States of Guernsey

GUERNSEY STRATEGY FOR COASTAL DEFENCE AND BEACH MANAGEMENT

VOLUME I - STRATEGY REPORT

MARCH 1999

POSFORD DUVIVIER

Rightwell House
Bretton
Peterborough
PE3 8DW

STATES OF GUERNSEY
DEPARTMENT OF ENGINEERING

GUERNSEY STRATEGY FOR COASTAL DEFENCE AND BEACH MANAGEMENT

VOLUME I
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—	March 1999	JE Cooper AJ Sleigh	ECP Knowles	NW Beech	Final

Posford Duvivier
Consulting Engineers
Rightwell House
Bretton
Peterborough
PE3 8DW

E-mail: mail@posford.co.uk
Telephone: 01733 334455
Fax: 01733 262243

States of Guernsey
Department of Engineering
Sir Charles Frossard House
P O Box 43
La Charroterie
Guernsey
GY1 1FH

Telephone: 01481 717000
Fax: 01481 720968

SUMMARY

BACKGROUND

In August 1998 the States of Guernsey, Board of Administration, appointed Posford Duvivier to undertake the preparation of a strategy for the future management of the coastal defences and beaches around the islands of Guernsey and Herm. This report describes the findings from the work undertaken during the study and sets out a proposed strategy for the management of the islands' defences and beaches over the next 50 years.

NEED FOR A STRATEGIC APPROACH

The maintenance of the coastal defences around the two islands, to date, has been largely reactive with works directed at problems as they arise. This approach has generally been successful but it is becoming increasingly apparent that there are problems with the defences that are not being satisfactorily addressed by this reactive approach. The problems largely relate to the lowered beach levels, which can result in increased wave overtopping and lead to the foundations of the seawalls being undermined.

This report responds to these problems with the view to establishing a more strategic approach to the maintenance and improvement of the coastal defences.

APPROACH USED FOR THE STUDY

The development of the strategy is divided broadly into two stages: a first stage that deals with the collection and analysis of data and a second stage that uses this information to appraise potential options for coastal defence and beach management.

The outcome of the first stage is an overview of the Guernsey and Herm coastlines in terms of the coastal processes, the coastal defences and the environmental assets and issues.

The knowledge acquired in the first stage has been used to appraise options for coastal defence in the second stage. At a strategic level, these options are either **Do Nothing** or **Do Something**. The option to Do Nothing involves no coastal defence activity. In contrast, Do Something involves the provision of coastal defence by either sustaining or improving the defences. Sustaining would mean keeping the present standard of protection against flooding and/or erosion, and improving would involve raising the standard.

For convenience the coastline of the two islands have been divided into 25 so-called "coastal units" (23 on Guernsey and two on Herm), these are shown in Figures 1 and 2 at the end of this summary.

The two-stage process has led to the selection of a preferred strategy option for each coastal unit, together with appropriate schemes for the implementation of the strategy. The selection is based on an appraisal of the technical, environmental and economic issues within the unit.

FINDINGS OF THE STUDY

The findings of the study are summarised in Table 1. The table lists the preferred strategy option and selected scheme option for each coastal unit.

Table 1 Proposed Strategy

Coastal Unit		Strategy Option	Scheme Option
No.	**Name (Key Features)**		
1	Pezeries Point to Imperial Hotel	Do Something (Sustain)	Continue existing practice
2	Imperial Hotel to Fort Grey (Rocquaine Bay)	Do Something (Sustain)	Continue existing practice
3	Fort Grey to L'Erée Headland (Rocquaine Bay)	Do Something (Interim: Sustain, Long term: Improve)	Continue existing practice and minor works pending selection of long-term option
4	L'Erée Headland and Lihou Island (Lihou Island)	Do Something (Improve)	Excavation and/or protection of archaeological resource
5	Fort Saumarez to Le Catioroc	Do Something (Improve)	Continue existing practice pending selection of long-term option
6	Le Catioroc to Fort Richmond (Perelle Bay)	Do Something (Improve)	Beach nourishment
7	Fort Richmond to Fort Le Crocq	Do Nothing	—
8	Fort Le Crocq to Fort Hommet (Vazon Bay)	Do Something (Interim: Sustain, Long term: Improve)	Continue existing practice and minor works pending selection of long-term option
9	Fort Hommet to Le Guet (Albecq)	Do Something (Sustain)	Continue existing practice
10	Le Guet to Grandes Rocques (Cobo and Saline Bays)	Do Something (Interim: Sustain, Long term: Improve)	Continue existing practice and minor works pending selection of long-term option
11	Grande Rocques to Rousse (Port Soif and Portinfer)	Do Something (Sustain)	Continue existing practice
12	Rousse to Chouet (Le Grande Havre and Ladies Bay)	Do Something (Interim: Sustain, Long term: Improve)	Continue existing practice pending selection of long-term option
13	Chouet to Fort Pembroke	Do Something (Sustain)	Continue existing practice
14	Fort Pembroke to L'Ancresse (Pembroke and L'Ancresse Bays)	Emergency works pending selection of strategy	See strategy option
15	L'Ancresse to Fort Doyle (L'Ancresse and Fontenelle Bays)	Do Nothing	—
16	Fort Doyle to Bordeaux	Do Something (Sustain)	Continue existing practice
17	Bordeaux to Vale Castle (Bordeaux Harbour)	Do Something (Sustain)	Continue existing practice and minor works
18	Vale Castle to Spur Point (St Sampson)	Do Something (Sustain)	Continue existing practice
19	Spur Point to La Salerie (Belle Greve Bay)	Do Something (Interim: Sustain, Long term: Improve)	Continue existing practice and minor works pending selection of long-term option
20	La Salerie to La Vallette (St Peter Port)	Do Something (Improve)	Raise seawall
21	La Vallette to St Martin's Point (Soldiers and Fermain Bays)	Do Something (Sustain)	Continue existing practice
22	St Martin's Point to Le Gouffre (Moulin Huet, Saint's and Petit Bôt Bays)	Do Something (Sustain)	Continue existing practice
23	Le Gouffre to Pezeries Point	Do Nothing	—
24	Herm – South (Belvoir Bay)	Do Something (Improve)	Re-profiling of rock protection
25	Herm – North (Herm Harbour)	Do Something (Sustain)	Continue existing practice

RECOMMENDATIONS

The report recommends a programme for undertaking the monitoring, studies and coastal defence works to implement the strategy.

The immediate actions recommended are as detailed below.

Monitoring

- Commence and continue monthly inspections of defences in Unit 14 (Fort Pembroke to L'Ancresse) until a long-term strategy is determined.

- Commence and continue a programme of summer and winter beach surveys within the following units:

  - Unit 2 (Imperial Hotel to Fort Grey)
  - Unit 3 (Fort Grey to L'Erée Headland)
  - Unit 8 (Fort Le Crocq to Fort Hommet)
  - Unit 10 (Le Guet to Grandes Rocques)
  - Unit 19 (Spur Point to La Salerie).

- Commence and continue a programme of annual inspections of the defences within all units.

- Commence and continue a programme of five-yearly inspections of the cliffs in Unit 1 (Pezeries Point to Imperial Hotel).

Studies

- Undertake a short study to determine an approach for protecting the archaeological resource within Unit 4 (L'Erée Headland and Lihou Island).

- Undertake a detailed study investigate the environmental viability of the inland flood bank scheme within Unit 5 (Fort Saumarez to Le Catioroc), and select the preferred scheme option for the unit.

- Undertake a study of the proposed beach nourishment scheme (to include consideration of the environmental issues) within Unit 6 (Le Catioroc to Fort Richmond).

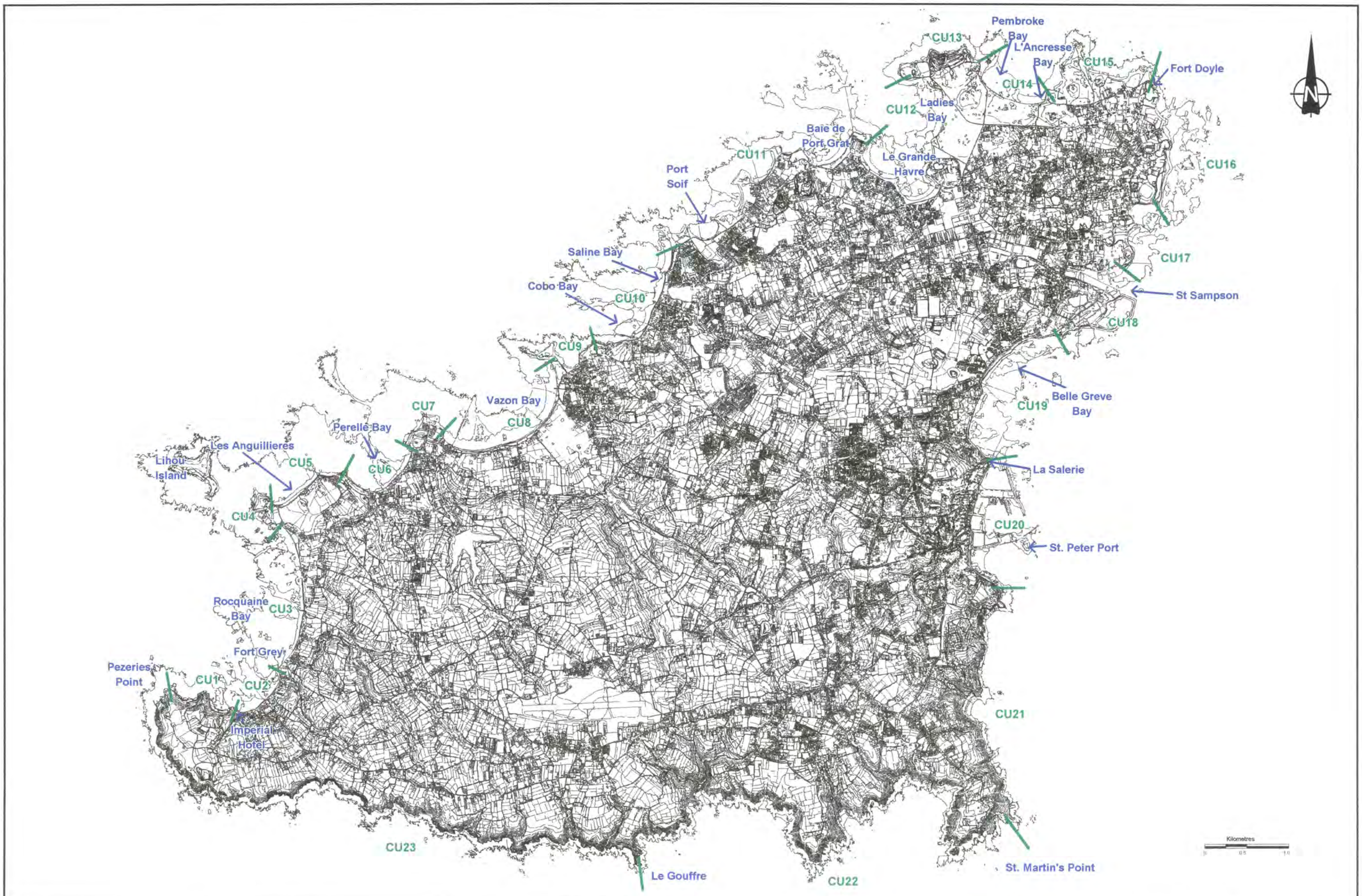
- Undertake a detailed study to refine and reassess the viability of abandoning the defences in Unit 14 (Fort Pembroke to L'Ancresse).

Works

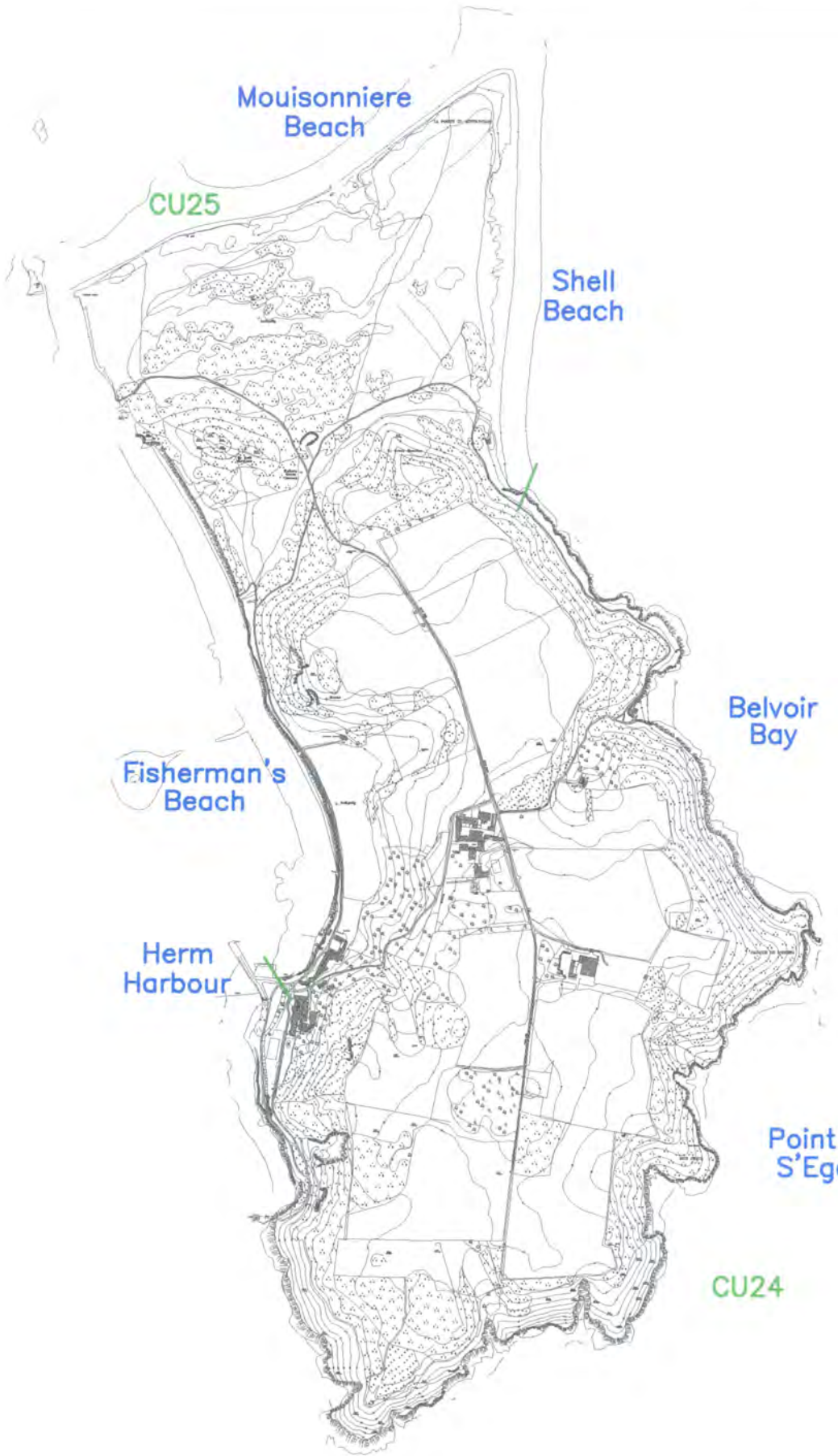
- Undertake ongoing maintenance within each unit.

