting the accretion of sand on Seven Mile Beach.

13th March – 17th March 2003: Ralph Clark of the Florida Department of Environmental Protection's Bureau of Beaches and Wetlands Resources invited to Grand Cayman at the request of BRAC to provide an overview and review of his experience with beach erosion in the Cayman Islands.

14th March 2003: Fifth BRAC meeting at the Department of Environment. Ralph Clark gives a presentation to BRAC outlining the current status of erosion control in Florida and a brief review of Dr. Seymour's Options Paper. Extensive questions and discussion follows presentation.

28th March 2003: Sixth BRAC meeting at the Department of Environment. Review of Draft Interim Report begins. Extensive discussions.

11th April 2003: Seventh BRAC meeting at the Department of Environment. Continued review of Draft Report with discussion and amendments made.

16th April 2003: Eigth BRAC meeting at the Department of Environment. Continued review of Draft Report with discussion and amendments made.

23rd April 2003: Ninth BRAC meeting at the Department of Environment. Final review of Draft Report.

9th May 2003: Amended Draft Report delivered to Committee Members for Final Review – final comments to be received by May 13th 2003.

6. CLASSIFICATION OF SEVEN MILE BEACH

Figure 1: Map of the West Bay Peninsula showing the two separate sand transport systems identified in the Interim Report.

The Committee recommends that Seven Mile Beach is geographically defined as all beaches between the West Bay Public Beach (Block 5B Parcel 179) and Pageant Beach (Block 13E Parcel 165) in the South.

In addition the Committee was advised that within the defined geographical boundaries of Seven Mile Beach there exists two distinct sand transport systems that can be considered as separate systems (Seymour, 2001; Roberts 1977). These systems can be defined as (i) North of Crescent Point (Block 13B Parcel 7 to Block 5B Parcel 179) and (ii) South of Crescent Point (Block 13B Parcel 7 to Block 13E Parcel 165) and which, by nature of the different sand transport systems, will most likely require different solutions to erosion problems. While many of the recommendations outlined in this report are applicable to the whole of Seven Mile Beach and beaches and coastlines in general a few recommendations, mainly dealing with nourishment issues, are only applicable to the sand transport system North of Crescent Point. Recommendations only applicable to the section North of Crescent Point will be highlighted. The Committee anticipates further recommendations for the areas South of Crescent Point that will be reviewed and included in the full report.

7. SEVEN MILE BEACH PROCESSES

7.1 North of Crescent Point (Block 13B Parcel 7 to Block 5B Parcel 179).

Limited research has been conducted on the Seven Mile Beach sand transport system North of Crescent Point although various accounts have been provided over the years. The most recent review of Seven Mile Beach processes was provided by Dr. Richard Seymour in his November 2000 report '*Seven Mile Beach: A Natural History*' the conclusions of which have been presented here for reference.

(a.) During most of the year, a series of crescent-shaped beaches exist, stabilized by headlands and beach rock.

(b.) Seven Mile Beach exists because it is a lee shore for most of the year.

(c.) The southern end of the beach is highly susceptible to rapid narrowing during storms with waves from the south, aggravated by artifically-narrowed beaches and fine-grained sand.

(d.) Sand is lost from the system even under relatively benign conditions.

(e.) Beach surival therefore requires a natural supply of sand.

(f.) Nor'westers, although the cause of flooding and wave impact damage, are responsible for delivering replenishment sand to the beach and moving it southward.

(g.) Northwesters, appear to move sand from the western sand plain offshore of North West Point to Seven Mile Beach.

(h.) The western sand plain appears to be an extension of the northern between-reef sand system.

7.2 South of Crescent Point (Block 13B Parcel 7 to Block 13E Parcel 165).

The section of Seven Mile Beach South of Crescent Point has been classified as separate from the sand transport system that maintains the Seven Mile Beach North of Crescent Point. More specific recommendations will be formulated for the southern section following more detailed analysis of this area. These recommendations will be incorporated into the full Committee Report submitted at a later stage.

8. OVERVIEW OF THE CURRENT STATUS OF SEVEN MILE BEACH NORTH OF CRESCENT POINT

The opinion of both beach consultants who recently visited Grand Cayman (Dr. Richard Seymour and Mr. Ralph Clark, PE) is that the Seven Mile Beach system North of Crescent Point, although currently experiencing sporadic heavy erosion events, is a relatively healthy, stable system. Much of the heightened perception of erosion has been caused by periodic blocking of alongshore access in a few areas due to loss of beach and the presence of obstructions (Figure 2).

Figure 2: Alongshore access blocked by poorly sited structures.

This view has also been expressed by some long-term residents who point out that certain sections of beach around the Cayman Islands have always eroded and have then recovered. Historical photographs of beach erosion dating back to the 1970's and presented in Section 11.2 (page 26) also support this opinion.

In addition the recent weather patterns over the last 5 years have contributed to more erosion on the Southern section as a series of tropical storms have passed mostly to the South and West of the Cayman Islands (Figure 3). These storms have generated wave patterns that predominantly impacted the corresponding south and west coasts of the islands as each storm passes. Waves approaching from a southerly and westerly direction cause sand to be removed from the southern ends of Seven Mile Beach and pushed North. Added to the tropical storms is also the apparent lack of sizeable Nor'westers that would typically rebuild or replenish the Southern section of Seven Mile Beach during the winter season with waves approaching from a Northwesterly direction and pushing sand South (Table 1).

Two years of unusually high tides have also significantly increased erosion and also the perception of decreased beach width with more of the beach being covered by water. It is unclear if these weather patterns are set to continue on an annual basis, but given the current trend and taking into consideration Global Warming and Sea Level Rise it is reasonable to assume that this trend will continue to worsen.

		Total days of Year								Average	
		1995	1996	1997	1998	1999	2000	2001	2002		
Wind Direction by Quadrant	N- NE	90.5	71.0	63.2	56.6	87.4	96.6	74.1	78.0	77.2	
	NE-E	136.1	172.7	150.8	150.1	160.9	176.3	179.2	154.1	160.0	
	E-SE	72.5	60.4	85.9	89.1	62.3	60.5	66.4	84.8	72.7	
	SE- S	43.6	38.9	44.2	49.1	25.3	21.0	22.3	31.0	34.4	
	S- SW	2.9	4.8	5.8	4.1	9.0	1.6	3.6	2.9	4.3	Northerly transport of sand
	SW -W	2.2	1.8	3.4	3.2	4.2	0.9	3.7	3.1	2.8	
	W-NW	3.9	1.8	3.3	4.8	2.7	1.3	3.4	3.8	3.1	Southerly transport of sand
	NW-N	13.3	13.7	8.4	7.9	13.2	6.8	12.3	7.2	10.4	
Wind data supplied by the Civil Aviation Met Office and based on hourly readings between 6 am and 9 pm.											

Table 1: This table shows wind direction per quadrant and the total number of days for each successive year between 1995 and 2002.

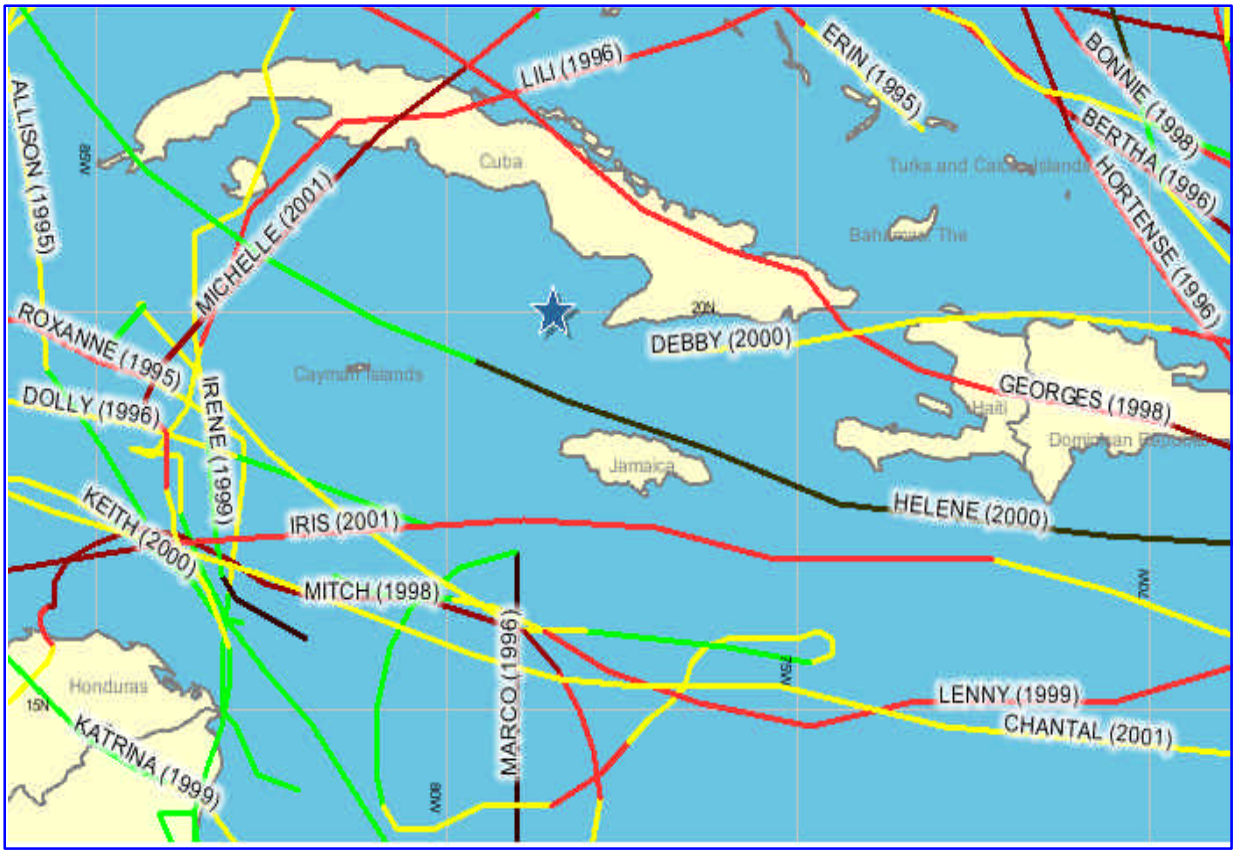


Figure 3. Map of the Caribbean showing the Hurricane and Tropical Storm paths between 1995 and 2001. Note the majority of storms pass to the South and West of the Cayman Islands generating large wave activity approaching from the southwest and causing extensive problems for the Southern end of Seven Mile Beach.