- Undertake emergency works as required to maintain the defences in Unit 14 (Fort Pembroke to L'Ancresse), pending the selection of a long-term strategy.

Further recommendations are made for tasks to be completed within three and five years.



PROJECT **GUERNSEY STRATEGY FOR COASTAL DEFENCE AND BEACH MANAGEMENT**	TITLE **COASTAL UNITS - GUERNSEY**	CONSULTING ENGINEERS POSFORD DUVIVIER	Job No. E3309	DATE February 1999	
			ACAD Ref.	CHECKED JC	PASSED
			DRAWN JLH	FIGURE 1	REV



PROJECT GUERNSEY STRATEGY FOR COASTAL DEFENCE AND BEACH MANAGEMENT	TITLE COASTAL UNITS – Herm	CONSULTING ENGINEERS POSFORD DUVIVIER	DRAWN MDWP	SCALE 1:10,000
			DATE FEB'99	CHKD JEC
			DRG No. FIGURE 2	

SECTION 1

INTRODUCTION

1.1 Background

Guernsey and Herm are members of a group of small islands (known as the Channel Islands) located in the English Channel 45km from the coast of Normandy, France. Guernsey is the larger of these two islands, with an area of about 58km^2 and a population of approximately 60,000. Herm, located 5km to the east of Guernsey, has a land area of about 2km^2. The location of the islands is shown in Figure 1.1, at the end of this section.

In August 1998 the States of Guernsey, Board of Administration, appointed Posford Duvivier to undertake the preparation of a strategy for the future management of the coastal defences and beaches around the islands of Guernsey and Herm. The Posford Duvivier study team then undertook a five-day data gathering and site inspection expedition to the islands (in September 1998).

This report describes the results of the work undertaken during the *Guernsey Strategy for Coastal Defence and Beach Management* study and sets out a proposed strategy for the management of the islands' defences and beaches over the next 50 years.

1.2 Scope of Study

The study has been undertaken in accordance with the proposal submitted by Posford Duvivier dated July 1998 and broadly comprises the following aspects:

- data gathering and site inspections
- assessment of coastal processes
- environmental review
- a review of the availability of suitable material (sand and shingle) for beach nourishment
- technical, environmental and economic appraisals of options to sustain and/or improve the defences/beaches (where the strategic Do Something option is selected, see Section 5.2)
- the selection of preferred options.

As noted in Section 1.1, the study covers the coastlines of both Guernsey and Herm. The two coastlines, respectively 66 and 6km in length, are shown in Figures 4.1 and 4.2, at the end of Section 4. For the purposes of this report, references to "Guernsey" should generally be taken as referring to "Guernsey and Herm" unless the context suggests otherwise.

1.3 Layout of Report

Following this introductory section, the report is set out so that the reader is provided with an overview of the coastal processes, coastal defences and environmental attributes and issues around the islands. This is intended to provide the background to the data and other information used in the appraisal of options for the defences. For convenience, the coastline has been divided into a number of so-called "coastal units" and these form the framework for the appraisal of coastal defence options (i.e. the appraisal has been undertaken using a unit by unit approach).

The report comprises the following sections:

Section 2 – Purpose of Study – This section explains both why there is a need for a strategic approach to the management of the defences and beaches and the approach adopted; and sets strategic management objectives for the study.

Section 3 – Coastline Overview – This section provides an overview of the coastlines of Guernsey and Herm. For convenience the coastline is divided into four segments: Guernsey (west coast, east coast and south coast) and Herm. For each length of coastline descriptions of the coastal processes, coastal defences, land use and human and built environment, natural environment, and present planning policies is provided.

Section 4 – Coastal Units – As noted previously, the coastline is further sub-divided into a number of coastal units. This section provides a definition of these units and explains how they have been derived.

Section 5 – Introduction to Option Appraisal – This section provides an introduction to the procedures for appraisal of the coastal defence options and the method of selection used to derive a preferred option for each coastal unit.

Section 6 – Appraisal of Options – This section sets out the appraisal of options on a unit by unit basis.

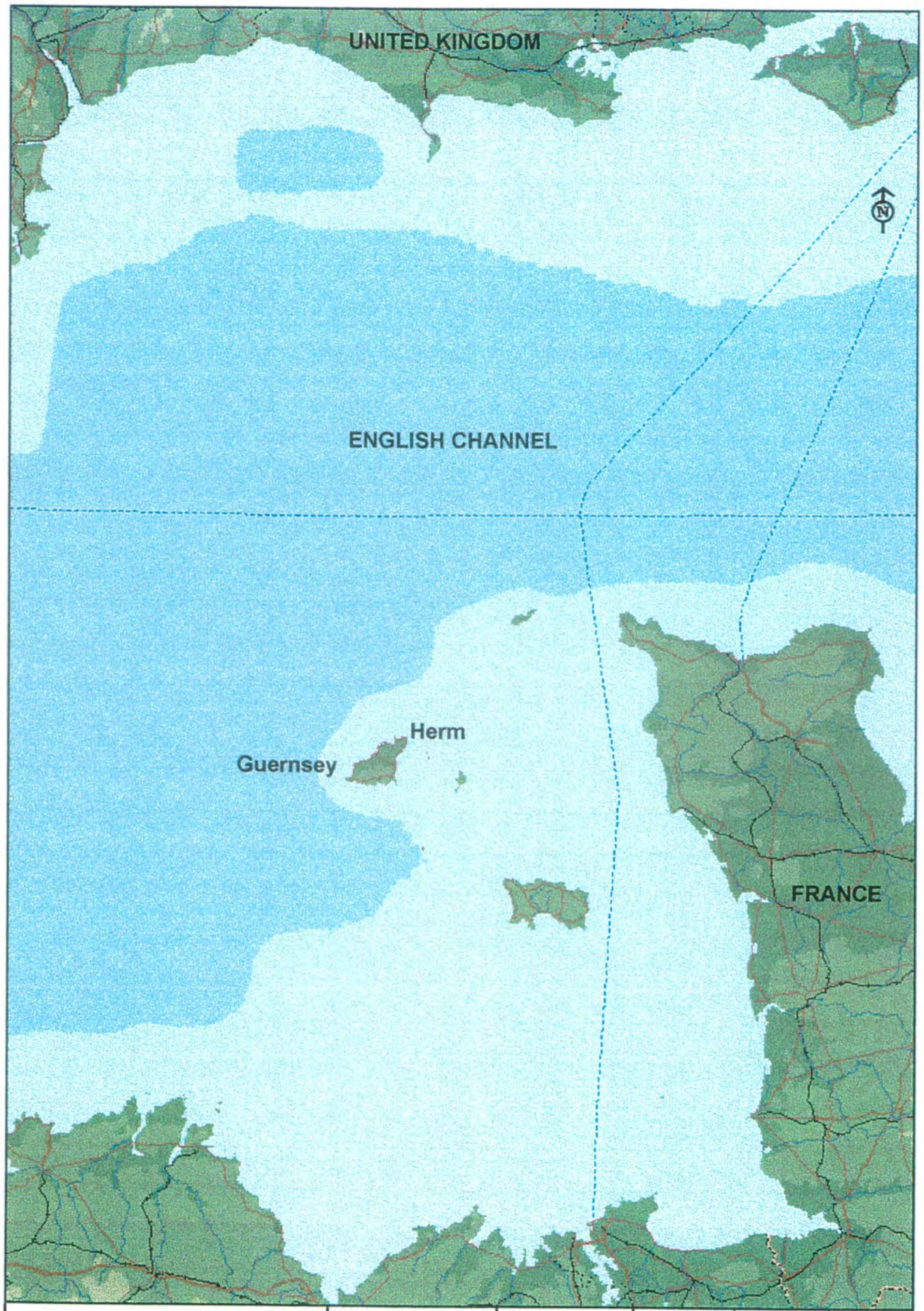
Section 7 – Summary of Appraisal – This section summarises the results of the appraisal described in Section 6.

Section 8 – Recommendations – This final section of the report makes recommendations relating to the need for works to the defences (and also prioritises this need). The section also makes recommendations for future monitoring and studies.

As part of the strategy study, an inspection of all the coastal defences around Guernsey and Herm was undertaken. The detailed findings of this inspection are held in Appendix A (all Appendices are bound separately in Volume II).

The findings of the review regarding the availability of suitable material for beach nourishment are held in Appendix B.

Appendix C gives details of the consultation process, Appendix D shows photographs of the coastal units, Appendix E describes the numerical modelling undertaken for the study, Appendix F lists the appropriate planning policies for the islands and Appendix G gives details of the scheme option benefits and costs.



GUERNSEY STRATEGY FOR COASTAL DEFENCE AND BEACH MANAGEMENT	LOCATION PLAN	CONSULTING ENGINEERS POSFORD DUVIVIER	Job No. E3309	DATE Mar. 1999	
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			DRAWN JLH	FIGURE 1.1	REV

SECTION 2

PURPOSE OF STUDY

2.1 Need for a Strategic Approach

For the most part, the islands' coastal defences consist of vertical masonry walls, many of which date back to Victorian times. Within a number of bays, there are also vertical concrete walls constructed by the Germans during their wartime occupation of the island. In addition, and mainly around headlands, isolated lengths of rock protection have been constructed.

The States of Guernsey currently spend some £100,000 per annum maintaining these defences. The maintenance programme is largely reactive, with works being directed at problems as they arise.

To date, this approach has generally been successful in protecting the coastal assets from flooding and erosion. It is, however, becoming increasingly apparent that there are problems with the defences that are not being satisfactorily addressed by this reactive approach. These problems relate to the lowered beach levels, which can result in increased wave overtopping of the seawalls and lead to the foundations of the seawalls being undermined. Although not directly relevant to coastal defence, the low beach levels are also reducing the amenity value of the coastline.

This report responds to the problems described above with the view to establishing a more strategic approach to the maintenance and improvement of the coastal defences. While it is recognised that the report is very much focused on the management of the defences and beaches, nonetheless, it takes into account the needs of all those with an interest in the coastline in deriving a sustainable defence strategy for the island. Thus, in appraising the coastal defence requirements, the following factors are also considered: agriculture, fisheries, recreation and tourism, archaeology and built heritage, offshore activities, the natural environment, geology and geomorphology, landscape, water quality and industry.

2.2 Approach

The development of a strategy for Guernsey and Herm can be divided broadly into two stages: a first stage that deals with the collection and analysis of data and a second stage that uses this information to appraise potential options for coastal defence and beach management.

The first stage involved the study team in a five-day visit to the island during which:

- data were obtained from the States of Guernsey and other local interests. A full list of those contacted during the study is held in Appendix C, and the reference materials obtained are listed in the Bibliography at the end of the report.
- an inspection of the defences and beaches throughout the islands was undertaken. Information sheets setting out the results of the inspection are contained within Appendix A. The inspection also included a photographic record. Photographs of each coastal unit are given in Appendix D.

The data and information gathered in this first stage were used to:

- assess the coastal processes, that is the action of waves, tides and currents and their influence on the movement of sediment
- assess the performance and standard of the coastal defences and beaches
- obtain an appreciation of the environmental assets and issues significant to the Guernsey coastline (both the natural and the human and built environments).

The outcome of this first stage is an overview of the Guernsey coastline in terms of the coastal processes, coastal defences and environmental assets and issues.

The knowledge acquired from the first stage of the work was used to appraise a range of options for coastal defence around the islands. For convenience, the coastline was divided into a number of coastal units and a strategy was determined for each unit.

2.3 Strategic Objectives of Study

The strategic objectives are intended to ensure that the strategy developed for the island meets the general requirements for coastal defence and beach management and takes into consideration other interests around the coastline of the island. These interests include agriculture, fisheries, recreation and tourism, archaeology and built heritage, offshore activities, the natural environment, geology and geomorphology, landscape, water quality and industry. The objectives are based on good coastal management practice, and are in line with those set for similar studies undertaken within the UK.

The strategic objectives are used in the appraisal of options and hence the development of particular strategies within each coastal unit. They are necessarily wide ranging so that they are relevant to the entire island coastlines. More specific interests are identified for each coastal unit as part of the appraisal process.

The strategic objectives for the study are listed in Table 2.1.

Table 2.1 Strategic Objectives

Strategic Objectives
Four strategic objectives for coastal defence and beach management have been identified, these are: 1. To develop a coastal defence and beach management strategy that is technically sound, environmentally acceptable and economically viable. 2. To develop a sustainable coastal defence and beach management strategy that avoids, as far as possible, tying future generations into inflexible and expensive options for defence. 3. To develop a coastal defence and beach management strategy that is compatible with the coastal processes. 4. Within the framework of the coastal defence and beach management strategy, to develop scheme options that: - protect human life - protect property - allay undue anxiety caused by the risk of erosion and/or flooding.

SECTION 3

COASTLINE OVERVIEW

3.1 Preamble

This section provides an overview of the coastlines of Guernsey and Herm. It presents a summary of the data collected and the work undertaken during the initial stage of the study. More detailed and specific information relating to particular stretches of coast (coastal units) is provided within Section 6, which deals with the appraisal of options.

For convenience, the coastline has been divided into Guernsey: west coast (Pezeries Point to Fort Doyle), east coast (Fort Doyle to St Martin's Point), south coast (St Martin's Point to Pezeries Point); and Herm. These lengths are also illustrated on Figure 4.1 and Figure 4.2 at the end of Section 4. For each of these lengths a description of the coastal processes, land use and the human and built environment, natural environment and the present planning policies is provided.

3.2 West Coast, Guernsey

3.2.1 Coastal Processes

Physical Characteristics

a) Bathymetry

The nearshore bathymetry of the west coast of Guernsey is complex in comparison with the east and south coasts. The 10m contour varies considerably in distance from the coast. Where it lies far offshore, the bathymetry is shallow with numerous rocky outcrops.

In Rocquaine Bay in the south, the 10m contour lies about 3km offshore, whereas within Vazon Bay and Cobo Bay it is approximately 1.5km offshore. It then follows the coastline roughly parallel to the coast at a distance of 1km offshore to the eastern end of L'Ancresse Bay. It then moves to only 200m offshore towards Fort Doyle.

Rocky outcrops (which dry at low water) are a feature of the entire west coast. These outcrops form small islands at low water. They occur as far seaward as the 20m contour and are most numerous around Rocquaine Bay and Grand Havre. The largest outcrops occur off L'Erée Point and are known as Lihou Island and Lihoumel.

The 50m contour is some 5 to 6km offshore, increasing in distance from the coastline towards the northern end of the island.

The nearshore bathymetry has a significant influence on the size and direction of waves approaching the coastline. This is discussed further under ***Marine Climate.***

b) Coastline and Beaches

The coastline between Pezeries Point and Fort Doyle is characterised by rocky platforms overlain with sand/shingle beaches, and peat and clay deposits overlain with sand/shingle beaches. In a number of the bays and around some headlands erosion of weathered rock (termed "head", see Section 3.2.4) is evident.

From Pezeries Point and Portelet Harbour, cliffs are fronted by a rocky foreshore. Portelet Harbour consists of a sand/shingle upper beach extending seaward to rocky outcrops, common to much of the west coast. The beach and foreshore of Rocquaine Bay (and L'Erée Bay) is similar to that of Portelet Harbour.

The L'Erée headland is entirely surrounded by a rock platform. Lihou Island can be reached from the headland by a causeway, which is open at low water. The foreshore of the island comprises a rock platform occasionally interspersed with shingle deposits.

To the east of L'Erée headland, the foreshore is protected by a shingle bank that extends down the beach. The coastline is then characterised by a series of rocky headlands with sandy bays. The main bays are named Perelle, Vazon, Cobo, Saline, Le Grande Havre, Pembroke, L'Ancresse and Fontenelle. Historically, these bays have been subject to erosion and a general lowering in beach levels.

In the bays between Saline and Le Grande Havre an upper storm beach comprising shingle and cobbles exists above a rocky foreshore. Much of the foreshore of the Le Grande Havre consists of sand with some shingle above a rocky outcrop within the bay. A cobble beach exists towards Baie de la Jaonneuse. Pembroke Bay and L'Ancresse Bay comprise a sandy beach with some shingle against the seawall.

Between the eastern end of L'Ancresse Bay and Fort Doyle the foreshore comprises shingle and cobble beaches with a rocky foreshore.

Marine Climate

a) Tidal Conditions

The tides around Guernsey are semi-diurnal, i.e. the water level rises and falls twice a day. Table 3.1 details the tidal levels at St Peter Port on the east coast. These are predicted astronomical tidal levels and do not take account of surges, which can have a significant effect. Surges are related to the meteorological conditions and under extreme conditions can increase the predicted astronomical tidal levels.

Levels are given in metres relative to Chart Datum (CD), which is usually close to the lowest astronomical tidal level for the area. CD is 5.06m below the local Ordnance Datum (OD).

Table 3.1 Tidal Levels at St Peter Port

Place	Heights in Metres above Chart Datum			
	MHWS	MHWN	MLWN	MLWS
St Peter Port	9.3	7.0	3.6	1.5

The tidal flows along the west coast of Guernsey are extremely complex. During the early stages of the flood tide, flow rates of up to 2m/s occur in a south-westerly direction. Around mid tide, the flows reverse to a north-easterly direction and peak at 1.7m/s around high water. Flows reverse again midway through the ebb hide.

Close inshore for much of the tidal cycle, flows are in the opposite direction to the main tidal flows past the island. This is caused by the separation of flows around the island, which results in the set up of weaker "return" currents close to the shore.

b) Wave Conditions

Conditions along the west coast are dominated by waves generated by the prevailing westerly winds blowing over the long fetches from the Atlantic Ocean. Offshore significant wave heights are 6.5 and 9.9m for storms with return periods of 1 and 100 years respectively.

As these waves travel towards Guernsey they are modified by the complex bathymetry along the west coast. Inshore significant wave heights (along the –5m CD contour) are typically 6 and 7m for storms with return periods of 1 and 100 years respectively. The headlands and rocky outcrops have a tendency to "funnel" waves as they approach the shoreline. Within the bays this results in waves approaching the shore in a broadly normal direction and a concentration of wave energy in the gaps between the rock outcrops.

The conditions discussed above have been determined from offshore wave data purchased from the UK Meteorological Office. These data have been transformed to represent inshore conditions by using numerical modelling techniques. Further details may be found in Appendix E.

Sediment Processes

a) Beach Behaviour

Much of the west coast is made up of bays, often large, separated by rocky headlands. The shelter provided by the headlands and rocky outcrops tend to funnel waves into the bays so that they approach the shoreline broadly normal to the frontage. As a consequence, there is limited longshore movement of sediment through the bays. Within some of the larger bays there is, however, evidence of weak longshore drift, the direction being variable depending upon the prevailing wave conditions. For example, in 1947 a section of wall near Vazon Tower collapsed following the removal of a slipway by the Germans. It is believed that the slipway acted as a groyne and held beach material in front of the seawall.

Cross-shore transport, however, plays a much greater role than longshore transport in the development of the beaches within the bays. It is evident from an inspection of the beaches and discussions with the States of Guernsey that beach levels can change dramatically both during a single storm event and between the winter and summer seasons.

There is documentary evidence to support the conclusion that, historically, the beach levels along the west coast have been falling. For example, a letter from the States Office, Guernsey, to The President of the States of Guernsey in 1949 noted that ... *since the walls within Rocquaine Bay were built* (some years before World War I) *the level of the beach has lowered some 10 to 12 feet.*

There are a number of factors that have contributed to the falling beach levels. Material has been removed from the beaches of Guernsey for many (hundreds) of years before the practice was finally stopped in the 1940s. During the Occupation of the island, the German forces removed beach material for use in the production of some 270,000m^3 of concrete for Hitler's Atlantic Wall. The construction of seawalls will also have increased the tendency to beach loss through the reflection of wave energy from the face of the defences. Finally, lower beach levels have increased the volatility of the beach and contributed to the offshore loss of sediment.

There is little evidence to indicate that this trend of beach loss is continuing at a similar rate. However, in a number of bays (e.g. Perelle, Vazon) the beaches have fallen to a level at which the underlying clay and peat layers are now regularly exposed.

3.2.2 Coastal Defences

a) Existing Defences

The west coast of Guernsey is protected by a combination of man-made and natural defences. It has seen more intervention by way of man-made defences than the south and east coasts. The following paragraphs provide an outline of the defences throughout the west coast. Further information on the standard and condition of these defences may be found in Section 6 and Appendix A.

The coastline from Pezeries Point to Portelet Harbour is fronted by natural defences. Portelet Harbour is protected by breakwaters. The coastline from Portelet Harbour to L'Erée headland is defended by a combination of vertical masonry and concrete walls. Some lengths have additional toe protection added after the initial construction.

The L'Erée headland is fronted by natural defences as is Lihou Island, except for short lengths of rock protection. A shingle ridge provides protection to the frontage of Les Anguillières. The Haute Banque is fronted by a vertical masonry wall and a rock revetment. Perelle Bay is protected by a vertical masonry wall. The headland that separates Perelle Bay from Vazon Bay is fronted by natural defences and *ad hoc* placing of building rubble and rocks.

Vazon Bay is defended by a combination of vertical masonry walls and stepped concrete walls with wave returns at the crest. Some sections of the walls have additional toe protection. The remains of a short groyne field are present in the centre of the Vazon Bay defences. The headland separating Vazon Bay from Albecq is largely unprotected by man-made defences. A short section of vertical masonry is present in Albecq adjacent to the coast road. Further short sections of both masonry and concrete walls exist, protecting the coast road towards Cobo Bay.

Cobo Bay, like Vazon Bay, is protected by a combination of vertical masonry walls, some with additional toe protection. A short length of rock revetment defended the coastline at the western end of Cobo Bay. Saline Bay is defended by vertical masonry walls and a rock revetment at the northern end, before natural dune defences prevail around Grandes Rocques.

The headland of Le Port Aux Malades is defended by a combination of natural and man-made defences. The man-made defences typically consisting of rock revetments protecting the soft coastal edge. This is the case at Le Grandes Rocques, Port Soif, Portinfer, Baie des Pêqueries and Baie de Pulias. A short length of vertical masonry wall exists within Baie de Port Grat where the coast road is close to coastal edge.

The land from Rousse Tower into Le Grande Havre is generally protected by natural defences, comprising a shingle upper beach against dunes with a sandy foreshore. There is a short length of vertical masonry wall to the south of the Picquerel headland. The foreshore is then defended by intermittent lengths of rock revetment against the soft coastal edge.

The coastal edge of Ladies Bay is protected by natural defences to the south from Amarreurs Harbour. This then changes to a rock revetment with a masonry faced concrete toe towards the kiosk. The northern end of Ladies Bay and Chouet are defended by a combination of shingle/cobble beaches and intermittent rock revetments.

Le Grand Camp is fronted by a rock revetment. Pembroke/L'Ancresse Bay is protected by a concrete anti-tank wall built during the Occupation of the island. The western end of this wall has sheet-piled toe protection. The small bays that exist around the Fort le Marchant headland are usually fronted by shingle/cobble beaches. Fontenelle Bay is protected by a shingle beach and scattered boulders.

b) Coastal Defence Issues

The main concerns relating to the defences along the west coast arise from the general lowering of beach levels. This has resulted in increased overtopping of the defences and the exposure of the foundations to the seawalls.

These problems are currently causing concern at the following locations along the west coast:

- Rocquaine Bay - overtopping of the seawall
- Perelle Bay - overtopping of the seawall and exposure of the foundations
- Vazon Bay - overtopping of the seawall and exposure of the foundations
- Cobo Bay - overtopping of the seawall.

In addition, there are problems arising from the condition of the defences in Pembroke Bay.

3.2.3 Land Use and the Human and Built Environment

Guernsey only became an island following the end of the last ice age and early settlers from the European mainland have been traced back as far as 7,000 BC. Remains from this earliest period are very limited but include the important "long mound" of Les Fouaillages at L'Ancresse, which, dated at about 6,000 years old, is probably the oldest known stone structure in Europe. There is substantial evidence for occupation and settlement during Neolithic times in the form of dolmens and menhirs, which occur over many parts of the island, but in particular along the west coast and L'Ancresse Common in the north. Archaeological evidence for settlement during the Bronze and Iron Ages comes from pottery and structures found at a number of sites, including the L'Erée headland. The history of the past 2,500 years reflects a number of phases of invasion and occupation by various groups of people, including the Gauls in the later stages of the Iron Age and the Vikings towards the end of the first millennium. The Romans used the island as a trading post, and possibly settled parts of the east coast in the vicinity of modern-day St Peter Port. All of these invasions have left their mark on the island, in the form of settlements, boundaries, language, customs and place names.

Allegiance to England came in 1204, when King John lost all his French lands but the Channel Islands elected to stay with England rather than France. As a consequence, there have been repeated attempts by the French to invade the island. Fears of invasion resulted in substantial improvements to the coastal road network and fortification works along the west and north coast, particularly during the Revolutionary and Napoleonic Wars in the 18th and 19th centuries. Many of these forts and towers can be still be seen on prominent headlands and likely landing points, e.g. Fort Saumarez on the L'Erée headland and the pre-Martello Towers at L'Ancresse. During the German occupation in World War II, many of these sites were used and further additional fortifications against attack added, including the large anti-tank walls in Vazon Bay and Pembroke Bay, which today function as coastal defences.

Land use and the character of the coastal landscape of western and northern Guernsey represent the historic and present day influences of man-made and social elements upon the original natural landscape. The coastline of this part of the island can effectively be split into two distinctive character types.

From Fort Pezeries at Pleinmont in the south up to Cobo in the north, the west coast comprises an 8km long sequence of bays and headlands, characterised by extensive intertidal flats and long sandy and shingle beaches. These bays and beaches, particularly Vazon and Cobo Bays, are important recreational areas, for both water-based activities (such as windsurfing) and more traditional beach activities, and form a significant component of the island's attraction for tourists. The bays are backed by "mares", originally lagoons in the low-lying flat land between bays and the escarpment at the mouths of valleys, but these have been separated from the coast by sea defences and the coast road. The headlands between the bays create a serrated exposed land jutting out into the Atlantic Ocean. Each headland is marked by a fortification, either Napoleonic or German or sometimes both. The headlands provide pedestrian access to the inter tidal rocks and beaches, as well as car parks and viewing points, although the car parks have tended to extend further out onto the headlands. With the exception of these car parks and isolated clusters of development, particularly at Richmond, the headlands still retain dramatic, rough, semi-natural and exposed characteristics.

The coast road running the length of the west coast, provides virtually continuous views out to sea and access to the beaches. With the exception of Richmond, development has been restricted to the landward side of the road. Along Rocquaine Bay and part of Vazon Bay, many of the houses are low vernacular fisherman's cottages with granite walls and tamarisk hedges. Further to the north, development becomes denser and more suburban in character. Agricultural and horticultural land use predominates between areas of residential development along the entire coastline. Glasshouses are predominant features of the landscape to the north of Vazon Bay. Originally supplying tomatoes for export, the principal crop is now flowers for the English market. Verges of established dune grassland and a small area of shifting dunes alongside the coast road are all that remain of the once extensive coastal dune ridge that backed the bays.