9. EROSION PROBLEMS OF SEVEN MILE BEACH

(a.) Development on the beach ridge and associated dune system has removed the rapid self-healing capability from much of the length of the beach. Typically the dune system behind the beach ridge would consist of sand reserves deposited over decades or centuries. During major erosion events these sand reserves would be exposed and would form an important contribution to the recovery by providing additional sand. Development on the beach dune system effectively removes this reserve by locking it behind seawalls, buildings, covering it for carparks or removing it for foundation construction.

(b.) Inappropriately sited structures, in particular seawalls, have been the root cause of almost all the development-induced problems on Seven Mile Beach. When properly constructed and properly sited, seawalls are an important means for protection from all but the most extreme storms [National Academy of Sciences, 1995, page 222]. *However, seawalls built within the expected range of incursion of the shoreline will inevitably be at the water's edge at some point and will impede or deny both lateral access and the recreational use of the beach surface.*

(c.) The Seven Mile Beach system has been described as a 'leaky beach' with potential for large losses of sand through gaps in the outer reef. The western shelf seaward of Seven Mile Beach can be considered as narrow with extremely deep water and steep slopes close to shore. Consequently the loss of sand to deep water down the slopes of the outer shelf is potentially large. The existence of large 'rivers' of sand (sand chutes) moving over the 'West Wall' to deeper water and potentially out of the system has been demonstrated, but actual volumes of sand lost from the system through these 'leaks' is not known.

(d.) The Development and Planning Regulations have over the years not adequately protected the beach and have significantly contributed to the problem by allowing developments to be sited on the active beach relative to a continually fluctuating Low Water Mark. Additionally, historic building practices have permitted the removal of large quantities of sand for foundation construction and cement ingredients. Beach ridges have also been mined as a source of sand for local building and road construction, a practice that still continues in all three Islands.

10. ESTABLISHMENT OF A STRATEGIC BEACH MANAGEMENT PLAN

The Committee recommends the establishment of a **'Strategic Beach Management Plan'**. The Strategic Beach Management Plan would form a dynamic comprehensive policy and management tool for all beaches of the Cayman Islands. The Plan would include all topics outlined in the following section on Beach Management Strategies. In addition the document would include separate management plans with more specific recommendations for individual beaches or districts throughout the Cayman Islands. It is anticipated that this plan would be made available to the public through web based media for public comment and feedback.

11. BEACH MANAGEMENT STRATEGIES

11.1 Removal of Obstructions to Alongshore Beach Access:

Recommendation:

Remove existing rock or rubble obstructions identified by the Department of Environment along Seven Mile Beach, North of Crescent Point, examples include Block 12E Parcels 17 and 91.

Figure 4 & 5: Examples of rubble structures currently obstructing alongshore beach access.

Rationale:

(a.) There are perhaps three or four existing rock or rubble structures on Seven Mile Beach which, for short distances, make alongshore access on the beach difficult or dangerous and which prevent the existence of any width of sandy beach because they are placed too close to the sea. In most instances this was done in order to protect Casuarina trees. Examples are the rock revetments at Block 12E Parcels 17 and 91.

(b.) These structures should be removed immediately and the beach allowed to reestablish an equilibrium profile. It is likely that the Casuarinas will also need to be removed. If the owners of these properties determine a need for a new seawall then the

new structure should be built in accordance with the recommendations for setbacks contained in this report. The new wall would then be sufficiently landward of the active beach to allow for safe and pleasant alongshore access and the maintenance of a sandy beach.

(c.) Sea grape and other suitable vegetation can be planted at a distance landward of the High Water Mark that is approximate with the Historic Vegetation Line.

(d.) The Department of Environment will continue to assess the length of Seven Mile Beach for similar obstructions requiring removal.

11.2 Coastal Construction Setbacks –

Recommendations:

(a.) **The Development and Planning Regulations (1998 Revision) should be amended so that the line of historical vegetation is used as the baseline for coastal setback determination for all three Islands.**

(b.) **No development should be permitted seaward of the Historical Vegetation Line with the obvious exception of jetties and docking facilities (except on Seven Mile Beach). Cabanas may be permitted seaward of the Historic Vegetation Line subject to agreed design criteria established in the Strategic Beach Management Plan and relevant Planning approval.**

(c.) **There should be a minimum setback of 20 feet landward of the Historic Vegetation Line for seawalls and other ancillary structures.**

(d.) **A Coastal Setback Category Map, which will detail site-specific setback distances, should be generated for all coastlines on Grand Cayman (beginning with Seven Mile Beach) as well as the Sister Islands.**

(e.) **Work on determining future setback categories for Seven Mile Beach should begin immediately upon acceptance of this Report by Government.**

(f.) **The final report will include the development of policies for Seven Mile Beach for the immediate repair and rebuilding of existing structures damaged during storm events.**

Rationale:

In the recent past coastal construction setbacks on Grand Cayman have been based upon tidal datum – the elevations of either High or Low Water Mark. Although these elevations are well established and easy to survey, they do not represent fixed points on a map. The intersection of high tide on certain sections of Seven Mile Beach have been shown in DOE/Lands & Survey Beach Monitoring profiles to vary more than 200 feet perpendicular to the shoreline in a single year! This means that setbacks based upon measuring the beach at its widest could result in buildings in the water when it is narrowest.

Minimum setbacks based upon tidal datum further make the erroneous assumption that wave attack potential is everywhere constant. Common experience, confirmed by multi-year beach profile surveys on Seven Mile Beach, shows that there are wide variations along the beach in seasonal width excursions. This means that some beachfront properties are at higher risk from wave attack than others. These differences are largely determined by the presence or lack of protective rock ledges, or headlands and midreef hard structures that can modify wave intensity. The prediction of these ranges of excursion, except through long and expensive measurement programs, is beyond the existing capabilities of coastal engineers.

On the other hand, Nature has provided a long term integration of the maximum incursion of the ocean onto the land through the vegetation line. This line can seldom be determined on the modern shoreline of Seven Mile Beach because of the introduction of non-indigenous species, seawall construction and other modifications. However, the historical vegetation limit can be established through the careful interpretation of pre-development aerial photography (made possible by conversion to digital images and the use of analysis software) and this can be converted to a series of legally defined horizontal survey points (at each property boundary or more closely spaced when necessary). **The line of permanent vegetation is recommended as the best baseline for the measurement of setbacks as it is reflective of the energy level of the coast over the long term.**

No development should be permitted seaward of the permanent vegetation line with the obvious exception of jetties and docking facilities (except for Seven Mile Beach where no docks and jetties should be permitted). In addition there should be a minimum setback of 20 feet landward of the Historical Vegetation Line for seawalls.

It is recommended that actual setbacks from the line of permanent vegetation should be developed for each region of Seven Mile Beach and the rest of the islands based on the following parameters;

(a.) Historical changes in the coastline position using the aerial photography dating back to the 1960's.

(b.) Recent beach changes using beach monitoring data collected by the Department of Environment and Lands and Survey.

(c.) Changes in coastline position likely to occur as a result of predicted rise in sea level.

(d.) Offshore features such as reefs and terraces and alterations such as channels.

(e.) Coastal geomorphological features such as exposed beachrock and anthropogenic features such as beach mining and back-filling.

(f.) Planning considerations such as lot size, Marine Parks and protected area designations.

The Committee therefore recommends that a Coastal Setback Category Map be generated, reflecting the criteria outlined above (a–f) for the beach coastlines in Grand Cayman (beginning with Seven Mile Beach) as well as the Sister Islands. A similar exercise was done

in Antigua in 1997, which resulted in the generation of Antigua's Coastal Setback Categories Map for Beaches, which designates minimum coastal setbacks from the permanent vegetation line ranging from 60 feet to 130 feet in three categories (Figure 6).

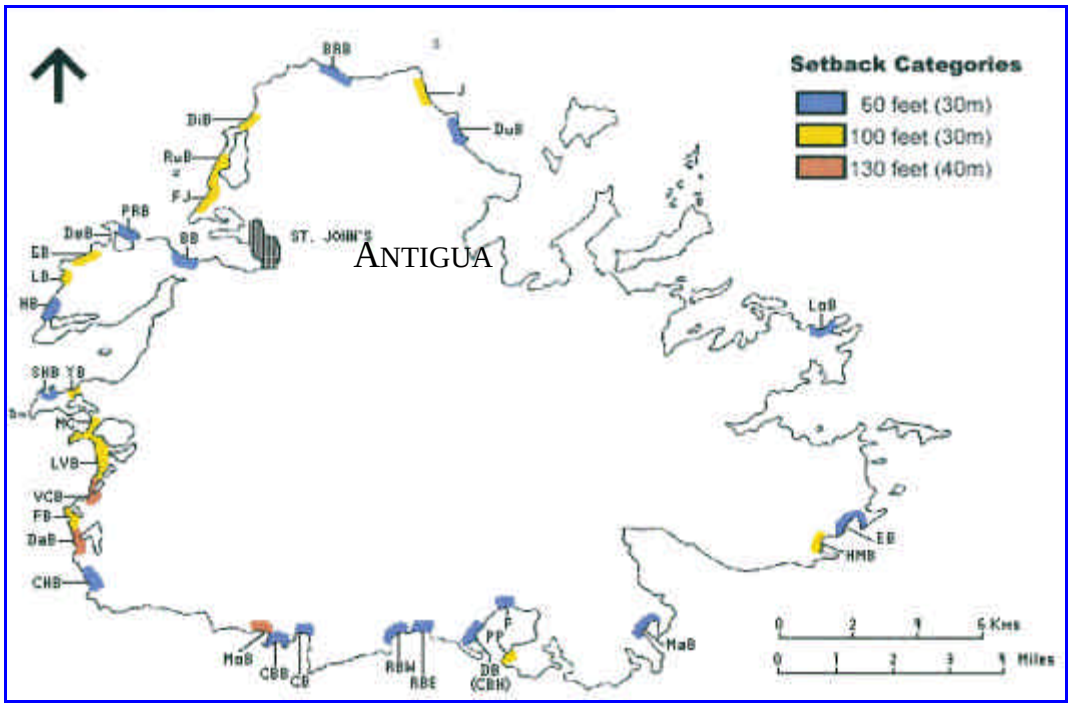


Figure 6. An example of a Coastal Setback Categories Map produced for the Caribbean island of Antigua in 1997.