The headlands and islets around the north coast from Port Soif to Fontenelle Bay tend to be lower and, perhaps, less dramatic than the main west coast headlands. Unlike the western coastline it is backed by lowlands rather than by cliffs or escarpment. In contrast to the densely populated hinterland, the coastline is still generally open and undeveloped. However, many of the rocky promontories have been exploited over the years through quarrying, waste disposal and various recreational activities. A number of these areas are still affected by rutted trackways and coastal defence works, notably rock revetment on the seaward faces of low cliffs, but support important semi-natural habitats.

There are areas of sandy heathland between the headlands. Primarily of dune origin, they are characterised by scattered "hougues" (rocky hillocks) made more prominent by the general lack of trees. Apart from L'Ancresse Common, much of this habitat has been enclosed for agriculture or given over to residential development.

3.2.4 Natural Environment

a) Geology

The islands of Guernsey and Herm, although small in area, have an extensive geological history dating back more than 2,500 million years to some of the oldest rocks found anywhere in Europe. In terms of its geology, and scenery, Guernsey can be broadly split into two areas.

The southern part of the island is formed largely of ancient metamorphic rocks, known as the Icart and Perelle Gneisses. The Icart Gneiss is now generally believed to have originated as an intrusion of granite around 2,000–2,500 million years ago into even older rocks, whose remnants can still be discerned as "rafts" of schist such as the Jerbourg Metasediment. These schists probably originated as silty sediments formed on a sea floor perhaps 2,600 million years (or more) ago. The Perelle Gneiss, which outcrops in the central and south-western parts of the island, also originated as an igneous rock, probably a diorite intrusion. The age of emplacement of the Perelle Gneiss and the date(s) of metamorphism of both the gneiss groups is somewhat uncertain, but perhaps occurred around 1,000 million years ago. These rocks form an elevated plateau, dissected by several steep-sided wooded valleys such as St Peters and Petit Bôt. The plateau is flanked to the east and west by spectacular cliffs. To the west, the descent to sea level is somewhat gentler, an ancient cliff line (now a steep, wooded slope) descends to a series of low-lying "marais" or mares (former coastal lagoons) that form the narrow coastal plain.

The northern part of the island is formed of rather younger igneous rocks such as granite, diorite and gabbro, which are associated with a 200 million year phase of mountain-building some 700–500 million years ago termed the Cadomian Orogeny. The earliest phase of the orogenic activity is represented in Guernsey by the intrusion of the L'Erée Granite dated around 650 million years ago. Following this, the next phase of magma intrusion is represented by the St Peter Port Gabbro, about 500-550 million years ago. The final phase of activity resulted in the emplacement of the Bordeaux Diorite, followed in turn by the Cobo Granite and the L'Ancresse Granodiorite in relatively rapid succession (in geological terms). Also associated with the Cadomian Orogeny are a large number of minor igneous intrusions known as dykes and veins. The Herm Granodiorite, which forms the entire island, is similar in structure and appearance to the Bordeaux Diorite and was probably emplaced during the same period of intrusive activity.

Both Guernsey and Herm, as they are today, have been shaped by a hundreds of millions of years of geological processes, including several submergence and mountain-building phases. However, the modern landscape owes much of its appearance to events over the last 5–10 million years, and particularly the great Ice Ages of the last 2 million years. The 90 and 60m high plateaux on Guernsey and Herm correspond to periods of higher sea level some 5–10 million years ago when the "tops" of the islands were planed off as wave-cut platforms.

The repeated changes in sea level associated with the Quaternary Ice Ages are represented on the island by a series of beach platforms and various sedimentary deposits. Remains of the highest platform, at about 30m above present sea level, are fragmentary but can be seen in places around the "fossil" cliff line above Rocquaine Bay. This platform is considered to have been formed during the Hoxnian Interglacial some 180,000 years ago. The 18m raised beach platform is very clearly seen in Rocquaine Bay where its stretches from Pezeries Point to Fort Grey and inland for about 0.5km. It is backed by the "fossil" cliff line rising up to the 60m Tertiary plateau surface. The age of this beach is thought to be around 150,000 years. The youngest beach platform is the 8m raised beach, which is well exposed around the L'Erée headland. This probably dates from the Ipswichian Interglacial, about 100,000 years ago.

The periglacial conditions that predominated during the last major ice advance (Devensian) led to the formation of large amounts of frost-shattered rock. This material, through a process of repeated freezing and thawing, slumped downslope to infill many small valleys with angular rock fragments, sand and silt, which is now termed "head". This material can be seen in many of the bays forming steep unstable cliffs, such as those at Moulin Huet on the south coast. In addition, a series of windblown sediments (dust and silt) known as Loess were deposited over a large part of the island. These deposits form the basis of the fertile soils in the southern part of the island. Since the retreat of the ice-sheet, sea level rose slowly and the Channel Islands became cut off from Continental Europe. Evidence of lower sea level during this period is provided by the exposure of peat deposits, normally buried beneath beach sands, in some of the west coast bays, such as Vazon Bay. These peat beds contain remains of trees such as birch, oak and alder, and have been dated as being about 5,000 years old. The youngest geological features are the deposits of wind-blown sand found in the north of both Guernsey and Herm.

b) Habitats and Species

The entire western and north coasts, with their numerous small bays, islets and reefs encompasses a diverse range of habitats, which in turn support a variety of different plant and animal species.

The sublittoral and intertidal zones of Guernsey, and in particular of the west coast, contain a wide variety of habitats, communities and species. Of particular interest are the range of hard substratum communities related to wave exposure and shelter, under-boulder communities and communities associated with tide-swept cobbles. Sand or silt biotopes often separate onshore and sublittoral rocky outcrops, and are important both for their rich infaunal communities and for their function as feeding grounds for wintering birds.

The tidal range of Guernsey is one of the largest in the world (over 10m), creating an extensive intertidal zone with a high diversity of macroalgae. Furthermore, the geographical position of Guernsey means that the area is an important transition zone between the Lusitanian (warm temperate) and Boreal (cold temperate) provinces, and many plant and animal species are found at the edges of their range.

The sublittoral and intertidal zones of Guernsey are significant for their flora and fauna at both a European and international level. The intertidal zone of the west coast has been highlighted as being of particular importance, with reference to the following sites Lihou to Le Catioroc, L'Erée to Pezeries, Fort Le Crocq, Vazon Bay, Port Soif to Fort Grat, and Grande Havre. In addition, the whole nearshore subtidal zone is considered to be important for wildlife, particularly the smaller offshore islands and reefs.

The entire coastal strip from Pleinmont round to Fort Doyle is of national importance for wintering ringed plover and, together with the east coast (principally Belle Greve Bay), is internationally important for wintering turnstone. Many other wading birds including dunlin (*Calidris alpina*) and oyster-catchers are present during winter and migration when up to 25 species of wader can be found. The principal feeding areas are centred on Richmond, Rocquaine and Grande Havre. A number of roosting sites have been identified, e.g. Pêqueries, Miellette and Portinfer, and these are as important as the feeding grounds. The offshore islands, such as La Capelle and Lihou, and some of the more secluded headlands, provide safe and undisturbed roosting sites.

Several species of gulls can be found on the beaches and offshore reefs. A resting area at Vazon has had up to 200 great black-backed gulls present. Common terns nest on several of the offshore islets, e.g. Omptolle, and use the bays for feeding. The intertidal zone and inshore waters, especially in the sheltered bays of Vazon, Pembroke, Grande Havre and Perelle to Rocquaine, provide refuge and feeding for several marine species especially divers, grebes and sea-duck.

The vegetation of the western and north coasts reflects, in part, differing substrate conditions, aspect and past management practices. Only limited areas now remain of the original coastal vegetation that fringed the bays and mares, the majority of which is mainly "squeezed" between coastal defences (seaward) and development along the coast road (landward). The headlands support rough grassland and scrub and areas of shorter maritime grassland with specialist species closer to the cliff edges. In relatively undeveloped areas, such as Port Soif and L'Ancresse, larger tracts of semi-natural vegetation remain, the coastal heathland of L'Ancresse being of interest for the flora and bird species that it supports.

Of particular importance are the coastal dune habitats, which include dunes, dune slacks, maritime grassland, beaches and shingle banks. These are probably the most important habitats in Guernsey and support rich and diverse flora and fauna, with over 70 identified priority species. They are also among the most threatened habitats, and have suffered extensive losses to development, recreational pressure and inappropriate management over the past century. In addition, many dune habitats have been artificially stabilised as a result of sea defence construction, resulting in either the loss of habitat owing to the spread of scrub vegetation or the compression of habitat zones into a narrow strip bordering the coastal defences.

The flora of dune areas varies according to the level of stabilisation, proximity to direct saline influence and substrate type. The remnants of the west coast dunes support many species that are considered rare in the UK. Of note are species such as the sand crocus (*Romulea columnae*), which thrives in suitable locations in the north of the island; early sand grass (*Mibora minima*) and sand cat's tail grass (*Phleum arenarium*), both of which are often common in the short turf of fixed dune areas; and dwarf pansy (*Viola kitaibeliana*), which is sometimes quite common on open sandy turf. In addition, these areas often support an interesting and varied invertebrate fauna, including local specialities such as the blue-winged grasshopper (*Oedipoda caerulescens*) and the Jersey bush-cricket (*Platycleis albopunctata jerseyana*).

The importance of some areas for the habitats and species they support is recognised by the States of Guernsey in their designation as Sites of Nature Conservation Importance (SNCIs). On the western and north coasts sites include La Claire Mare, Lihou Island, the headland of Grande Rocques and L'Ancresse Common, among others.

3.2.5 Planning Policies

The west coast is covered by the Rural Area Plan. The Phase 2 Plan covers the coastline from Fort Pezeries to the western side of Vazon Bay, with Phase 1 covering the remainder of Vazon Bay round to Fort Doyle.

Policies from these plans with relevance to coastal defence planning and works are reproduced in Appendix F.

3.3 East Coast, Guernsey

3.3.1 Coastal Processes

Physical Characteristics

a) Bathymetry

The bathymetry of the east coast of Guernsey is characterised by depth contours that lie approximately parallel to the coast. The 10m contour is about 1km offshore. Rocky outcrops, which are exposed at low water, are a feature of the coastline, particularly the northern end. A large sandbank (3,500 × 500m), called The Great Bank, is located about 1km offshore from the southern end of the east coast. It is believed to be composed of shingle.

Little Russel Channel separates the island of Herm from Guernsey's east coast. Herm is approximately 5km from Guernsey (see Section 3.5.1 for details of Herm).

b) Coastline and Beaches

The coastline between Fort Doyle and St Martin's Point is characterised by rocky outcrops, with sand/shingle beaches to the north and cliffs to the south.

The intertidal zone is dominated by rocky outcrops, particularly along the northern half of the east coast. Between Fort Doyle and Bordeaux Harbour there are only limited quantities of mobile sediment overlying the rock platform.

The foreshore of Bordeaux Harbour is predominantly sand with some shingle on the upper beach. The material gradually becomes coarser towards the promontory of Vale Castle. The foreshore of Vale Castle comprises a rock platform and boulders.

Much of the coastline fronting St Sampson is reclaimed land built on quarry waste. The rocky foreshore is still evident at low water. Belle Greve Bay predominantly comprises shingle-sized particles at the top of the beach and rock outcrops on the lower foreshore.

Havelet Bay is composed of a sandy foreshore interspersed with rocky outcrops. The coastline from Havelet Bay to St Martins' Point is dominated by high cliffs. This cliff line is broken by Soldiers Bay and Fermain Bay. Both bays contain sheltered shingle beaches. At low tide a sandy foreshore is exposed in Fermain Bay.

Marine Climate

a) Tidal Conditions

The tidal flows along the east coast are complex. During the early stages of the flood tide, flow rates of up to 2.6m/s occur in a south-westerly direction. Around mid tide, flows reverse to a north-easterly direction and peak at 2.7m/s around high water. Flows reverse again midway through the ebb tide. These flows are in the Little Russel Channel between Guernsey and Herm, to the south of this passage the currents are more moderate.

b) Wave Climate

The easterly aspect of the coast means that it is sheltered from the prevailing westerly winds and waves. In addition, the proximity of Herm and the Normandy coast of France partly shelters the coast from easterly waves. As a consequence, wave conditions are less severe than on the west coast of the island and inshore significant wave heights are typically 2.9 and 4.0m for storms with return periods of 1 and 100 years respectively. These conditions were hindcast using wind data obtained from the Guernsey Meteorological Office.

Sediment Processes

a) Beach Behaviour

Along the northern half of the coast there is only limited evidence of any longshore movement of sediment. For example, in the past when quarry spoil was dumped on the foreshore to the south of Bordeaux Harbour it was found to be "filling up Bordeaux Harbour", indicating northerly longshore drift, possibly influenced by the strong flood tidal currents.

A longshore distribution of sediment occurs within the bays, however, the cross-shore movement of finer sediment during storms is likely to be more significant. Sediment drawn down the beach during storms can be transported away by the strong tidal currents and, thereby, permanently lost.

Along the southern cliffed length of the coastline there is limited sediment at the shoreline and longshore transport rates are low. The small bays are protected from the oblique wave attack and, therefore, are not vulnerable to the longshore movement of sediment. Cross-shore losses are unlikely to be significant because of the coarse nature of the beach material.

3.3.2 Coastal Defences

a) Existing Defences

The east coast of Guernsey is protected by a combination of natural and man-made defences. The following paragraphs provide an outline of the defences throughout the east coast. Further information on the standard and condition of these defences may be found in Section 6 and Appendix A.

The coastline from Fort Doyle to Bordeaux Harbour is protected by natural defences with the exception of a length of rock revetment protecting reclaimed land immediately to the north of the harbour. Bordeaux Harbour is protected by a rock revetment against the soft coastal edge around the northern half, which protects the minor road behind. There is then a short length of unprotected dunes followed by a vertical masonry wall protecting the coast road.

La Banque Imbert is fronted by a shingle/cobble beach leading towards the promontory of Vale Castle, which is protected by a vertical masonry wall. There is a short length of rock revetment protecting the soft coastal edge between St Sampson Harbour and Vale Castle. The whole of St Sampson Harbour is edged by vertical masonry walls, including the breakwaters. The land to the south of the harbour as far south as Spur Point is reclaimed. The reclamation edge is protected by a large rock revetment. Further reclamation is underway immediately to the south of the harbour where large rock breakwater bund has been constructed. The reclamation is referred to as Longue Hougue.