Figures 7, 8 and 9 illustrate both why the historical vegetation line is such an ideal baseline for setback determination and how the task of establishing setbacks based on this line will be undertaken.

Figure 7 shows the historical vegetation line digitized through careful interpretation of pre-development aerial photography. A minimum of two points on the north and south boundaries of each parcel will be identified and located using survey techniques in order to establish the line on the ground.

The purple lines in Figures 8 and 9 represent the surveyed parcel boundaries. It can be seen that the seaward extent of these boundaries varies widely depending on when the survey was conducted. Surveys carried out prior to 1987 determined the seaward extent of the property boundary using the line of permanent vegetation (Historical Vegetation Line). Surveys conducted after 1987 defined the seaward boundary of the property using the High Water Mark. Post 1987 surveys also vary due to the fluctuations in the High Water Mark from year to year. The red line represents the **approximate** location of the newly introduced 130 ft. setback from the High Water Mark.

The Historical Vegetation Line can be used as a firm reference point for the maximum expected erosion line at any particular point on the beach. Dense vegetation and large trees take considerable time to become established and their presence indicates that erosion has not

occurred to that particular point during recent years and possibly decades. The tendency for vegetation to advance down a beach through natural succession means that in areas where there is no substantial vegetation the most likely explanation is that erosion or shifts in the beach area has restricted the vegetation's advance.

Figure 8 clearly shows the Marriot seawall constructed on the Historical Vegetation Line, which partly explains why this site is frequently devoid of sand. It also illustrates the vulnerability of structures approved under the previous setbacks based on the Low Water Mark.

In comparison, Figure 9 clearly demonstrates why properties such as the Plantana Condominiums have, thus far, never experienced serious erosion as they are setback from the historical vegetation line.

Figure 7. 1971 Aerial Photography showing Historical Vegetation Line.

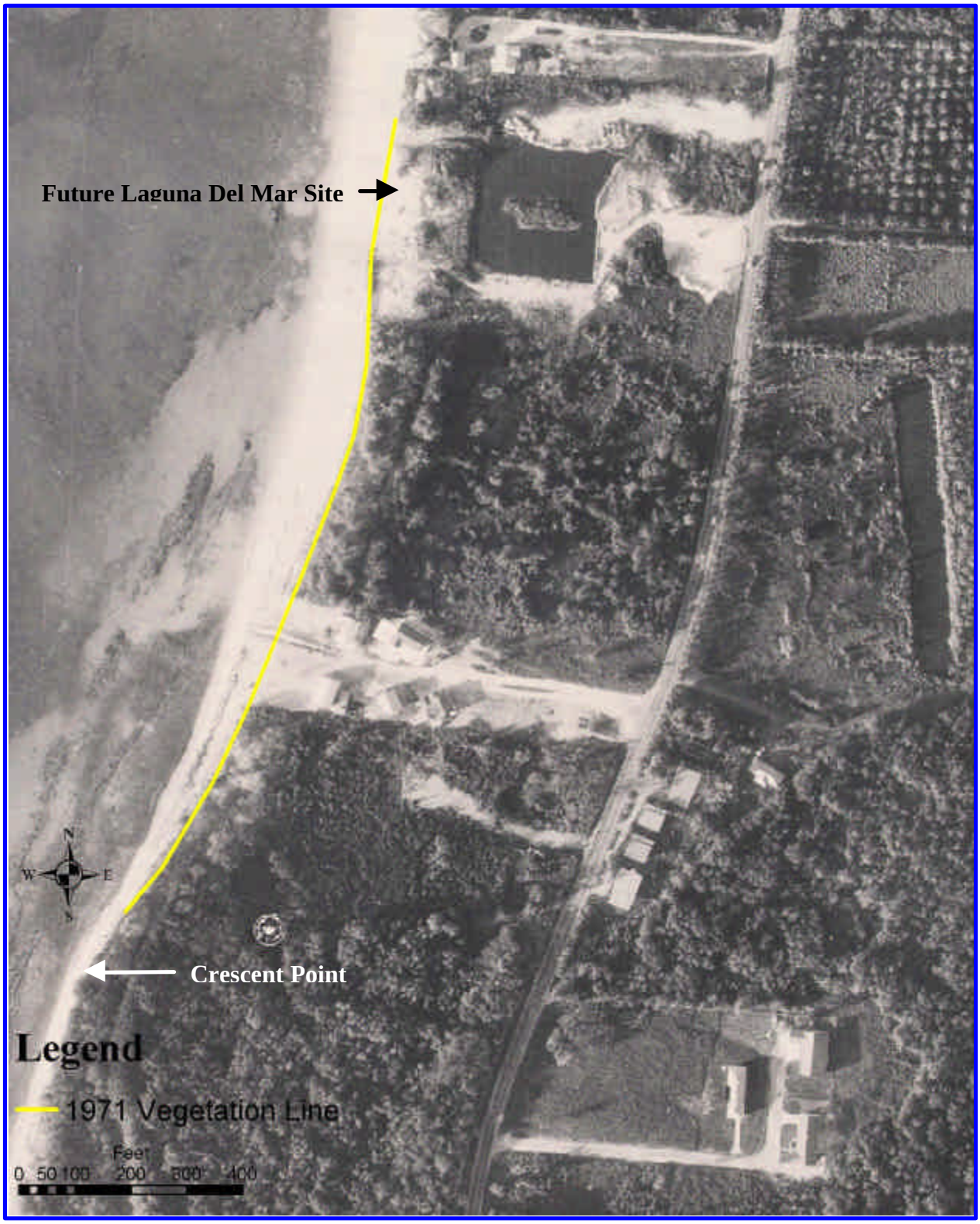


Figure 8. 1999 Aerial Photography showing Historical Vegetation Line superimposed against a Southern section of Seven Mile Beach.

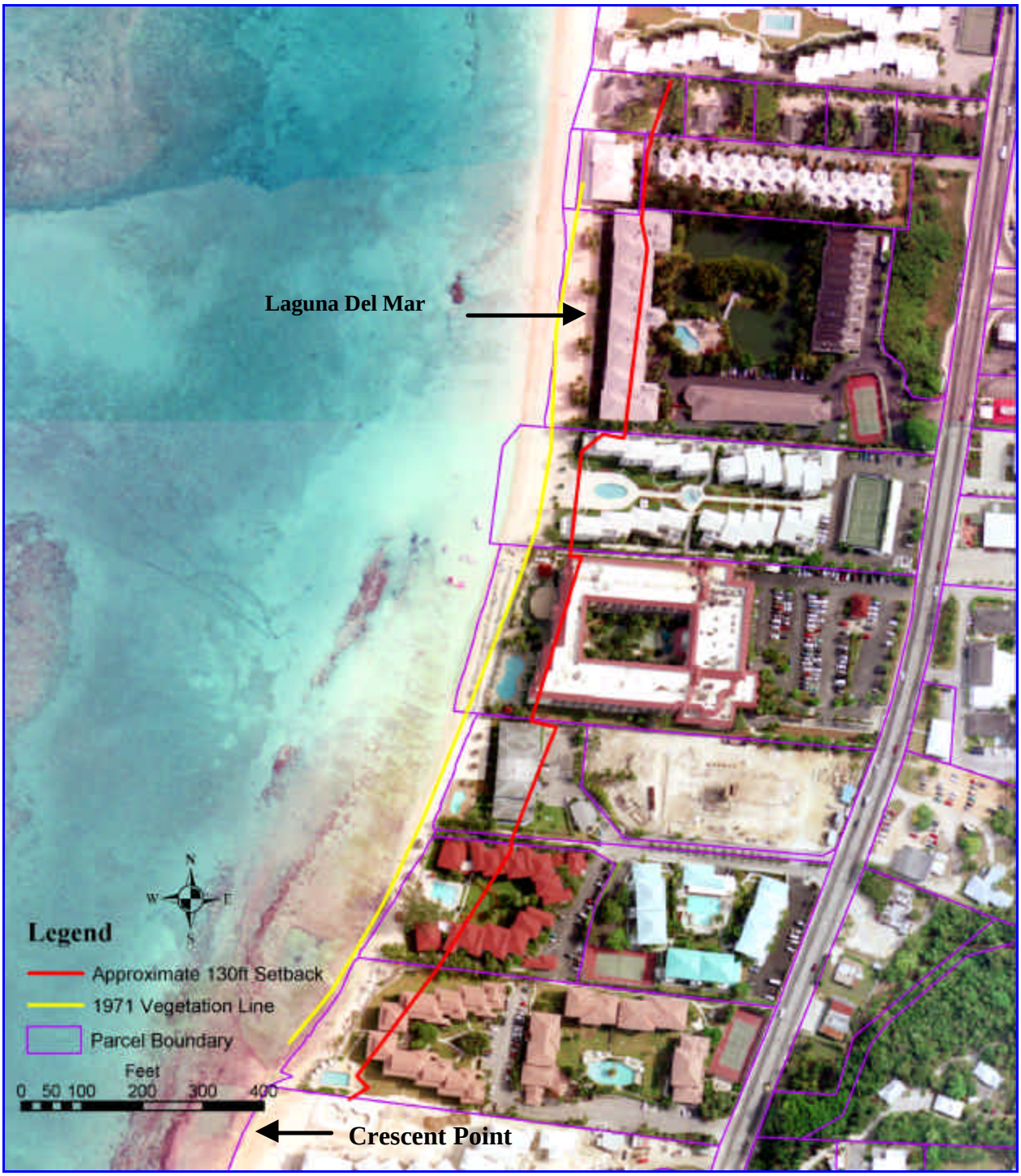
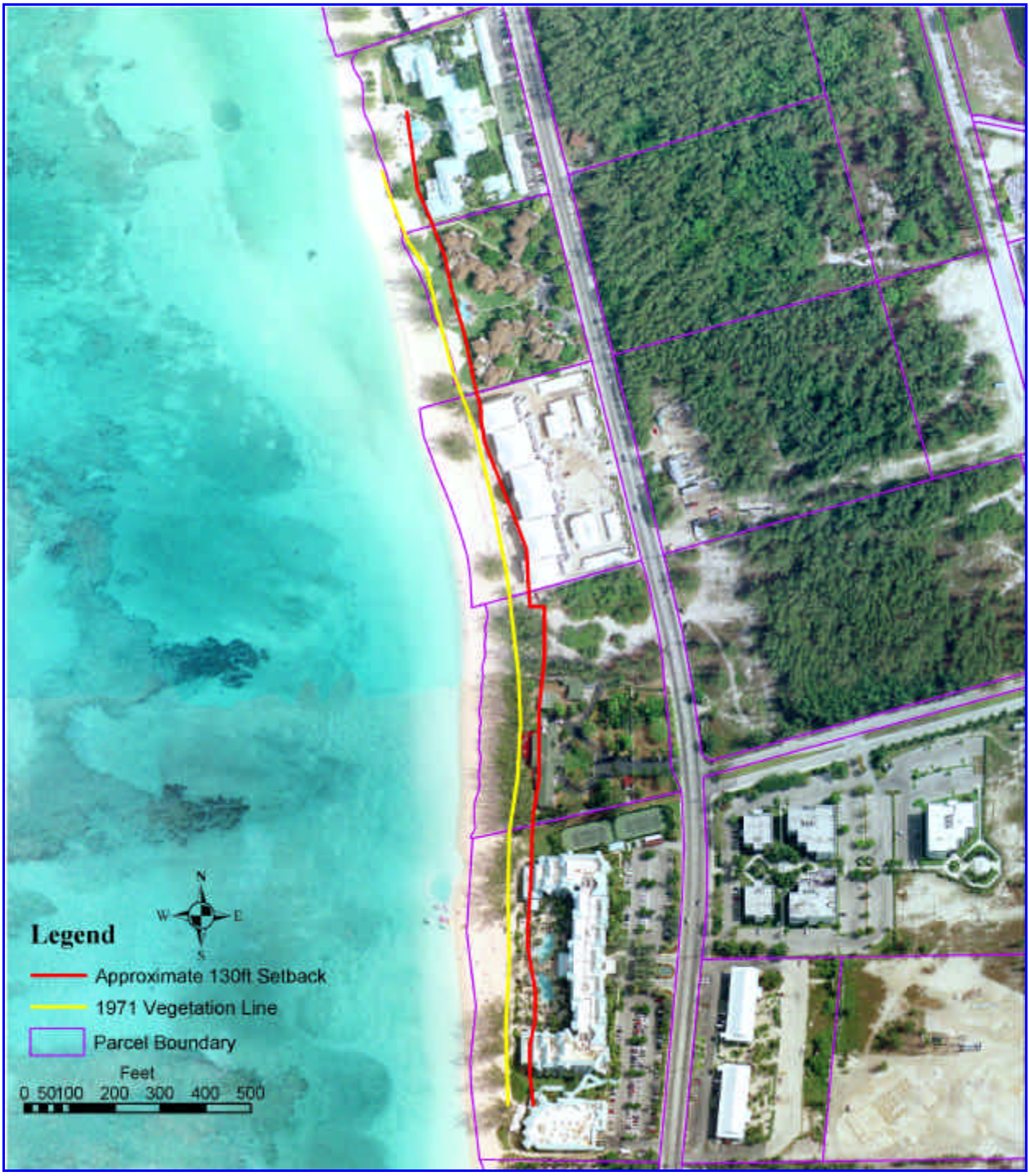