The promontory of Spur Point is defended by a combination of natural defences and rock dumped on the foreshore. Belle Greve Bay is protected by a vertical masonry wall to Halfway. Between Halfway and just north of Le Grande Bouet roundabout, there are no man-made defences, and a shingle ridge fronts the foreshore. The remainder of Belle Greve Bay is defended by a combination of vertical masonry walls, some with sheet piled toe protection.

St Peter Port Harbour is protected by vertical masonry walls. The main (northern) breakwater arm is also protected by a rock revetment. Havelet Bay is protected by a vertical masonry wall. The coastline is then generally unprotected, being dominated by high cliffs with the exception of Soldiers Bay, which is fronted by a shingle beach and Fermain Bay which is protected by a vertical masonry wall.

b) Coastal Defence Issues

Away from the ports, the man-made defences on the east coast of Guernsey generally maintain the continuity of the coast road. Rubble has been placed on some of the headlands to reduce the erosion of the soft deposits. Rock revetments protect the reclaimed land in St Sampson from erosion. The breakwaters in St Sampson and St Peter Port act to reduce wave action within the harbours and thus reduce flooding.

The defences are currently causing concern at the following locations along the east coast:

- Belle Greve Bay - overtopping of the seawall and damage to the sheet-pile protection
- St Peter Port - overtopping of the quay wall within Victoria Marina.

3.3.3 Land Use and Human and Built Environment

The east coast of Guernsey can essentially be split into two basic characteristic areas, with the built-up area of St Peter Port straddling the transition between them. From Fort Doyle in the north east to St Peter Port Harbour, the coast forms part of the lowland plateau that makes up most of northern Guernsey. In the north east of this area, from Fort Doyle to St Sampson, land use is dominated by former quarry workings and horticulture, with smaller areas in residential or general agricultural use. The shoreline is predominantly rock and shingle, with the beaches comprising large amounts of dumped quarry spoil.

The underlying character of the natural landscape changes slightly from St Sampson southwards. However, this central part of the east coast is dominated by the residential development and harbour of St. Peter Port and the smaller commercial and industrial area centred around St Sampson further to the north. A large reclamation scheme on the southern side of St Sampson Harbour forms a prominent feature along this section of the coast. Throughout this urbanised area the coast road runs adjacent to the shoreline and is backed by residential or commercial development, particularly within the wide sweep of Belle Greve Bay.

The coastal frontage of St Peter Port is dominated by the piers, jetties and marinas of the Harbour. Originally the main commercial harbour for the island and a centre for shipbuilding, the old docks and harbour areas were converted into marinas in the 1970s and 1980s. The coastline in the vicinity of St Peter Port has provided sheltered anchorage since at least Roman times, as shown by the discovery of a Roman shipwreck and evidence of settlement in and around the harbour. The southern side of the harbour is dominated by the islet of Cornet, upon which stands the imposing Castle Cornet.

The landscape changes noticeably from the southern side of St Peter Port, as lowland northern Guernsey gives way to the higher ground that forms the central and southern upland plateau. The seaward edge of this plateau, from St Peter Port to Fermain Bay, comprises steep wooded cliffs rising to a height of about 75m, with residential development along the cliff top. As exposure increases southwards to St Martin's Point the coastline takes on a more rugged character, which is reflected in a change from wooded to scrub and grassland covered cliff faces. The cliff footpath along this section of coast is well used. The small, sheltered shingle beaches of Fermain Bay and Soldiers Bay are popular locations for swimming and general beach activity.

As with a large part of the Guernsey coastline, former defence points and fortifications against attack are much in evidence. Prominent in the north east is the Napoleonic Fort Doyle, while further to the south at Bordeaux, is Vale Castle, a former Iron Age hill fort that provided defence against coastal attack up to the end of World War II. Other important sites include Fort George and its associated batteries opposite Soldiers Bay and the pre-Martello Tower in Fermain Bay.

3.3.4 Natural Environment

a) Geology

The geology of the east coast essentially comprises three main rock formations. The Bordeaux Diorite Complex outcrops in the north east as far as the southern side of Bordeaux Harbour. The central part of the coast around Belle Greve Bay is formed in the St Peter Port Gabbro, although natural exposure is largely limited to the foreshore. Apart from the Jerbourg Metasediment, which forms the southern end of the Jerbourg Peninsula, the steep and vegetated cliffs of the south east are formed in the Icart Gneiss Group. As with the rest of the island, deposits of glacial head and loess commonly overlie the main rock platform and in the south east cover cliff faces and infill small valleys and gullies. The 8m wave-cut platform is prominent along the cliffed south eastern section of the coast. (An overview of the geology of the islands is included in Section 3.2.4 *a)*.)

b) Habitats and Species

The habitats, flora and fauna in this part of Guernsey clearly reflect the more sheltered conditions prevalent along the east coast and vary from north to south in response to changes in topography and human activity. The far north east around Fort Doyle, with its heathland and scrub, is a continuation of the northern part of L'Ancresse Common. The low cliffed coastline and shoreline are generally rocky with smaller areas of intertidal sand and silt. Much of the foreshore comprises dumped quarry spoil. Owing to the development of St Sampson Harbour, and the reclamation works to the south, ecological interests are limited in this area.

The large tidal range within Belle Greve Bay creates a wide variety of habitats for many species. The numerous low-lying rocks and reefs are used by roosting gulls and waders. Over 100 turnstones may be present in early winter. This is over 10% of the total population wintering on the island. The areas of mud and sand are used as feeding grounds for ringed plover, oyster-catchers and grey plover. The sheltered bay also provides a suitable habitat during the winter for grebes, divers and sea-duck.

The east coast cliffs running from St Peter Port to the Jerbourg Peninsular are essentially a continuation of the steep and rugged cliffs of the south coast. However, the vegetation changes in response to the more sheltered easterly aspect. The cliffs and steep slopes are well wooded with holm oak, ash (*Fraxinus excelsior*), elm and sycamore (*Acer pseudoplatanus*). Towards the southern end of this length, where there is more exposure, scrub and maritime grassland tend to dominate.

3.3.5 Planning Policies

The east coast is covered by all three of the Area Plans. The Urban Area Plan effectively covers St Peter Port and St Sampson Harbour. The Rural Area Plan covers the remainder of the coast, with Phase 2 including the section from Fermain Bay to St Martin's Point and Phase 1 from Bordeaux Harbour to Fort Doyle.

Policies from these plans with relevance to coastal defence planning and works are reproduced in Appendix F.

3.4 South Coast, Guernsey

3.4.1 Coastal Processes

Physical Characteristics

a) Bathymetry

The depth contours run approximately parallel to the south coast. The 50m contour is approximately 1.5km offshore making this length of coast the most steeply shelving of the three lengths around Guernsey. Rocky outcrops are present and are exposed at low water.

b) Coastline and Beaches

The south coast of Guernsey is dominated by 100m high cliffs, broken by occasional small sandy bays. These bays occur to the east of Le Gouffre and are characterised by an upper beach of shingle and foreshore of sand. To the west of Le Gouffre the coastline is an unbroken line of cliffs with very limited sediment along the base. Throughout the coast the upper sections of cliff are prone to slippage.

Marine Climate

a) Tidal Conditions

As with the west and east coasts, tidal flows are complex. During the early stages of the flood tide, weak flows occur in an easterly direction along the coastline. The flows remain in this direction throughout the flood increasing in strength up to 1.5m/s. Slack water occurs for 1–2 hours after high water and flows up to 1m/s then occur in a westerly direction.

These complex flows are, for part of the tidal cycle, in the opposite direction to the main tidal flows past the island. This is caused by the separation of flows around the island and the complex patterns that occur in the sea between the Channel Islands and the French coast.

b) Wave Climate

The southerly aspect of the coastline means it is protected from the prevailing westerly winds and waves. The coastline, however, is exposed to waves generated over 75km fetch across to the Brittany coast of France. This combined with the steeply shelving seabed, means the coastline is exposed to wave attack.

Sediment Processes

a) Beach Behaviour

Along the eastern half of the south coast several small bays have formed at the base of the cliffs owing to weaknesses within the cliffs. These beaches are situated between rocky headlands that provide shelter, making the beaches relatively stable. The beaches are characterised by an upper foreshore of shingle and a lower foreshore of sand.

There is potential for the longshore movement of sediment within the small bays. However, the headlands protect the bays from oblique wave attack and sediment is not moved along the bays. Cross-shore movements are likely to take place during storms with sand drawn down the beach. Once drawn down the beach, the sand is vulnerable to transport by tidal currents. However, the headlands of Jerbourg Point and Icart Point deflect these tidal currents away from the shoreline and the drawn down sand remains available for beach rebuilding once the storm has passed.

Elsewhere along the south coast, there is little sediment present at the shoreline and longshore transport rates are negligible.

3.4.2 Coastal Defences

a) Existing Defences

The majority of the south coast is undefended. There are short sections of masonry walls within the bays at the eastern end of the coast that protect the base of the cliffs from erosion. Further information on the standard and condition of these defences may be found in Section 6 and Appendix A.

b) Coastal Defence Issues

The cliffs along the south coast are subject to wave action and are thus undergoing gradual erosion. The short lengths of masonry wall present in the bays protect the base of the cliff from erosion and prevent undercutting and rock falls. The rates of cliff loss are considered to be low and therefore erosion is not an issue along the south coast.

The high levels of the land along the south coast mean that flooding is not an issue.

3.4.3 Land Use and Human and Built Environment

The south coast is the wildest and most dramatic part of Guernsey. The rugged, 100m high sheer cliffs drop from the upland plateau into the sea, cut by occasional short steep valleys and backed by largely undeveloped agricultural land. The combination of these features creates a dramatic open landscape, which contrasts with the intimate enclosure of the island's interior. Between the bare lower cliff face and the cultivated land, the main slope is covered by rough vegetation (grassland and scrub).

The eastern section of the south coast contains a number of small bays with sandy beaches. These sites are important recreational sites, particularly for beach activities, swimming and shore angling. With road access to the shore, Moulin Huet Bay, Saint's Bay and Petit Bôt Bay are the most popular destinations. A well-used coastal footpath runs along the entire length of the southern cliffs, walking being one of the most popular recreational activities on the island. The path provides access to the shoreline and stunning views, such as that afforded of the offshore rocks known as The Pea Stacks (Les Tas de Pois d'Amont), are an important landscape element at the southern tip of Jerbourg Point. The dramatic cliffed coastline from Le Gouffre to Pezeries Point lacks the small sheltered embayments that are found to the south east. However, the area with its superb coastal scenery, wildlife and historic fortifications is still well visited, particularly by walkers. Minor roads and tracks from the main coastal road provide access to small cliff-top car parks at several locations.

Fortifications from several periods are prominent along the south coast. During the Iron Age, the Jerbourg peninsula was converted into a promontory fort, while the remains of a Roman bank and ditch system have been recorded on the cliffs at Havre de Bon Repos. This site has further fortifications dating from the medieval period (Château de Corbière), from the Napoleonic Wars and World War II. Other structures include pre-Martello Towers in Saint's Bay and Petit Bôt Bay and Napoleonic watch towers at Mont Hérault and at Pleinmont. German fortifications are particularly prominent along the south-west coast and include the impressive direction-finding tower at L'Angle.

3.4.4 Natural Environment

a) Geology

The south coast is largely formed in the Icart Gneiss Group. There are small exposures of the Jerbourg Metasediment and Perelle Gneiss Group on the Jerbourg peninsula, and the Pleinmont peninsula provides exposure through small outcrops of the intrusive L'Erée Granite–Perelle Gneiss Group, and the Pleinmont Metasediment. The steep cliffs of the south coast are in places formed in, or covered by, head material, which is prone to slippage. Both the 18 and 8m raised beach platforms can be seen around the coast, particularly in Moulin Huet Bay and at Pleinmont. (An overview of the geology of the islands is included in Section 3.2.4 *a)*.)

b) Habitats and Species

From an ecological perspective, the southern cliffs probably represent the most natural and unspoilt part of the island. In places they support an interesting flora and provide ideal habitat conditions for a number of bird species found nowhere else on the island.

The dominant vegetation is maritime grassland with scrub. Small pockets of mature deciduous and coniferous woodland occupies some of the small cliff top valleys. The flora of the southern cliffs is diverse and includes a number of notable species found rarely elsewhere on the UK mainland. The cliffs provide suitable breeding habitat for a number of seabirds including fulmar, shag and great black-backed gull, while the heathland along the cliff tops supports the rare Dartford warbler (*Sylvia undata aremorica*).

3.4.5 Planning Policies

The south coast is covered by the Rural Area Plan (Phase 2).

Policies from this plan with relevance to coastal defence planning and works are reproduced in Appendix F.

3.5 Herm

3.5.1 Coastal Processes

Physical Characteristics

a) Bathymetry

The bathymetry off the coast of Herm is complex. To the west, the 10m seabed depth contour lies about 2km offshore. Little Russel Channel separates Herm from Guernsey. To the north the 10m contour lies approximately 1km offshore. Rocky outcrops, which are exposed as small islands, are a feature of the west and north coasts of Herm.

The 10m depth contour moves towards the coastline on the east and south coasts of Herm, becoming roughly 200m offshore on the south coast. This is similar to the south coast of Guernsey. The island of Jethou is about 800m off the south coast of Herm. Big Russel Channel lies between Herm and the island of Sark to the east.

c) Coastline and Beaches

Herm is similar in character to Guernsey, with high cliffs forming the main feature of the southern half of the island and sandy beaches with dunes prominent around the northern half. There are approximately 3.3km of cliffs and 2.8km of sand/shingle beaches (in some areas these features overlap).

The northern half of the island comprises Fisherman's Beach and Bear's Beach on the west coast, which are backed by cliffs; the long expanse of Mouisonniere Beach along the north coast; and Shell Beach on the east coast. All the beaches are sandy, with large shell deposits being found along Shell Beach.

The southern half of the island is cliffed with the exception of a small and steep sandy beach (Belvoir Bay) on the east coast. A small sandy beach has also developed to the south of Herm Harbour breakwater.

Marine Climate

a) Tidal Conditions

Tidal flows around Herm are complex. During the early stages of the flood, flow rates of up to 2.5m/s occur in a south-westerly direction through the Little Russel and Big Russel Channels. Around mid tide, the flows reverse to a north-easterly direction and peak at 2.5m/s around high water. Flows reverse again midway through the ebb tide.

b) Wave Conditions

The exposure of the coastline to wave attack varies considerably. The west coast is sheltered from the prevailing westerly waves because of the close proximity of Guernsey. The east and south coasts are more exposed but, nevertheless, are sheltered by the presence of Sark and the French coastline. In contrast, the exposed north coast is subject to attack from storm waves generated in the English Channel.

Sediment Processes

a) Beach Behaviour

The rocky nature of the southern half of Herm means that there is very limited movement of sediment at the shoreline. The headlands either side of Belvoir Bay effectively trap the sandy beach within the bay. The beach, however, is susceptible to cross-shore losses during easterly storms. Erosion of the soft upper cliffs is evident at a number of locations, in particular, along the west coast between the Rosière Steps and Herm Harbour.

The mobility of the beaches around the northern half of Herm is dictated by their degree of exposure to storm waves. As consequence, the beaches on the west and east coasts are relatively stable with no evidence of the erosion of the dunes or soft cliffs. In comparison, Mouisonniere Beach on the exposed north coast is subject to erosion resulting in the gradual retreat of the dune system.

3.5.2 Coastal Defences

a) Existing Defences

The island is largely undefended. Further information on the standard and condition of these defences may be found in Section 6 and Appendix A.

On the west coast, a short length of masonry wall exists immediately to the north of Herm Harbour and rock protection has been placed against the eroding cliff face between the harbour and the Rosière Steps. On the east coast, a short length of rock protection has been constructed within Belvoir Bay to protect the café and access to the beach.

b) Coastal Defence Issues

The main concerns over the defences on Herm arise from the continuing erosion of the soft cliff between Herm Harbour and the Rosière Steps. The rock protection has not stopped the erosion of the cliff, which may, in part, be a result of weathering. Further erosion of the cliff could threaten an access track running between the steps and the harbour.

3.5.3 Land Use and Human and Built Environment

Herm is largely undeveloped, apart from the area in the immediate vicinity of the harbour, comprising the White House Hotel and associated buildings. Herm Harbour, originally more extensive than today, was constructed to serve the quarries that can still be seen along the island's west coast. Quarrying began in 1815 and by the middle of the 19th century, employed around 400 people. The largest of these quarries, just to the north of the Rosière Steps, is now used as the island's rubbish/landfill site.

The interior of the island comprises farmland (semi-improved pasture) but in general semi-natural vegetation dominates around the coastline, particularly on Herm Common and the rugged cliffs of the south coast. Tourism represents the main economic activity on the island, with the majority of people staying or visiting for the tranquillity, the sandy beaches of the north of the island, and the coastal scenery. Walking the cliff-top footpath is perhaps the most popular recreational activity within the southern part of the island.

There are the remains of at least a dozen cists or graves on the higher parts of Herm and several more on Herm Common, with some menhirs and a stone circle. Herm was thought at one time to have been used by ancient peoples, as a burial place, but evidence for occupation is provided by the number of worked flints that have been found there. From a much later period, there are the remains of an early 11th century Augustinian Priory.

3.5.4 Natural Environment

a) Geology

The island of Herm is entirely composed of granodiorite, a coarse-grained grey igneous rock, similar to the paler varieties of Guernsey's Bordeaux Diorite. Head deposits, laid down during the last glacial cycle, are prominent overlying the cliffs from the Rosière Steps into Fisherman's Beach. The dunes at the northern end of Herm are made up largely of blown shell sand deposited on top of the remains of a large "fossil" wave-cut platform, which extends to the north of the island as a series of reefs. (An overview of the geology of the islands is included in Section 3.2.4 *a)*.)

b) Habitats and Species

The blown sand forming the northern third of the island supports a diverse dune flora and fauna, including many of the species found on the west coast of Guernsey. The shoreline supports a number of characteristic species, including the rare sea dock. Dune stabilisation measures, including the emplacement of mesh fencing, have been undertaken along the northern section (Mouisonniere Beach) of Herm Common to reduce the rate of erosion along this frontage.

The cliffs in the south of Herm are primarily of importance for the small breeding population of puffin that they support. In addition, there are small populations of fulmar, shag, lesser black-backed gulls (*Larus fuscus*) and great black-backed gulls. Much of the coastal slope above the bare cliff faces is carpeted by bracken (*Pteridium aquilinum*) with some areas, mainly right at the cliff edge, supporting a typical maritime flora. The slightly acidic soils enable plants such as foxglove (*Digitalis purpurea*) to flourish in certain areas. The rare dwarf rush has been recorded in the past.

The intertidal and subtidal areas around the island support a diverse and rich marine flora and fauna. Many of the recorded species are at either the northern or southern limits of their ranges, giving an interesting mix of two biotopes. In addition, the intertidal zones of the north and north-west coasts, together with agricultural pasture land, supports a wintering population of about 100 dark-bellied Brent geese.

3.5.5 Planning Policies

Herm is owned by the States of Guernsey, but has been leased to the Wood family since 1949. It is the present owner's responsibility to manage the various interests of the island.

3.6 Sea Level Rise

Relative sea level rise, the change in sea level with respect to the land, is caused by changes in the level of the land and absolute changes in the level of the oceans. It is the combined effect of local crustal movement owing to post-glacial recovery and changes in global sea levels owing to global warming.

The Inter-governmental Panel on Climate Change has produced various reports documenting their findings on the rate of mean sea level rise owing to global warming. The annual rise has been estimated at a rate of 1–2mm throughout the last century; however, no reliable predictions are available for future changes. Superimposed on this change is the local crustal movement. Within the UK, the removal of the weight of ice after the last glacial period is causing Scotland to rise and southern England to sink. However, the south west of England is known to be rising.

Although no physical data have been collected for Guernsey, it is expected that the relative rise in sea level will be similar to that predicted for the south-west coast of England, which is 1–2 mm/year. An annual rise of 2mm, which equates to relative sea level rise of 0.1m over 50 years, has been adopted for the strategy.

This change will lead to larger waves attacking the coastal defences around Guernsey. However, there is unlikely to be a significant increase in the exposure of the defences, as the incremental change in water depths is small in relation to the tidal range. Possibly of more significance, is the potential increase in longshore and cross-shore sediment movements brought about by increased wave heights. A further consequence of sea level rise is the likely increase in the incidence of overtopping within sheltered areas (e.g. harbours) during surge tides.

SECTION 4

COASTAL UNITS

4.1 General

Although the coastlines of Guernsey and Herm measure only 66 and 6km respectively, they provide spectacular and diverse changes in scenery. This is evident from the coastal overview provided in Section 3 and summarised in the following list.

- **West Coast, Guernsey** – the west coast comprises a series of wide sweeping bays located between low rocky headlands.
- **East Coast, Guernsey** – the east coast comprises the wide expanse of Belle Greve Bay and, to the north and south, a more rugged and cliffed coastline.
- **South Coast, Guernsey** – the south coast comprises high cliffs, which include a series of small bays over its eastern half.
- **Herm** – the southern half of the island comprises a rugged and cliffed coastline, whereas the northern coastline is characterised by wide sandy beaches.

The above paragraphs illustrate the diverse nature of the coastlines. This diversity means that it is impracticable to deal with the islands as a single entity and it is, therefore, appropriate to divide the coastlines into a number of so-called "coastal units".

4.2 Derivation of Units

For the purposes of the study, the coastlines of Guernsey and Herm have been divided into a series of units within which the sediment processes are coherent. The phrase "sediment processes" is taken to include the following characteristics: coastal geomorphology, longshore transport of sediment, and sediment sources and sinks. This results in two broad types of sediment process unit, i.e. bays and cliffs. For example, Perelle Bay on the west coast is dealt with as a single unit as the sediment processes throughout the bay are coherent and there is a limited exchange of sediment between the bay and the coastline on either side.

A secondary consideration in establishing the extent of the coastal units has been the land use within the immediate hinterland. This has resulted in some of the headlands between bays being identified as separate units as they are largely undeveloped, i.e. rural. In contrast, the hinterland of the west-coast bays is generally developed, i.e. used for residential, commercial or industrial purposes.

The above approach has resulted in a total of 25 coastal units, including two on the island of Herm. Coastal Unit 1 is located on the south west corner of Guernsey (on the west coast) and extends from Pezeries Point to the Imperial Hotel. The units have then been numbered in a clockwise direction around the island. Coastal Units 24 and 25 cover the southern and northern coastline of the island of Herm respectively.

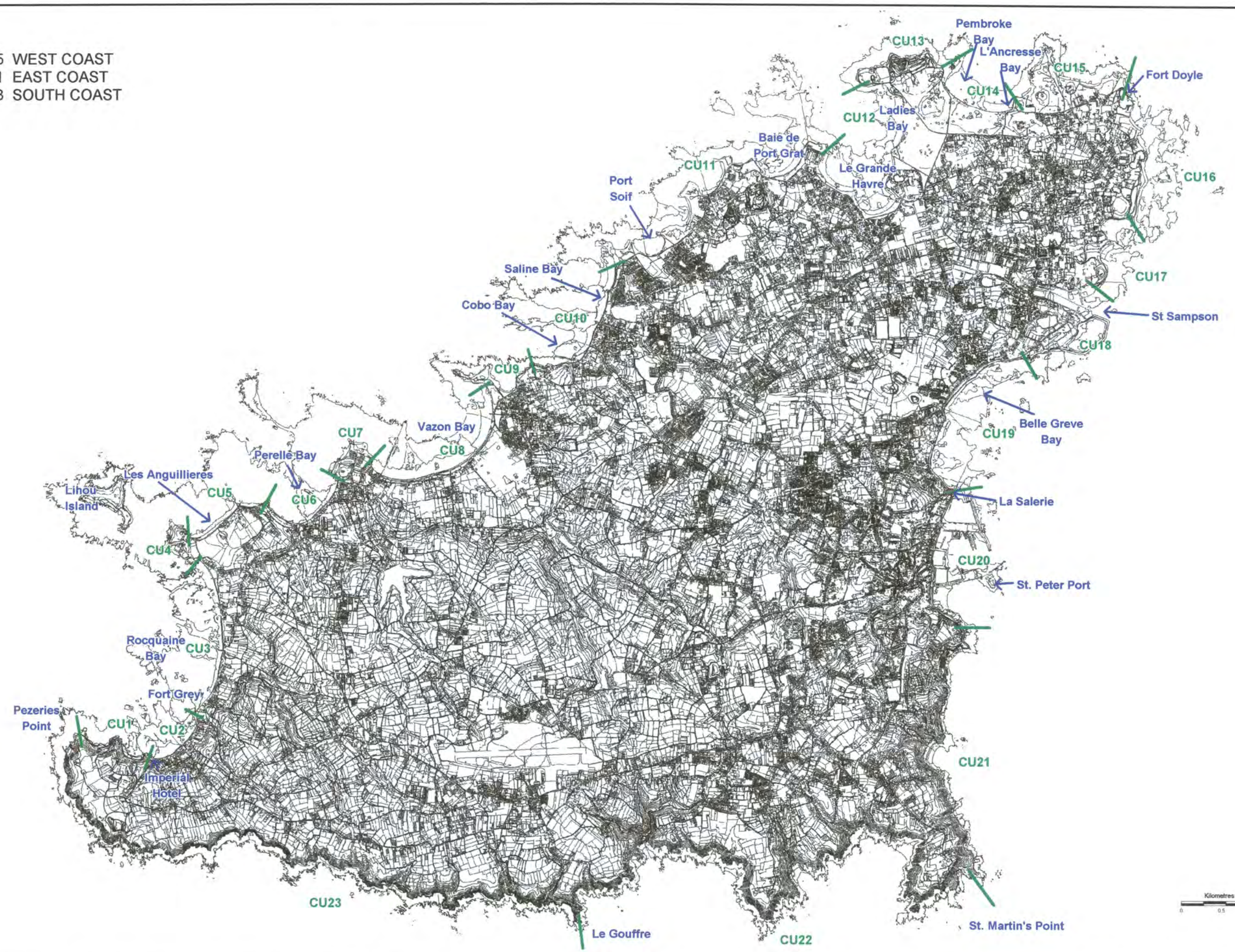
The units are described in Table 4.1, and are illustrated in Figures 4.1 and 4.2 at the end of this section. The table also identifies the approximate length of each unit, the places or features that mark the boundaries of each unit, any significant features (i.e. towns, bays, etc.) within the unit and the reasoning behind the selection of the boundary positions.