Figure 9. 1999 Aerial Photography showing Historical Vegetation Line superimposed against a central section of Seven Mile Beach.



Historical Erosion on the Southern Section of Seven Mile Beach 1972

Figure 10: Evidence of erosion on the Southern section of Seven Mile Beach in 1972. Photos: Caymanian Compass.

Figure 11: Evidence of erosion on the Southern section of Seven Mile Beach in 1972. Photos: Caymanian Compass.

Photographs of the southern end of Seven Mile Beach (Schoenheit Residence shown) from 1972 depict natural storm-induced erosion corresponding to the vegetation line. Interestingly this erosion still continues to occur to approximately this extent on a regular basis demonstrating that beach erosion is not a new phenomenon and is predictable based on the vegetation line. Note the vegetation line shown in these images is more or less consistent with the interpreted vegetation line shown in the 1999 images.

11.3 Beach Nourishment Options:

Recommendations:

(a.) **Conduct an immediate trial for Spot Nourishment utilising sand sources stockpiled on the island from previous construction projects.**

- **Spot Nourishment (mechanical placement of beach sand only in areas where erosion has occurred) of heavily eroded areas following the next major erosion event should be planned for.**
- **An Engineering Feasibility Study should be conducted to determine the most economically feasible methods for conducting Spot Nourishment projects in frequently eroded areas North of Crescent Point.**

(b.) **Opportunistic Nourishment (return of stockpiled beach sand from previously approved development and any sand removed from the beach ridge during the construction of new foundations, seawalls and pools) should be immediately implemented.**

(c.) **Legislation should be amended to require that all sand excavated for construction purposes must be returned or placed in the active beach system.**

Rationale:

The Committee considered several options for the recovery and repair of sections of Seven Mile Beach affected by erosion including the introduction of various engineered beach stabilization structures. Detailed descriptions of each option are provided below. The Committee's consensus established that beach stabilization structures would be uncharacteristic of the Seven Mile Beach experience and that no scientifically proven system has been identified to date. With beach stabilization structures excluded at this stage from the options alternative approaches of beach nourishment (mechanical placement of sand) were considered. The following options outline various degrees of beach nourishment efforts from an intensive full-scale nourishment project for the whole of Seven Mile Beach to small-scale localised nourishment of specific areas. Based on the advice of the consultants, at this stage the Committee does not feel that a full scale nourishment project is required on Seven Mile Beach and instead **recommends that Option ii: Spot Nourishment of Heavily Eroded areas is the most likely scenario that should be explored further and prepared for.**

In addition the Committee considered that **an immediate opportunity exists to assist beach sediment supply by requiring that stockpiles of sand removed from the beach system during construction and storm clean up projects be returned to the Seven Mile Beach system at the earliest opportunity (i.e., Option iv: Opportunistic Nourishment)**.

11.3.1 Options

(i) General Nourishment of the Beach

In this option, the width of the beach is increased by utilising suitable beach-grade sand that is initially distributed more or less uniformly throughout the length of the beach. **The Committee recommends that this option should not be undertaken at this time, but should be considered in the event that total beach supply diminishes substantially.**

Excerpt from Dr. Seymour's Report

(a.) *This method results in a substantial increase in the available sand in the beach system and will result in some increase in the protection to structures during moderate storm events through the buffering effect of sacrificial beach erosion. [National Academy of Sciences, 1995, page 3]*

(b.) *At least initially, it would ameliorate the alongshore access problems associated with structures sited too close to the shoreline.*

(c.) *Beach nourishment is an engineered structure. Further, there is a potential – as in any operation of this magnitude – for damage to the environment.* ***Prior to deciding to undertake this option (or option 2, following) an engineering feasibility study accompanied by an environmental assessment is required. These studies would consider the viability of sand sources, make recommendations on acceptable methods for obtaining, transporting and distributing the sand on the beach, as well as cost estimates for the program. Restrictions on methodology or on source selection necessary to protect the environment would be determined as a part of these studies.*** *[National Academy of Sciences, 1995, page 10]*

(d.) *The existing beach configuration, and therefore to some extent the location of structures, is dictated by the existence of ledges, outcroppings and headlands of rock – all with low relief. Burying these features with sand would result initially in a more mobile beach system. The location of the resulting shoreline is to some extent unpredictable and it most certainly would not remain as a uniform seaward offset of the present shoreline.*

(e.) *During the nourishment operations and for a period following there is either a total or a partial disruption of the recreational use of the beach. The most economical nourishment strategy is to perform it as a continuous operation so that the equipment is only mobilized once. The result with this option would mean sequentially taking each major section of the beach out of service for periods of up to a week or more (depending upon the contractor's equipment capacity). This is the only option that would result in significant impacts to the entire beach. However, the intervals between the implementation of this option would be expected to be on the order of a decade (perhaps more).*

(f.) *The cost of ocean dredging and beach nourishment is highly dependent on the world demand for services at the time, equipment available and other imponderables. It is*

known to vary by much larger factors than other construction operations. [National Academy of Sciences, 1995, page 287] A large project attracts more competitive bidding. It also costs more to move more sand. It is likely that the community would want to conduct this during a specific period of low tourist demand on the beach, which would reduce the likelihood of getting very low costs. If, however, the sand is delivered to onshore stockpiling sites rather than directly to the beach, this would allow the contractors to do the work at a time convenient to them and could result in a much more competitive tendering environment. These savings must be weighed against the costs associated with double handling of the sand.

(g.) *Small increases in width would be unlikely to change patterns of beach sand behavior substantially. However, large increases could conceivably result in rapid losses of the most seaward material in major storms through providing more direct access to leakage channels in the reef.*

(h.) ***This option will not eliminate the erosion of the southern section of the beach in the event of the close approach of an energetic tropical storm****. It would be expected to produce a wider beach than is presently achieved after recovery during a Northwester, however.*

(ii) Spot Nourishment of Heavily Eroded Sections

In this option, rapid mobilization of beach nourishment with pre-selected beach grade sand is used to restore specific sections of the beach that have been eroded to an extent that they are no longer a functional recreational beach. **The Committee recommends that this option is prepared for immediately with the initiation of the Engineering Feasibility Study as outlined in Section 11.3.1.(i)c. (page 28).**

Excerpt from Dr. Seymour's Report

(a.) *It is expected that this option will principally involve the sector north of Crescent Point which has a history of erosion back to the seawalls following major tropical cyclone events. However, changing weather patterns or conditions could make the option equally useful at the northern end of the beach or in any trouble spot.*

(b.) *As in option 1, it is important to consider the feasibility of stockpiling material on shore in advance of need. This is clearly the most reliable way to assure rapid response capability. If the material is dredged and transported directly to the site it would necessitate a locally based dredge. Although the floating equipment could be relatively modest in size and cost, it would be difficult to maintain the assets and the skilled manpower in the required state of readiness.*

(c.) *To produce a level beach area 10 yards wide (an estimate of the appropriate minimum for an emergency recovery effort) might require about 75 cubic yards per yard of shoreline (estimates only, with allowance for overfill, as above). Again, approximating the lengths of shoreline involved based upon experience with hurricane-induced erosion, a total amount of sand in the order of 100 thousand cubic yards might be*

required for a typical post storm recovery nourishment from Crescent Point northward to the vicinity of the Sovereign property.