Table 4.1 Categorisation of Coastal Units

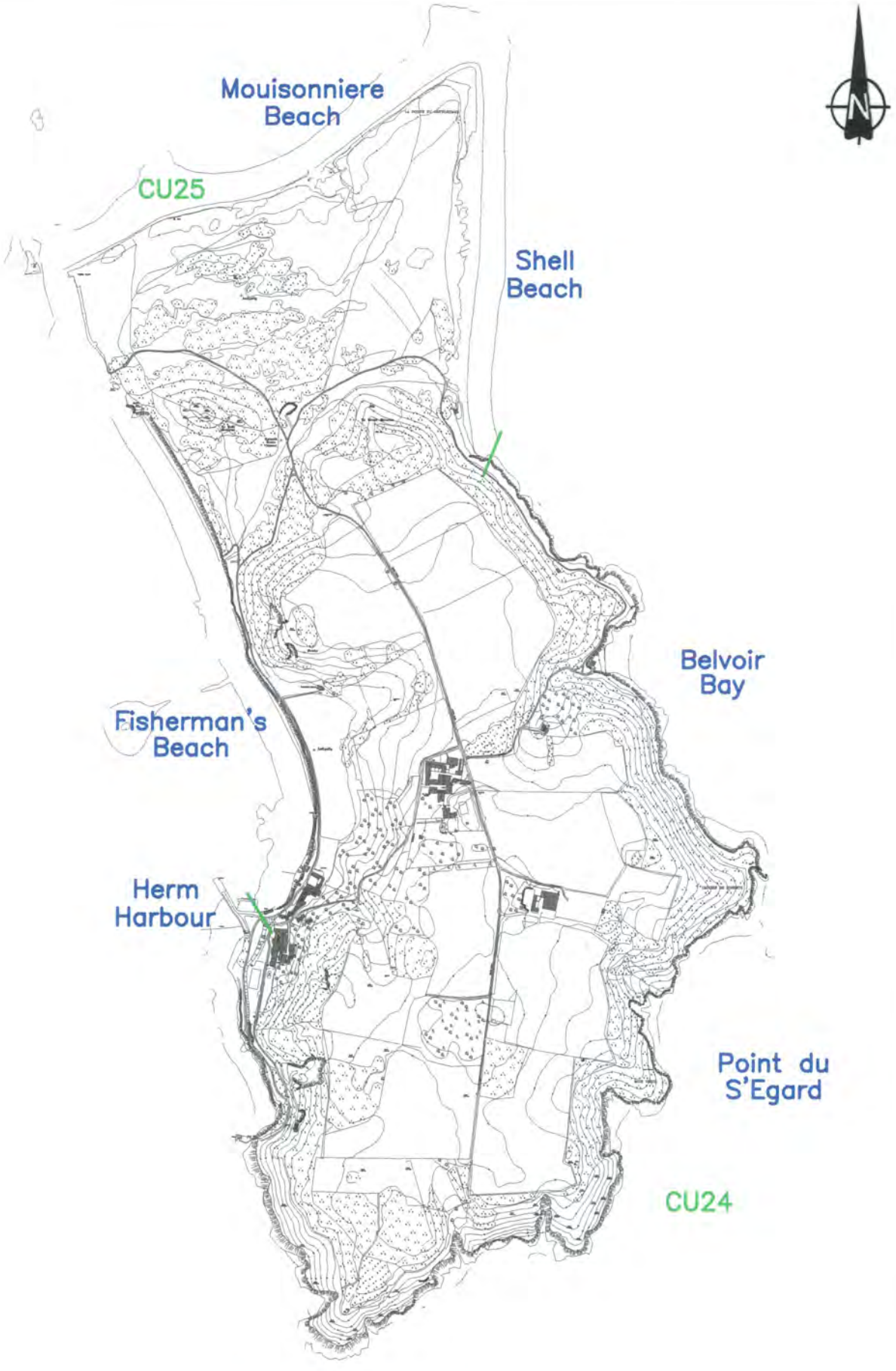
Coastal Unit	Length (m)	Location	Key Features within the Unit	Type of Unit	
				Process	Land Use
1	1,800	Pezeries Point to Imperial Hotel		Cliff	Undeveloped
2	800	Imperial Hotel to Fort Grey	Rocquaine Bay	Bay	Developed
3	1,900	Port Grey to L'Erée Headland	Rocquaine Bay	Bay	Developed
4	1,500	L'Erée Headland and Lihou Island	Lihou Island	Cliff and Island	Undeveloped
5	1,000	Fort Saumarez to Le Catioroc		Bay	Undeveloped
6	1,200	Le Catioroc to Fort Richmond	Perelle Bay	Bay	Undeveloped
7	1,600	Fort Richmond to Fort le Crocq		Cliff	Undeveloped
8	2,300	Fort le Crocq to Fort Hommet	Vazon Bay	Bay	Developed
9	2,300	Fort Hommet to Le Guet	Albecq	Cliff	Developed
10	1,900	Le Guet to Grandes Rocques	Cobo Bay and Saline Bay	Bay	Developed
11	6,500	Grandes Rocques to Rousse	Port Soif and Portinfer	Cliff and Bay	Developed
12	3,500	Rousse to Chouet	Le Grande Havre and Ladies Bay	Bay	Developed
13	2,200	Chouet to Fort Pembroke		Cliff	Undeveloped
14	1,400	Fort Pembroke to L'Ancresse	Pembroke Bay and L'Ancresse Bay	Bay	Undeveloped
15	2,800	L'Ancresse to Fort Doyle	Fontenelle Bay and L'Ancresse Bay	Cliff and Bay	Undeveloped
16	2,100	Fort Doyle to Bordeaux		Cliff	Undeveloped
17	1,400	Bordeaux to Vale Castle	Bordeaux Harbour	Cliff and Bay	Developed
18	1,800	Vale Castle to Spur Point	St Sampson		Developed
19	2,400	Spur Point to La Salerie	Belle Greve Bay	Bay	Developed
20	1,900	La Salerie to La Vallette	St Peter Port	Bay	Developed
21	5,200	La Vallette to St Martin's Point	Soldiers Bay and Fermain Bay	Cliff and Bay	Undeveloped
22	1 0,000	St Martin's Point to Le Gouffre	Moulin Huet Bay, Saint's Bay and Petit Bôt Bay	Cliff	Undeveloped
23	8,500	Le Gouffre to Pezeries Point		Cliff	Undeveloped
24	3,300	Herm (South)	Belvoir Bay	Cliff	Undeveloped
25	2,700	Herm (North)	Herm Harbour	Bay	Undeveloped

KEY:

CU1 - CU15 WEST COAST
CU16 - CU21 EAST COAST
CU22 - CU23 SOUTH COAST



PROJECT: GUERNSEY STRATEGY FOR COASTAL DEFENCE AND BEACH MANAGEMENT	TITLE: COASTAL UNITS - GUERNSEY	CONSULTING ENGINEERS POSFORD DUVIVIER	Job No. E3309	DATE February 1999	
			ACAD Ref.	CHECKED JC	PASSED
			DRAWN JLH	FIGURE 4.1	REV



PROJECT: GUERNSEY STRATEGY FOR COASTAL DEFENCE AND BEACH MANAGEMENT	TITLE: COASTAL UNITS – Herm	CONSULTING ENGINEERS: POSFORD DUVIVIER	DRAWN MDWP / SCALE 1:10,000
			DATE FEB'99 / CHKD JEC
			DRG No. FIGURE 4.2

SECTION 5

INTRODUCTION TO OPTION APPRAISAL

5.1 Introduction

The early stages of the study have developed a broad understanding of the coastal processes, human and built environment and natural environment around the island (Section 3). Using this knowledge, the coastline has been divided into 25 coastal units (Section 4) and these lengths have been used as the framework for the appraisal and selection of options for coastal defence and beach management around the island (Section 6).

The purpose of this section is to provide the background to the appraisal process that is actually applied in Section 6. The section has been set out as follows:

Section 5.2 – Definition of Coastal Defence Strategy Option – provides a definition of the two strategic options considered within the study.

Section 5.3 – Discussion of Coastal Defence Scheme Options – discusses a range of possible schemes that could be used to sustain or improve the coastal defences around the islands. It concludes with a "shopping list" of schemes that are technically viable for use around the islands.

Section 5.4 – Appraisal Procedure – sets out in detail the appraisal procedure used in Section 6.

Section 5.5 – Layout of Section 6 – Appraisal of Options – explains the layout of Section 6.

5.2 Definition of Coastal Defence Strategy Options

At a strategic level, there are two fundamental options available for the management of the coastal defences and beaches of the islands. These are to either **Do Nothing** or **Do Something**.

The option to **Do Nothing** within a particular coastal unit would involve no coastal defence activity apart from monitoring/inspection and any works needed for safety reasons (e.g. these may not be coastal defence works). It might, for example, involve leaving the natural coastline undefended or the abandonment of defences along a length where structures have previously been constructed.

The adoption of **Do Something** would involve, by intervention, the provision of coastal defences within a coastal unit. The term "intervention" implies a commitment to provide a level of protection to the assets behind the coastal unit from flooding and coastal erosion. It does not imply the wholesale construction of new defences throughout the coastal unit. Intervention could involve a range of options from simply maintaining the existing defences through to substantial improvements to existing defences and, possibly, the construction of new lengths of defence.

5.3 Discussion of Coastal Defence Scheme Options

5.3.1 Introduction

In general, coastal defence schemes are built either to prevent erosion of the coastline or to limit the risk of flooding to low-lying land (or both). As part of the study, existing defences around the island have been categorised as either **flood defences** or **erosion defences**. The results of this classification are shown on Figures 6.1 to 6.25 at the end of Section 6.

It is apparent from the inspection of the coastline that the majority of assets are already protected by defences largely built over the last 100 years. As a consequence, new coastal defence schemes are more likely to deal with problems within existing defences rather than constructing new defences on a previously undefended length of coastline. The range of problems likely to be encountered is discussed in Section 5.3.2.

Section 5.3.3 is directed at schemes that address problems with the existing defences and discusses the various technical methods available. If, during the appraisal, the need for new defences along an undefended length of coast is identified, then possible technical methods will be discussed within the particular unit.

5.3.2 Definition of Problems

Problems with the existing defences broadly fall into three categories, these are:

- excessive overtopping
- undermining of the toe of the structure
- structural failure of the defence.

All three mechanisms can lead to the collapse of the defences and erosion and/or flooding.

Overtopping can cause inundation, resulting from the excessive quantity of seawater passing over the crest of the wall. In the extreme case of overtopping, the washout of material from the landward side of the structure can lead to a collapse of the rear face and loss of the defence.

The movement of the sand or shingle beach fronting the defence can lead to the exposure of the underlying clay or peat layers. Once exposed, these layers are vulnerable to erosion by wave action and tidal currents. This loss of the clay or peat layer is permanent and can lead to the failure of the defences as the toe is undermined. In contrast, a mobile beach can rebuild.

The third problem, or failure mechanism, is the general deterioration of the defence ,which in time would lead to the collapse of the structure.

In order to establish the magnitude of a problem within a particular coastal unit, the standard of defence and the residual life of each length of coastal defences have been determined.

The standard of defence relates to the quantity of overtopping that can occur and the risks to the coast road, property and, ultimately, people. The existing defences have been graded as follows:

- **Low Standard** - Overtopping causes operational problems every year (e.g. closure of the coast road) and there is a risk of washout from the rear of the defences.
- **Medium Standard** - Overtopping causes operational problems every year.
- **High Standard** - Overtopping causes no, or very limited, operational problems.

The residual life relates to both the condition of the defences and the time before failure would occur if no maintenance or repairs were undertaken. As part of the inspection of the defences, the residual life has been categorised in the following bands: 0–10 years, 10–25 years, and greater than 25 years.

Estimated values for the standards of defence and the residual lives of the defences are given in Section 6 and Appendix A.

5.3.3 Possible Defence Methods

The coastal engineer has several methods available to provide coastal defence. Such methods can be used to provide either new defences or reconstruct and refurbish existing defences. Some of the methods available are discussed below and those appropriate to the islands are highlighted. In addition, the discussion assesses the merits of the various methods in terms of their ability to address the three failure mechanisms identified in the previous section.

Continue Existing Practice

Continue existing practice is, effectively, the continued maintenance of the masonry and concrete seawalls and the rock structures.

Continuing the existing practice might address the problem of structural failure but will not necessarily reduce overtopping or prevent undermining of the toe of the defence.

Toe Protection

Toe protection would involve strengthening the toe of the defence to prevent undermining of the structure. This could be achieved using the following methods: a masonry apron, a rock revetment or steel-sheet piling.

Toe protection would address the problem of toe undermining but not overtopping or structural failure of the defence.

Structure Protection

Structure protection would involve works to protect the "body" of the defence. This could involve the construction of a large rock revetment to reduce the level of wave loading on the existing structure. Alternatively, an existing wall could be strengthened by refacing the wall.

Structure protection would address the problem of structural failure and, if a rock revetment were adopted, also overtopping and toe undermining. In contrast, refacing would only address the problem of structure failure.

Crest Protection

Crest protection would involve works to the crest of the defence to control the seawater overtopping the structure. This could be achieved by raising the crest level of the structure, and reducing the overtopping quantities; and/or protecting the rear face of the structure, and reducing the risk of washout.

Crest protection would address the problem of overtopping but not structural failure or undermining of the toe.

Beach Management

An alternative to the above structural methods is to manage the beach fronting the defence. The methods available include beach recycling, beach nourishment or beach nourishment with control structures.

The review of coastal processes around the island indicates that the major movement of beach sediment occurs across ("cross-shore" transport) rather than along (longshore transport) the shoreline. As a consequence, there is a general lack of sediment accumulation against headlands and other major obstructions within the foreshore and, therefore, limited quantities of beach material are available for recycling. For this reason, beach recycling is not considered appropriate for use on these islands.

Beach nourishment would involve the importation of substantial quantities of new material (sand or shingle) to renourish the shoreline over lengths where beach levels are low. Building up the beaches would protect the toe of the defence from being undermined and reduce the quantity of water overtopping by modifying the nearshore wave climate. It would provide limited protection to the "body" of the defence but would not eliminate the need for maintenance to prevent structural failure, unless the beach was of such a depth that it effectively isolated the defence from wave attack.

The importation of sand or shingle could be undertaken in conjunction with beach control structures. The purpose of the structures would be to control the movement and loss of sediment from the beaches. Broadly speaking two types are available: shore-normal structures (groynes), which control the longshore movement of sediment but not the cross-shore; and shore-parallel structures (detached breakwaters), which control the cross-shore movement of sediment, and also longshore movements to a degree.

As noted above, the major movement of sediment occurs across the beaches rather than through longshore transport. As a result, groynes would be ineffective but detached breakwaters would be effective in reducing cross-shore movements and, therefore, are carried forward as appropriate control structures. Within a given bay, the distribution of sediment is controlled by longshore movement. If it were required to isolate a part of the bay, e.g. to improve the beach or defence standard locally, then groynes (or a groyne) might be used to effect the separation of the two (or more) parts of the beach.

As with beach nourishment alone, the use of detached breakwaters (with nourishment) would protect the toe of the defence from undermining and reduce the quantity of water overtopping, however, it would not prevent structural failure of the defence.

5.3.4 Summary of Viable Defence Methods

The overview of defence methods in Section 5.3.3 identified those that are technically viable for use around the island. Table 5.1 lists these methods and identifies the situations in which they can be applied. The table provides the basis for the selection of scheme options at the appraisal stage (Section 6).