(d.) *It is important to note that the amount of sand put into the overall beach system by this option is a large fraction of that envisioned under option 1. That is, spot nourishment, over time, will result in a gradual increase in the average beach width and might eliminate the need for option 1.*

(e.) *To be effective, this option must have all permits and approvals in place before the storm event, sources identified, and negotiated contracts or other fiscal prearrangements such that response can be rapid and the costs controlled. This applies to either stockpiled or directly transferred sand. [National Academy of Sciences, 1995, page 9]*

(iii) Mechanical Rearrangement of Existing Sand

This option involves the movement of sand from regions with relative excess sand to eroded regions following severe storms. **The Committee recommends that this option is not undertaken at this time unless Spot Nourishment of Heavily Eroded Sections option is not implemented or undertaken**.

Excerpt from Dr. Seymour's Report

(a.) *"Sculpting" the beach to repair erosion hot-spots is a standard practice on many beaches, even some that must work around species protection restrictions (turtle nesting, pinneped haulout, grunion spawning, etc.). It is a specific recommendation of the U.S. National Research Council's study on Beach Protection [National Academy of Sciences, 1995, page 101].*

(b.) *In most non-tropical beaches severe erosion is associated with cold weather and limited beach use such that the presence of heavy equipment on the beach is not a significant problem.*

(c.) *Beaches are scraped routinely for other reasons (trash or marine plant fragment removal) and sculpting can be incorporated with only slight modification.*

(d.) *Seven Mile Beach is quite narrow and would cause difficulty accommodating beach goers and machines at the same time.*

(e.) *The importance of preserving beach rock outcrops for beach stability, even those that outcrop only in the eroded condition, make it essential that these assets be carefully mapped and flagged so they can be avoided during sand movement operations.*

(f.) *If the distances sand must be moved are short, the disruption of beach activities can be minimized (totally eroded beaches are presumed empty of beach users any way). It should be less disruptive than pumping wet sand onto the beach and pushing it around with a bulldozer as required in Options 1 or 2 and the costs are certainly significantly less than either option.*

(iv) Opportunistic Nourishment

This option involves the return to the beach system of sand that was historically part of the storm recovery material for this beach whenever it becomes available. **This option is recommended for immediate implementation.**

Excerpt from Dr. Seymour's Report

(a.) *Losses to the beach sand supply occur during major tropical cyclones as sand is carried landward by waves, flooding and wind. In most instances, this sand is removed in some fashion to restore the area to its previous condition. Under this option, it would be mandatory, as part of the costs of cleaning up after the storm, to return this sand to the beach. In general, no specific location need be designated, but the material should be returned to the active (wave affected) portion of the beach adjacent to the area from which it was recovered.*

(b.) *Construction of building foundations, utilities, roads, etc. can result in the excavation of sand that was historically part of the post-storm beach recovery supply. To simplify the determination of what constituted this supply, all material seaward of the present location of the highway could be considered (or some comparable distance shoreward from the historical vegetation line). Under this option,* ***all such material could not be removed from the site except to return it to the active beach as nourishment of the sand supply (after appropriate screening-out of rocks and debris).***

(c.) *Determination of the amount of sand that can be placed without an engineered plan directly onto the active beach adjacent to the construction needs to be a part of the implementation of this option. For larger amounts, a generalized permitting procedure would need to be developed, setting standards for screening, smoothing, and placement. Ideally, this option would become part of the general permit for the construction project.*

(d.) *Costs for this option are probably close to neutral (except for the incidental costs for enforcement) because the material must be removed in some fashion.*

(e.) ***Large stockpiles of sand extracted from Seven Mile Beach exist at various locations. It is important that these sand sources be incorporated into the overall plan for the beach and action should be taken to assure their beneficial return to the beach system.***

11.3.2 Issues

(i) Sand Retention / Beach Stabilisation

The ability to retain sand on beaches that have been nourished at considerable expense is an issue that has been considered by the Committee. Sand retention devices comprise a range of

structures, including groins and breakwaters, with potential for retaining sand at specific locations on the beach. At this stage and given the lack of supporting scientific information, this option is **not** recommended by the Committee for the Seven Mile Beach area North of Crescent Point. However, Sand Retention Devices may form suitable options for other beaches in the Cayman Islands not yet considered by the Committee.

Excerpt from Dr. Seymour's Report - Review of Sand Retention Devices

(a.) *Because the sand on the active beach face is constantly in transport either up or down coast, depending on the wave approach direction, any **sand trapping** device that is effective will necessarily **deny** sand to the beach down drift from this location. The NRC report states: "No device, conventional or unconventional, creates sand in the surf zone. Any accumulation of sand produced by a structure is at the expense of an adjacent section of the shore." The Shore Protection Manual states: "Rule 1: Groins can only be used to interrupt longshore transport. Groins do not interrupt onshore-offshore transport. They do not attract to an area any sand which would not otherwise have passed." [U.S. Army Corps of Engineers, 1984. Vol. 1, sect. 5, p35] Therefore, successful applications of these systems – for example, pairs or whole fields of groins – are initially filled with sand to their full ability to trap it and arrangements made, particularly at the ends, so that sand will bypass the filled system. [National Academy of Sciences, 1995, page 12] [Note that this pre-filling step contains all of the cost and disruption features of beach nourishment after the structures are built.] In this way, if appropriately designed and maintained, these devices will sustain wide beaches under design conditions. [It may not be obvious that any sand retention device requires a supply of sand past it to function, because there is leakage from within the enclosure most of the time. The curved jetties at Treasure Island Beach are an example of a pair of groin structures that can be initially filled but are emptied during storms and remain empty because there is no sand passing them.]*

(b.) *Groins function as barriers to alongshore transport. Shore-parallel breakwaters (the Reef Ball structure at the Marriott is an example of a submerged shore-parallel breakwater) attempt to reduce alongshore transport by reducing the intensity of the waves acting on the sand. If the sand moves into the shadow of the breakwater faster than it moves after it is in the shadow, it tends to pile up there. In principle at least, these breakwaters can be pre-filled to their trapping capacity and made to bypass sand around them.*

(c.) *Groin fields are most effective (some U.S. examples: the south coast of Long Island or certain Great Lakes sites) where the transport is dominantly in a single direction. Here the sand between groins forms a sawtooth shape, pre-fill volumes are low, and leakage is minimized. With reversals in direction, as is the case at Seven Mile Beach, a substantial amount of sand must be trapped on the narrow side of the compartment before it will bypass.*

(d.) *Shore-parallel breakwaters can result in a local widening of the beach. [U.S. Army Corps of Engineers, 1984. Vol. 1, sect. 5, pp 61.] The reef balls at the Marriott are a submerged shore parallel breakwater. Other shore parallel devices include fabric tubes in various configurations that are filled with sand or concrete and are sited on the beach or in the water offshore. The Reef Balls have added from one to three feet of*

width to the beach width at the Marriott compared to neighboring beaches (as of February 2, 2003.) However, during storms in which waves break over the structure, the resulting pileup of water can create excessive turbulence and strong alongshore currents out of the area behind the breakwater in both directions. This has been shown to cause faster erosion than on the unprotected beach to either side. This phenomenon occurs naturally as well. The property just north of the Holiday Inn has substantial offshore rock ridges that behave much like a shore-parallel breakwater. During times of relative calm, sand builds out almost to these ridges, but during storms this area is more severely eroded than the beach to either side. The strength and stability of the reef balls has not yet been tested in the energetic hurricane wave environment.

(e.) *Groins must be securely anchored into the shoreline. Because waves run up higher on beaches than their deep water crests, the highest point on the groin must be right at the shore [U.S. Army Corps of Engineers, 1984. Vol. 1, sect. 5, pp 40]. In cold climates, beach use is limited to the summer months when storm waves seldom occur. Groins are often covered with sand during the summer so that they do not restrict lateral access. Because hurricane waves overtopped sea walls on Seven Mile Beach in 2002, groins would have to be built at least as tall as the seawalls in order to prevent bypassing. The result is a complete compartmenting of the beach. Since groin spacing is a critical part of a successful design, [U.S. Army Corps of Engineers, 1984. Vol. 1, sect. 5, pp 45.] existing beach access would probably not suffice to allow public access to all of the compartments. The effects on the aesthetics and appeal to beach users of such a solution need no comment.*

(f.) *The basic sand retention (actually non-retention) problem is the northward loss of sand at the south end of Seven Mile Beach. This is driven by hurricanes or other severe tropical cyclones. Not only would sand retention structures have to be high enough to avoid being overtopped drastically by hurricane waves and storm surge, they also must withstand the wave forces. This means they must be constructed of concrete forms or selected boulders which are large enough, dense enough and strong enough not to be scattered by the huge waves. [The ocean floor offshore of the Treasure Island jetties is strewn with large (3-4 feet diameter) rocks displaced by waves.] The result is that very heavy equipment (trucks, cranes) would have to work on the beach because the rock outcrops offshore would make a floating construction scheme difficult or impossible. Taken together, these factors would clearly make these installations very expensive, as well as unsightly. Experience elsewhere has also shown that removal of such systems when they have been found ineffective can be almost as expensive as their construction.*

(g.) *Cost projections for these structures are beyond the scope of this paper (and the expertise of its author) but it is clear that this option will be a very expensive, probably non-functional system, and almost certainly will result in significant environmental degradation of a very valuable natural resource.*

(h.) *It is important to understand that this field has seen more than its share of patented or proprietary devices that purport to apply technology to fooling the sand into moving or staying. These include, of course, those of the "artificial seaweed" variety -- which was a disaster everywhere as it was on Seven Mile Beach – and all manner of inclined planes, airfoils and other shapes that sound suitably scientific. It can be stated*

categorically that none of these "technology" devices has ever been demonstrated to achieve promised results in field tests. There are no easy answers.

(ii) Engineering Feasibility Study

Given the likely scenario of further serious erosion events and the recommendation to carry out 'Spot Nourishment programmes along the affected areas of Seven Mile Beach **the Committee recommends that an Engineering Feasibility Study should be conducted in preparation for a beach nourishment program during the next major erosion event and as a key component of the Strategic Beach Management Plan.** The Engineering Feasibility Study would provide qualified recommendations on the most suitable methods to identify, acquire, transport and place large quantities of beach quality sand as part of a nourishment program. The Study would also explore the financial, environmental and economic implications of a nourishment program.

A. Sand Inventory Analysis

As part of the Engineering Feasibility Study the Committee recommends that a comprehensive investigation of potential sand sources should be carried out and an inventory identifying suitable sources to facilitate rapid response during emergency events when sand might be required should be created and maintained.

All potential sources of sand should be explored including 'off-island' and 'offshore' reserves. The Committee strongly recommends that in considering 'on island' and 'offshore' reserves that all environmental considerations are taken into account and that for large volume extractions an Environmental Assessment is undertaken prior to a decision to exploit a potentially sensitive resource.

The Committee recommends that, as part of Sand Inventory Analysis and in conjunction with the Seven Mile Beach Monitoring Program, sand grain analysis using internationally accepted protocols is conducted at suitable intervals along Seven Mile Beach on an annual basis. Sand grain analysis should also be completed for identified suitable sources of sand so that sand types used in re-nourishment efforts can be matched closely and rapidly.

B. Land to Beach Access Points:

The Committee recommends that an inventory of existing access points that would allow heavy vehicle access to the Seven Mile Beach for delivery of sand by trucks in the event of an emergency be prepared as a component of the Engineering Feasibility Study. Access points should be categorised as to their ease of use and proximity to additional access points. Property owners with suitable or critical access points in areas where few access points exist should be required to maintain these access points to the beach.

In addition the identified access points inventory should be updated on an annual basis and be expanded to include additional beaches on Grand Cayman and the Sister Islands.

The Committee recommends that Planning Regulations should be amended to include a requirement that Heavy Vehicle Access is created and maintained to the Seven Mile Beach between future buildings considered for Planning approval to allow heavy equipment access to the beach in the event of a major beach restoration effort. **Concurrently, existing Beach Accesses should be explored to determine those that can be 'combined' to create Heavy Vehicle Access Points**. Access points could be incorporated into the current requirement to maintain a fire lane between buildings with the obvious addition that the access must now extend to the beach. The lane can be lightly vegetated or landscaped as with fire lanes, but solid structures or structures and vegetation that would prevent heavy equipment from access should be discouraged.

C. Sea to Land Access Points:

In conjunction with the Land to Sea Access Point Inventory the Committee recommends that a bathymetric map is produced detailing contours on Seven Mile Beach that would highlight access points for barges and other large draught vessels carrying sand or otherwise involved in emergency restoration work along Seven Mile Beach.

In addition the identified access points inventory should be updated on an annual basis and be expanded to include additional beaches on Grand Cayman and the Sister Islands.

D. Funding

Beach management strategies will be expensive and can become an ongoing expense. Seven Mile Beach, in addition to the extremely active property and development market, provides a tremendously important local resource that is inextricably linked to the tourism industry and high quality of life in Cayman. As such there are many stakeholders that currently have an economic interest in the well being of this area. In the event of a major erosion cycle it is reasonable to assume that majority of residents and businesses alike will look to Government to implement the remedy. The Committee believes that a planned and coordinated approach for each region of the beach will prove far more effective and less costly than a piecemeal 'each to their own' approach. However there are currently no designated fees in place to support and allow Government to quickly initiate a large-scale restoration effort. Funding will probably prove the biggest obstacle and should be addressed as quickly as possible.

The Committee recommends that Government immediately establish a permanent Beach Management Fund as a critical component of the Strategic Beach Management Plan. It is envisaged that the Fund will receive contributions from the public and private sectors via mechanisms still under consideration. A sub-committee comprising members of the Committee with backgrounds in Finance have been charged with developing recommendations for funding mechanisms and their report is anticipated shortly. The Fund should be established with an initial injection from Government funds to contribute to the cost of an anticipated restoration effort along approximately 4,000 ft. of coast North of Crescent Point.

(iii) Pre-Permitting

Currently work above the Mean High Water Mark is the jurisdiction of the Central Planning Authority (CPA) and hence would require Planning permission, and work below the High Water Mark is considered under the jurisdiction of the Crown and hence requires Executive Council approval.

A beach nourishment exercise on a major scale would ultimately fall under both of these jurisdictions and each would have a part to play.

A. Offshore Dredging

Coastal Works Licences for work on the seabed are issued by the Governor-in-Council (i.e. ExCo). Conditions for such a licence would be determined as a part of the Engineering Feasibility Study and Environmental Impact Assessment.

B. Importation

The Committee recommends that the application and permitting procedures, at a minimum, should be clearly understood and if possible should be applied for and held in advance once a restoration approach has been determined and decided upon.

The importation of material from overseas sources may also require Executive Council permission and will also be subject to Port Authority Regulations and Fees. Currently other operations importing aggregate are charged CI$ 1.00 per cubic yard to offload anywhere on the Island. **The Committee recommends that all fees (e.g. import duties and Port Authority fees) associated with sand for nourishment are fixed at cost level only and additional amounts for revenue are waived. These decisions should be taken now by the relevant authorities.**

(iv) Establishing Beach Nourishment Plan Thresholds

The establishment of quantifiable thresholds will be an important factor in a Beach Restoration Plan. Criteria will have to be determined to clearly define what constitutes an emergency at the national level. Factors that need to be taken into consideration include the extent of the beach that is lost, the potential for threat to property, the loss of revenue generating amenities and public recreational use. The loss of small sections of Seven-Mile Beach while proving a problem in the immediate area may not pose a threat to the entire Seven-Mile Beach and such would not warrant a full-scale emergency response. It will be important to determine what individual stakeholders will be permitted to do in efforts to protect their property or restore beaches.

The Committee recommends that firm guidelines and policies are established to determine what individual property owners and other stakeholders will be permitted to do in efforts to protect property and restore beaches in the absence of an overall contingency response. These Guidelines should form part of the Strategic Beach Management Plan.

11.4 Construction Techniques

Construction techniques for beach developments and other coastal structures should be subject to specific Planning Regulations that minimize the impacts to beach systems while still maintaining building integrity and structure during storm and related erosion events.

The Committee recommends that acceptable beach construction techniques are researched and reviewed for suitability within the Cayman Islands.

11.5 Natural Vegetation

Vegetation plays a vital role in both the ecology and the stabilisation of beaches. In a significant storm event it is reasonable to assume that considerable quantities of beach vegetation, both natural and exotic will be lost. Rapid re-vegetation (2-3 months) of the beach will no doubt aid considerably in the further stabilisation of the remaining beach and improve recreational aesthetics.

The Committee recommends that beachfront property owners should be encouraged to assist with re-vegetation of suitable indigenous and endemic plants, shrubs and trees at their earliest convenience. Assistance should be offered in the form of information sheets on suitable beach vegetation and planting strategies.

In addition the Committee recommends the preparation of an owner's guide to beach restoration outlining the Development and Planning Laws and Regulations, Marine Park Laws where applicable and information on vegetation and techniques required for planting native material.

Potentially a suitable stockpile of plants should be cultivated and made available, and **residents encouraged to use native beach vegetation to assist beach stabilisation both before and after storm events**.

Department of Environmental Health land clearing practices should be reviewed to determine their necessity and effectiveness.

11.6 Sand Mining Practices

The Committee recommends that more thorough enforcement and stricter penalties should be implemented to deal with ongoing and increasing problems of illegal sand mining of beach ridge and beach front sand deposits. Well-known and documented problem areas exist in the Barkers Peninsula and Little Cayman, but likely occur islands wide.

Figure 12: A local individual collecting sand for domestic purposes.

In addition the Development and Planning Law (1999 Revision) Section 31 entitles the general

public to one cubic yard of sand (and other coastal material) from all Cayman beaches for domestic use (Figure 12). **The Committee recommends that this outdated law be amended to prevent the practice of sand removal from all beaches.**

11.7 Storm Damage and Rebuilding:

The Development and Planning Regulations and/or CPA policies should be amended such that all re-development / repair of coastal structures damaged by storms and hurricanes shall require planning permission. In granting planning permission the CPA shall consider the following factors, (i) the degree of damage, (ii) appropriate setbacks, (iii) historical damage and (iv) the economic impact of non-approval. Please note that post storm recovery policies for existing structures and buildings will be determined as per 11.2(f)

In addition the Planning Department/CPA (with advice from the Department of Environment) shall consider creating an Emergency Application Process that will facilitate rapid decision making for properties requiring redevelopment following storm events. Applicants shall be responsible for removing all debris and obstruction (concrete and rebar) left on a beach following storm damage and reconstruction.

Figure 13: Storm damaged seawall.

11.8 Beaching of Boats

The Committee has become aware that where boats come up on the beach for the purpose of loading or off-loading passengers localised beach erosion occurs due to the scouring effect caused by propellers (Figure 14 & 15). The Department of Environment has been recently approached by one watersports operation for permission to "correct" the problem caused by the buildup of sand seaward of the scour scar which results in a shallowing of the approach to the beach. There are also safety issues caused by the sudden significant deepening of water close to shore. This practice should be prohibited. **Boats should be required to shut off**

Figure 14: Local dive boats beaching to collect or drop off divers

Figure 15: Evidence of local beach erosion hotspots from repeated boat landings.

their engines and secure the vessels during loading and off-loading by using anchors.

11.9 Monitoring Programmes

The Committee strongly recommends that the current Department of Environment and Lands and Survey Beach Monitoring Programme is continued and information and data collected in this programme is incorporated into specific Beach Management Plans as part of the Strategic Beach Management Plan.

11.10 Education

The Committee recommends that Government consider an educational campaign to highlight the need for appropriate beach management, coastal construction techniques, setbacks and the potentially serious consequences of Sea Level Rise, increased storm intensity and frequency and associated beach erosion events that will likely occur as a result of Global Warming. A well-informed public will be tolerant of more stringent beach development regulations and will make better decisions with regards to beach management issues.

12. ADDITIONAL STUDIES

12.1 North Shore Sand Transport Studies

The Committee is aware that, while there is a generally good understanding of beach sediment transport patterns in the Cayman Islands, significant knowledge gaps still exist. In order to better understand and ultimately manage beach environments **the Committee recommends that additional studies be undertaken in particular to address the possibility of North Shore sediment supply to Seven Mile Beach and potential losses of sand through sand chutes located along the West Wall.** Such a study will be particularly important if consideration is to be given to a large channel in the North Sound. It has been suggested that collaboration with overseas academic institutions may prove a beneficial avenue in achieving reduced cost, but academically qualified answers to outstanding knowledge gaps.

12.2 Storm Incidence

Major storms and hurricanes are the main cause for massive erosion events along the Seven Mile Beach. Ralph Clarke in his 1988 report on erosion conditions looked at storm frequency and intensity influencing the Cayman Islands. In addition he modelled various storm scenarios to predict the likely beach erosion potential and impacts from wave damage. Seven Mile Beach has evolved considerably since the release of that report and many, if not all, of the setback recommendations have been ignored. Given the increase in development along Seven Mile Beach and many recent advances in current hydrographical modelling technology, it may well be prudent to revisit this study and update it.

The Committee recommends an update to Ralph Clarke's 1988 report on erosion conditions along Seven Mile Beach using the latest hydrographical modelling technology and storm prediction techniques.

13. BIBLIOGRAPHY AND OVERVIEW OF PREVIOUS WORK:

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(a.) Excavation for development limited to that necessary for foundations which should be designed to allow free flow of sand without obstruction. Any beach-grade sand unavoidably removed should be returned to beach system and used for beach or dune nourishment.

(b.) Minimum setback of 150' and 200' in some places to allow sufficient room for beach/dune system to "flex" during storm erosion conditions and recover without interference during post-storm conditions.

(c.) Protection of existing native beach/dune vegetation.

(d.) Sand inventory study for beach nourishment.

(e.) Continuation of beach monitoring programme initiated by Lands and Survey

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Roberts, HH and Snieder, RM (1982) Reefs and Associated Sediments of Grand Cayman Island, BWI: Recent Carbonate Sedimentation. *Field Trip Guide Book for the 1982 Annual Meeting of the Ecological Society of America*, New Orleans, Louisiana. Earth Enterprises, Inc.

Seymour, R. (2000) *Seven Mile Beach: A Natural History*.

University of Tennessee (1989) Cayman Islands Study: Grand Cayman, Vol 1, Technical Studies. Graduate School of Planning, University of Tennessee, Knoxville.

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National Academy of Sciences (1995) *Beach Nourishment and Protection*, National Academy Press, Washington, D.C. 334 pp.

Seymour, R. (2000) *Seven Mile Beach, A Natural History*.

U.S. Army Corps of Engineers (1984) Shore Protection Manual, Coastal Engineering Research Center, Department of the Army, 2 volumes.

15. INVITED CONSULTANTS PROFESSIONAL BACKGROUND.

15.1. Dr. Richard Seymour

Education:

B.S. in Engineering in 1951 from the U.S. Naval Academy, Annapolis, MD, and a Ph.D. in Oceanography in 1974 from the Scripps Institution of Oceanography of the University of California, San Diego.

Teaching:

Stanford University Graduate School of Aeronautics & Astronautics, Lecturer 1964-65.

University of California, San Diego, Scripps Institution of Oceanography, Lecturer 1980-1997

University of California, San Diego, Mechanical and Aeronautical Engineering Department, Adjunct Professor 1984-1990.

Texas A&M University Civil Engineering Department, Professor 1991-1997.

Ph.D. students advised, Daniel M. Hanes, Stephen L. Elgar, Jonathan D.Trent, James K. Orzech, James P. Barry, Eloi Melo, Waldo W. Wakefield, David B. King Jr, Forrest E. Sloan, William C. O'Reilly, Michelle S. Okihiro, Karl E. Rieder, Edith Gallagher, Zvi Friedman, Nels J. Sultan, Eustorgio Meza Conde.

M.S. students advised, Alan L. Higgins, Akihiko Hirayama, Bradley DeRoos, Sean Wiggins , Vincent Guerandel, Wilfred J. Lemasson, Stephen Riedl, Andrew C. Sarat, Stephane Vignet, Srikrishna Muraldidharan, Charles Zimmermann.

Professional Employment:

1984 - present:	Head, Ocean Engineering Research Group, Center for Coastal Studies Scripps Institution of Oceanography
1990 - 1997:	(Concurrent with Scripps appointment) Director, Offshore Technology Research Center, Texas A&M University, College Station, TX
1974 - 1984:	Staff Oceanographer. California Department of Boating and Waterways
1965 - 1969:	Manager, Techite Pipe Division, United Technologies Corp., Sunnyvale, CA.
1962 - 1965:	Chief Engineer, Titan III Booster Program, United Technologies Corp., Sunnyvale, CA.
1959 - 1962.	Head, Rocket Development Section, Thiokol Chemical Corp., Elkton, MD.
1951 - 1959:	Vice President, Wire Equipment Mfg. Co, Trenton, NJ.

Representative Consulting Experience:

U.S. Army Engineers.
Consultant on the experimental sand by-passing system at Oceanside, CA.
Authorship of chapters on wave climatology in the final report on the San Diego Region of the Coast of California Study.
Expert witness concerning wave damage at Redondo Beach, CA.

Government of Mexico, I.I.E., Cuernavaca.
Consultation on sediment transport at the Vera Cruz nuclear energy plant.

City and County of San Francisco.
Consultant for the Clean Water Program on shoreline erosion protection at Ocean Beach.

City of Oxnard, CA.
Prepare conceptual designs for shoreline stabilization projects.

Military Sealift Command, Pacific, U.S. Navy.
Expert witness on wave conditions in Los Angeles Harbor during the 1 March 1980 Storm.

Electric Power Research Institute.
Review of studies on renewable energy resources in the ocean.

California Energy Commission.
Review of proposals on alternate energy sources in the ocean.

U.S. Coast Guard.
Study of wave conditions at the site of the 1990 oil spill near Huntington Beach, CA.

City of Carlsbad, CA
Consultation on coastal processes associated with the wetlands restoration project at Batiquitos Lagoon.

Department of the Environment, Cayman Islands.
Consultant to Beach Erosion Committee.

Expert Witness.
Numerous cases involving injury, loss of life and property damage in presence of large waves.

Engineering Consultant.
Retained by a number of engineering firms for consultation on wave climate, beach processes and wave power devices.

Service:

American Society of Civil Engineers
Fellow
Waterways, Port, Harbor and Coastal Division, Research Committee Member, 1989-1993
Committee on Renewable Energy Member, 1985-1991
Task Committee on a National Coastal Facility Member, 1990-91.

American Society of Mechanical Engineers
Member
Ocean Engineering Division Chairman, 1997-98.
Commission on Engineering, Energy Committee Member, 1998-1999.

Marine Technology Society
Fellow
Publications Board Member, 1995-1997.

American Shore & Beach Preservation Association
Member.

American Society for Testing Materials
Subcommittee on standards for reinforced plastic pipe Member, 1968-69.

California Sea Grant College
Advisory Committee Member, 1986-1999

University of Southern California, Institute for Marine and Coastal Studies
Advisory Board Member, 1976-1991.

Marine Board, National Research Council
Member, 1984-90.
Chairman, 1994-96
Executive Committee Member, 1986-89
Vice Chairman, 1988-89
Committee on Information for Port and Harbor Operations Chairman, 1984-85
Committee on Beach Nourishment and Protection Chairman, 1992-1994
Wave Measurement Technologies Steering Committee Member, 1980-82
Panel on Assessment of Ocean Thermal Energy Conversion (OTEC) Ocean Engineering Member, 1981.
Liaison, Committee on Use of Composite Materials in Marine Structures, 1989-1991
Committee on Coastal Engineering Research and Education Member, 1989-1991.

San Diego Association of Governments (SANDAG)
Shoreline Erosion Task Force Member, 1980-82.

Foundation for Ocean Research
Trustee, 1980-1990.

Ocean Engineering Journal
Associate Editor, 1984-present.

Estuarine, Coastal and Shelf Science
Editorial Board Member, 1988-1998.

Shore & Beach
Special Edition Editor, v.57, no.4, October 1989.

Harbor Branch Oceanographic Institution, Inc., Ocean Engineering Division
External review committee Member, 1991.

World Technology Evaluation Center
Panel on Submersible Technologies Chairman, 1992-94.

Research Interests:

- The wave climate of the Pacific Coast of the United States.
- Effects of global climate shifts on wave intensity in the Pacific.
- Extreme wave events.
- Wave measurement technology.
- Beach erosion and erosion protection.
- Sediment transport models.
- Wave energy recovery technology.
- Composite materials applications in the ocean

Honors and Awards:

- Wofford Cain Senior Chair in Offshore Technology, Texas A&M University, 1991-1997.
- Joseph W. Johnson Award, California Shore and Beach Preservation Association, for Outstanding Contributions to the Sciences of Nearshore Processes and Oceanography, November, 1997
- Moffatt and Nichol Harbor and Coastal Engineering Award, American Society of Civil Engineers, 2000.
- Professor Emeritus in Civil Engineering, Texas A&M University, 1998.
- Fellow, American Society of Civil Engineering.
- Fellow, Marine Technology Society.
- State of Texas, Registered Professional Engineer, 1994-present

15.2 Dick L. Holmberg.

Founder of Holmberg Technologies, Inc.

Dick L. Holmberg is a naturalist and master mariner with a long history of being a trailblazer in solving erosion and other related problems plaguing the earth's beaches, undersea areas and waterways. His career spans more than a half century. During this time, his companies have completed more than one thousand erosion control projects. He is the pre-eminent leader in providing permanent solutions to solving abnormal shoreline problems associated with manmade earth changes. Through his years of research, he has found modern water management practices along with conventional marine engineering designs have altered and turned rivers and streams into systems of drainage, navigation and sewage disposal and from an ecological sense are no longer rivers but plumbed channels that create erosion and flush waste. Natural river systems long a symbol of life in the art of all cultures, now carry death and loss to our seas in the form of upland runoff that transport hazardous materials, waste and contaminated sediments that are no longer filtered through fresh water flood plains, wetlands and coastal deltas. He found that these unnatural erosion and de-stabilization processes are progressively and rapidly degrading and depleting fresh water supplies throughout the world as they actively destroy nature's fresh water filtration and soil retention systems: coastal beaches, deltas, flood plains, shallows, shoals wetlands, etc. whose functions were to protect and retain upland fresh water supplies and soils. This loss is the main reason two of earth's main resources its' arable soil and fresh water are vanishing from the earth's upland areas. Through his extensive research, he has accumulated numerous scientific documents and nautical data including: historical records, geological records, charts, erosion records and rates, satellite imaging, graphs, hydrology, maps, papers, photos, reports, shipping, surveys, wrecks, etc. that clearly define the cause of these problems.

Holmberg incorporated his experience, research and knowledge of the undersea world's working relationship with earth's ecosystems to pioneer the development of an evolutionary coastal restoration technology. His "Undercurrent Stabilizer"(UCS) systems have been documented in over twenty performance studies including some government funded. All have confirmed his benign technology and innovative methods are not only successful, but more importantly, very beneficial without undesirable side effects associated with traditional engineering methods. Some of his permanent systems are nearly thirty years old and still continuing to improve with age without any associated adverse impacts. He is the recipient of five U.S. and several Canadian Patents for his restoration techniques. His patented UCS system has been installed in applications from the Great Lakes to ocean environments including a recent installation under study in Saudi Arabia.

He is a master diver specializing in liquidized bottom penetrations, subsurface hydraulics, geo-grid placement and subsurface currents. He is a self taught natural earth scientist, inventor, researcher and writer as well as a pioneer in the use of geo-textiles for the marine construction and erosion control fields. He is an innovator in the development of underwater construction techniques including hydraulic concrete injection, lifting, liquefying, pumping and rigging. Many of his designs are protected as trade secrets. One of these designs increases the amount of excavated solid materials that can be moved in liquid solution and hydraulically transported through a pipe to a point of discharge. He also converted DUKW amphibious vehicles for

excavation, extraction, liquefaction, recovery, rescue, towing, sea-bed cleaning, salvage, etc. for work in his specialized field.

To locate shipwrecks during his salvage work, he used aerial photographing techniques to identify and differentiate shoreline abnormalities to find and identify over thirty shipwrecks hidden below underwater sand formations. He continued to develop this perceptive skill with satellite and infra-red imaging after it was released by the military for public use. He was one of the first to use this image overlay technique in the private sector for analyzing and monitoring global processes. This analysis records topographical changes of the earth's upper and underwater land surfaces. He used these advanced methods to foretell upcoming events by viewing images of topographical features to identify changes from normal behavioral patterns tracing these developing problems to their sources.

His comprehensive research and field work involved conducting underwater surveys during times of major storm events to evaluate various interactions between structures and fluid energy through these turbulent time periods. The main focus of his earlier research was to observe flow dynamics of currents, sand movement, erosional trends, tidal effects and changes, sea bed/surface changes, wave and structural damage. During this time, he discovered that when high groin fields were subjected to parallel water currents, spiraling eddies would formulate spawning gyrating underwater spouts that bore downward digging deep underground cavities in liquified sand bottoms. These powerful currents could rapidly erode and transport millions of cubic yards of soil at flood rate speeds from the beach to offshore bottoms. They could also excavate tunnels underneath and through massive jetties and breakwaters causing these enormous systems to collapse within minutes. His research discovered that waves can generate parallel flowing currents that can exceed flood rate velocities. Further, he discovered that extreme water pressures that develop under these conditions are capable of pinning and forcing a human body through rock structures.

His research with traditional erosion control structures showed that when approaching waves compressed against structures such as sea walls and rock revetments, near shore currents were accelerated increasing scour, soil loss, water depth, wave size, structural and erosional damage as well as erosion of adjacent shores. While viewing these destructive processes at work, he discovered the reasons traditional structures fail and how seismic activity destabilizes buildings without direct contact. This in depth field study of waves allowed him to develop a unique understanding of what occurs when man challenges these powerful, unrelenting forces in his attempts to abruptly halt their progress to keep them from encroaching on the shore. His insight into the destructive nature and power of waves includes their ability to downcut bottoms, liquefy soils, over top defensive structures, develop hydraulic pressures, striking power, as well as their seismic and water hammer abilities, etc.

Some of his earliest geo-textile designs of concrete filled systems were printed in a United States Army Corp of Engineers (USACE) manual (June 1973, Self Help Manual) as state of the art. Before and during the technical development of geo-textiles, he directly studied ways to improve performance levels of traditional erosion control structures that were placed in near and offshore waters. His prototype alterations of traditional groin designs successfully achieved non-conventional results and are now called "low-profile." One of his most outstanding achievements was discovering how to reverse beach erosion to a natural state of accretion by using his patented

UCS System. He also designed a system to counteract sub-sea structural settlement caused by wave induced liquefaction, motion and seismic activity. For years he worked with the textile industry to develop new uses for synthetic textiles in the erosion control field for filtration, sediment separation, purification, wicking, etc. He systematically field tested, consulted, and worked with an array of differing designs if they had any merit including artificial seaweed, a product from France that was found to be overmatched by the powerful elements of the sea. He field tested assorted types of textile materials, some filled with sand, cement or combinations of different mixes. He has also worked on ways to reduce industrial waste and contamination of fresh water supplies in plants using and discharging millions of gallons of fresh water a day. He worked on methods to recycle water through an enclosed circulatory system of filters where materials were removed and recycled instead of contaminating outside water sources. One of his purification designs included transportable excavation chambers or "pods" used for compressing fine sediments extracted from water as it moves through a series of bleeders, chambers and filtration processes.

Another important part of his work is to restore the back shore areas and upland bluffs, dunes, hillsides and the eco-systems they support. His agricultural studies focused on basic plant requirements particularly rooting abilities and water needs. He attended classes and participated in sessions on gardening, horticulture, landscaping and soils, receiving certification in erosion and commercial irrigation. His research included studying historical records on ancient agriculture and construction methods. For over thirty years he has been commercially field testing miscellaneous plant species along open coastlines to evaluate their growth and survival rates in altering terrains and adapting to harsh conditions. Again, by combining this insight and knowledge he has, developed specialized techniques to restore dunes, rebuild undercut hillsides and landscape bluffs ranging in height from a few to several hundred feet high. Part of this unique process is designed to stabilize soils to prevent erosion and to reshape newly terraced slopes while another combines a mixture of organic materials to create an interlocked grid system of geo-textile forms and filters to enhance growth, re-establish natural habitat, control ground water runoff, restore natural eco-systems, utilize water seepage and promote and enhance new plant growth to draw wildlife back to these destroyed, uninhabited, unsafe bluff areas.

He has worked successfully with government officials and legislators to change regulations to help expedite nationwide permitting processes for beneficial structures. This effort brought about the implementation of a new permitting classification (low profile groins) as a "minor permit" category. He has appeared before congressional committees testifying about resource degradation and to promote the natural restoration of shorelines worldwide. He has also worked with legislators to enhance water quality, protect and restore property rights, change jurisdictional statutes, reclaim resources, ecosystems, restore wetlands, benthic habitat, etc. He has set up web sites, produced videos, multi-media documentaries, slide presentations to help inform and alert the public and public officials to the serious nature of these accelerating global erosion problems that are destroying the planet's key resources, its' fresh water and soil.

Holmberg has been the subject of substantial media attention including newspaper articles, radio programs, television shows, talk shows and appeared on many major media network newscasts such as CNN. His work has been featured in newspapers, trade journals and magazines including: Engineering News Record, World Dredging, Land and Water, Landscape Design, Erosion Control Magazine and Landscape Architect. He has appeared before local, state, and

federal government committees advocating change to present coastal policies, which he views as causal and destructive. His technical papers have been presented at The International Erosion Control Association, Coastal Zone ‘85 USA, the Quebec Regional Symposium of Erosion 1999, and The First Soft Shore Protection Conference, Greece 2000. He has presented papers at International Erosion Control Association sessions and is recognized internationally as an expert in the field of coastal erosion and restoration. His concepts for solving earth's bio-sphere problems have been successfully tested beyond the standardized formats and are considered state of the art for preserving and restoring the world's interrelated eco-systems.

15.3 Ralph Clark P.E., P.L.S.

Bureau of Beaches and Wetland Resources,
Coastal Data and Analysis Section,
3900 Commonwealth Blvd., MS 300
Tallahassee, Florida 32399-3000

Cayman Islands' Experience:

1988 Report: Ralph R. Clark. *Investigation of Erosion Conditions on the Seven Mile Beach Grand Cayman* April 1988., Florida Department of Natural Resources- Division of Beaches and Shores.

1995 Report to address erosional conditions at Bodden Town and Rum Point as well as the Seven Mile Beach.

Review of Grand Cayman erosion projects for Dr. Harry Roberts (Louisiana State Univ.) and Dr. Lee Harris (Florida Institute of Technology).

Carbonate Beach Experience:

Currently employed by the Department of Environmental Protection, Bureau of Beaches and Wetland Resources working with carbonate sand beaches in the Florida Keys.

Consultant to the Mexican government on their Yucatan beach study over the last 3 years and serve on a technical committee investigating the feasibility to restore the beach at Cancun, Mexico.

Corroborating with a Russian expert on coral sedimentology who has conducted extensive research in the Seychelles Islands (Indian Ocean) and the Cuban barrier islands fronting the Banco Jardines directly north of the Caymans.

16. CASE STUDY: ROYAL PALMS BEACH.

The Royal Palms, Seven Mile Beach, provides an excellent example of a persistent erosion problem that was corrected by removal of a structure that had been placed too close to the active beach. The series of photographs below show the same stretch of beach both when the structure was present (Figure 1) but damaged by waves and erosion creating a lateral beach access problem, and at a later stage when the structure was


THE ROYAL PALMS

PRESS RELEASE

ROYAL PALMS
GRAND CAYMAN BWI

Figure 1

voluntarily removed to allow the beach to fluctuate (Figure 2). Figure 3 shows the Royal Palms Beach following the recent March 2003 heavy erosion event that caused extensive erosion on the Southern end of Seven Mile Beach. Figure 3 clearly illustrates that a healthy beach profile now exists in the area even though it has been significantly eroded. The picture shows clearly that visitors to the beach are utilising this stretch of beach and are most likely unaware that the beach is significantly eroded at this stage. If the structure had remained in place a healthy beach profile would not have formed and beach access would be blocked by the building in the water (Figure 1), significantly increasing the

Figure 2

Figure 3

public's perception of erosion and impacting the recreational functionality and value of the beach. The management of the Royal Palms undertook this option on a voluntary basis, fully understanding the benefits of the action and should be commended for their action.