Table 5.1 Viable Defence Methods

Method	Application versus Failure Mechanism		
	Overtopping of Crest	Undermining of Toe	Failure of Structure
Continue Existing Practice	x	x	✓
Toe Protection			
• Masonry Apron	x	✓	x
• Rock Revetment	x	✓	x
• Sheet Piling	x	✓	x
Structure Protection			
• Rock Revetment	✓	✓	✓
• Refacing	x	x	✓
Crest Protection			
• Seawall Raising	✓	x	x
• Backface Protection*	x*	x	x
Beach Management			
• Beach Nourishment	✓	✓	✓
• Beach Nourishment with Detached Breakwater	✓	✓	✓

✓ = viable
x = not viable
* does not prevent inundation from overtopping but reduces washout.

It should be noted that, at this stage, detailed consideration has not been given to the geotechnical aspects of the possible defence methods described above. For example, when strengthening and/or raising seawalls it will be important to ensure that the overall (and long-term) stability of the existing structure is not compromised.

5.4 Appraisal Procedure

5.4.1 Background

The following steps are undertaken as part of the appraisal of options for each unit:

- review of attributes and identification of key interests within each unit
- appraisal of strategic options (i.e. Do Nothing and Do Something)
- technical and environmental appraisals of potential scheme options (if Do Something option selected)
- economic appraisal of viable scheme options
- selection of preferred scheme option.

The steps are illustrated in the flow chart shown in Figure 5.1 at the end of this section, and explained further in the following sub-sections.

5.4.2 Review of Attributes and Identification of Key Interests

This initial step in the appraisal of options gathers together the data and information that are relevant to the coastal unit and highlights the key interests within the unit. These interests, together with the strategic objectives set in Section 2.3, are used to test the suitability of the various options.

5.4.3 Appraisal of Strategic Options

Do Nothing

This step considers the consequences of adopting a Do Nothing policy within the unit by identifying the short (0–10 years), medium (10–25 years) and long-term (> 25 years) consequences of adopting this option on the key interests. An indication of the likely economic damages through flooding and/or erosion is also given.

The option is tested against the strategic objectives set in Section 2.3 and a decision taken as to whether to reject or adopt the Do Nothing strategy for the unit.

Do Something

The rejection of the Do Nothing option automatically results in the adoption of the Do Something option with the proviso that a viable and acceptable scheme can be formulated.

Do Something may involve either sustaining or improving the defences. These have quite different implications.

Sustaining the defences would mean keeping the present level of protection. Sustaining the defences would most likely entail the continuation of existing practice, i.e. regular maintenance of the existing structures. No improvements would be made within the unit to the standard of defence against flooding or the extent of the unit protected from coastal erosion.

In contrast, improving the defences would involve raising the standard of defence against flooding and/or the extent of protection against coastal erosion.

At this stage in the appraisal it may be possible to conclude that the benefits derived from sustaining the defences are acceptable and that improvements are not warranted. If this is the case, then only scheme options that sustain the defences are considered in the next step of the appraisal. If the differentiation between sustaining or improving the defences is not clear, then both courses of action are considered.

5.4.4 Technical and Environmental Appraisals of Scheme Options

Given the need to Do Something, this step in the appraisal identifies a number of possible schemes to sustain and/or improve the defences within each unit. Appropriate schemes are selected from the "shopping list" of defence methods provided in Section 5.3; which includes the background justification for the selection of the scheme for a particular unit.

The technical performance of each scheme is appraised and the environmental issues that would arise if the particular scheme option were to be undertaken are considered.

5.4.5 Economic Appraisal of Viable Scheme Options

The purpose of the economic appraisal is to establish the worth of providing coastal defences. The two parameters that determine whether the coastal defences are economically viable are:

- the benefits derived from providing defences
- the costs of providing defences.

These benefits and costs can be expressed in monetary terms and the ratio of the two values is referred to as the benefit–cost ratio. If this ratio is greater than unity, then the scheme may be considered economically viable.

The strategic nature of this study means that a detailed quantification of the benefits and costs is inappropriate. Instead a more "broad brush" approach has been adopted, which nevertheless conforms with the general principles of economic appraisal. The method adopted may be outlined as follows below.

Benefits

Benefits are derived from the protection of assets behind (landward of) the defences from erosion and/or flooding.

In general, the defences preventing erosion protect the coast road and "ribbon" residential development adjacent to the road. The monetary value of these assets has then been established based on the length of road and length of ribbon development protected.

The benefits derived from the prevention of flooding have been determined by calculating the areas of developed and undeveloped land protected. Developed land is defined as land used for residential, commercial and industrial purposes, the remainder of land is defined as undeveloped (i.e. rural and agricultural land). The monetary value of these assets has then been established based on the area of land protected. It should be noted that this approach does not consider the residual damages that could occur even if flood defences were provided, i.e. damages that would be caused by a flood event in excess of the design standard of the defences.

It is assumed that these assets would be totally lost when the residual life of the defences expires. The present (or capitalised) value of these assets (and the benefits of providing defences) has been calculated using a discount factor of 6% per annum. A summary of the benefits within each unit is presented in Section 6.

It should be noted that the calculation of benefits takes into account erosion and flooding damages to property, roads and land. At this stage, no account has been taken of the intangible benefits (e.g. amenity and recreational values of beaches, potential environmental enhancements) in economic terms. For the purposes of this strategy, intangibles have been considered qualitatively within Section 6.

Costs

The costs associated with the implementation of a particular option broadly comprise:

- initial and future capital costs
- ongoing annual maintenance costs.

For each option, the works required within each coastal unit have been established from the inspection of the defences undertaken as part of the study. A summary of costs for each unit is presented in Section 6.

The present value of these costs, using a discount factor of 6% per annum, has been determined as follows:

- Initial capital costs are incurred when the residual life of the defences expires. It is assumed that the same value of works is necessary at 10-yearly intervals throughout the remainder of the strategy life (50 years).
- Annual maintenance costs are incurred throughout the life of the strategy.

Further details of the calculations of option benefits and costs are given in Appendix G.

Benefit–Cost Ratio

The final step in the economic appraisal is to calculate the benefit–cost ratio, which determines whether the scheme is economically viable.

5.4.6 Selection of Preferred Scheme Option

The final step in the appraisal process is the selection of a preferred scheme option for each coastal unit.

Based on the results of the appraisal, the scheme that satisfies both the technical and environmental issues within the unit and provides the best economic return is selected as the preferred option.

5.5 Layout of Section 6 – Appraisal of Options

A standard "framework" has been adopted for the layout of the appraisal procedure for each coastal unit. This framework follows the explanation of the process set out in Section 5.4 and is as follows:

a) Attributes – this provides a description of the coastal process and beach behaviour, coastal defences, land use and the human and built environment, natural environment and planning policies within the unit.

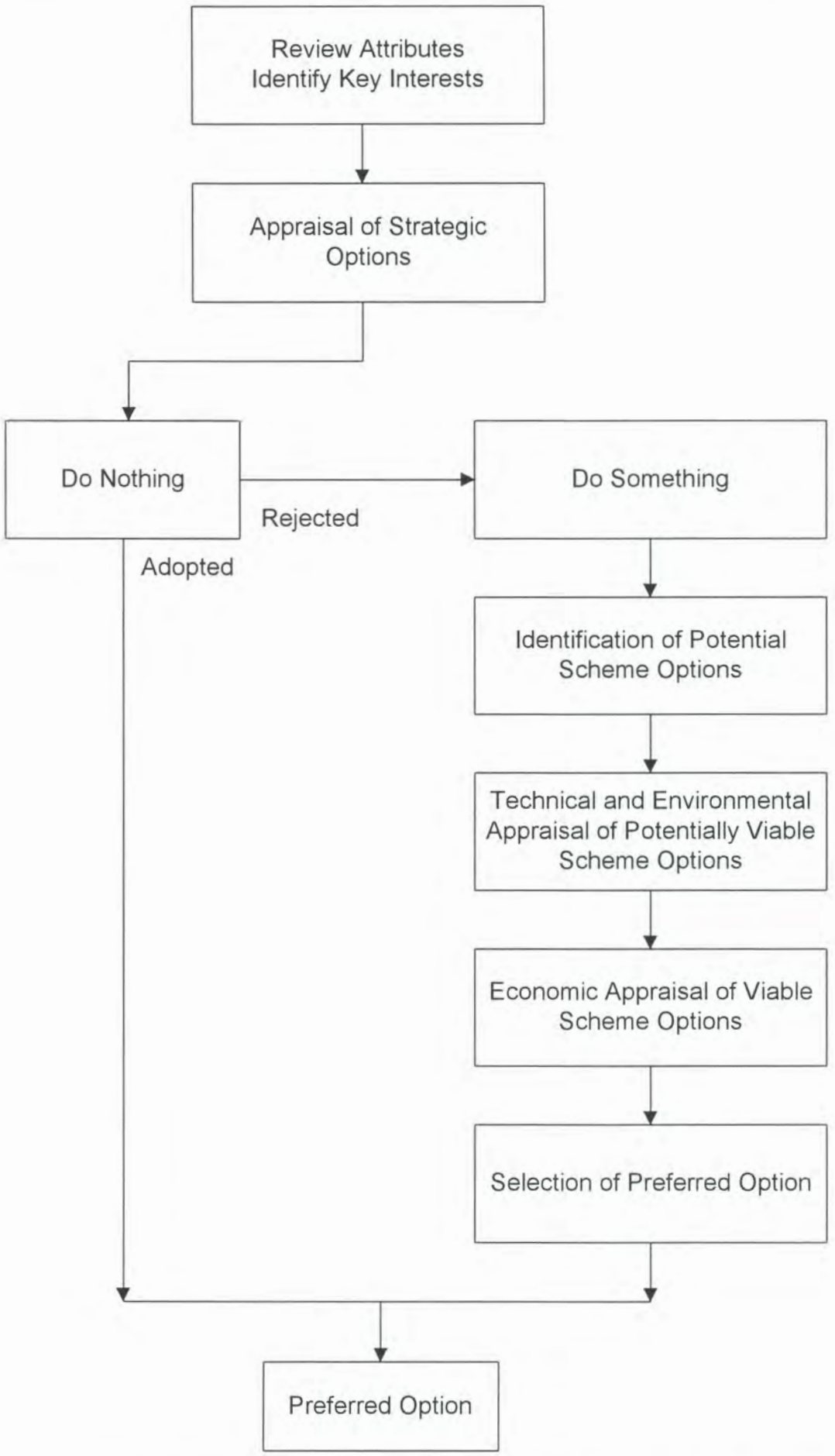
b) Key Interests within Unit – this lists the main interests within the unit that could, potentially, interact with or be influenced by coastal defence strategies.

c) Appraisal of Strategic Options – this outlines the consequences of the Do Nothing and Do Something options and selects the appropriate strategy for the unit.

d) Potential Do Something Scheme Options – this appraises the potential options. It provides a brief description of the option, considers the technical and environmental issues and summarises the economic appraisal.

e) Selection of Preferred Scheme Options – this explains the basis for the selection of the preferred option or options.

Note that if Do Nothing is selected, then steps **d)** and **e)** are not required.



PROJECT	TITLE		DATE 26/01/99	SCALE N.T.S
GUERNSEY STRATEGY FOR COASTAL DEFENCE AND BEACH MANAGEMENT	APPRAISAL PROCEDURE	POSFORD DUVIVIER CONSULTING ENGINEERS	DRAWN MDWP	CHKD AJS
				FIGURE 5.1

SECTION 6

APPRAISAL OF OPTIONS

6.0 Preamble

This section contains the appraisals for the 23 coastal units around Guernsey and the two covering Herm. The page numbers for each unit are listed below for convenience.

CORRECTION

Please refer to CONTENTS for correct page numbers to Sections 6.1 to 6.25

In addition, the coastal unit number is shown in the top right hand corner of each page (beneath the header), for ease of reference.

CU1

6.1 Coastal Unit 1 – Pezeries Point to Imperial Hotel

a) Attributes

Introduction

Coastal Unit 1 is located on the west side of the island and extends between Pezeries Point and the Imperial Hotel (see Figure 6.1), including Portelet Harbour, a length of approximately 1,800m.

Coastal Processes and Beach Behaviour

The frontage comprises a rocky foreshore from Pezeries Point to Portelet Harbour with little mobile sediment. Portelet Harbour consists of a sandy beach with a few sparsely spaced rock outcrops. Shelter is provided to the harbour by the rocky headlands and a breakwater.

The orientation of the shoreline, together with the small headlands, shelter the bays from the prevailing westerly waves of sediment through the bays. The unit is also partly sheltered from northerly storm waves by Lihou Island and the rock outcrops with Rocquaine Bay. The moderately sheltered nature of the unit means that there is only limited longshore and cross-shore movement of beach sediments.

Coastal Defences

The frontage from Pezeries Point to the west side of Portelet Harbour largely comprises natural defences. A number of granite-paved slipways exist along the coastline in the vicinity of Les Pezeries. Portelet Harbour is backed by a low-level masonry wall and rock protection defending the hinterland from erosion. The wall has an estimated residual life of between 10 and 25 years. The beach in front of the wall appears to absorb wave energy, limiting wave attack to the wall under extreme events. There is evidence of some (slight) undermining of the masonry wall at the eastern end of the harbour adjacent to the rock protection.

The breakwater on the western side of Portelet Harbour has a residual life of between 0 and 10 years. It is in need of some repair to ensure it continues to protect the harbour and defences from wave attack.

These defences are identified in Figure 6.1 at the end of this sub-section.

Land Use and Human and Built Environment

This section of the Pleinmont headland represents the western end of the southern plateau, and consequently forms the highest and most cliffed section found along the west coast of Guernsey. The open cliffs rise from a narrow shore platform to a height of 60m and are well covered by bracken, scrub vegetation and coniferous and deciduous trees. The secluded wooded valley of Le Vaux de Monel above Portelet Harbour is a National Trust of Guernsey property. The narrow coast road (Rue de la Varde) running along the base of the cliffs provides access to a couple of residential properties, but otherwise is not open to public traffic.

CU1

Portelet, as the name implies, has developed as a little port used by a fishing fleet, and seaweed (vraic) and ormer collectors. The breakwater and harbour are of no great age, although the structures probably replaced harbour works of an earlier date. Certainly of greater antiquity is Le Château de Pezeries (Fort Pezeries). Located on the small promontory at the western end of the unit this star-shaped fort is probably many centuries old. It was overhauled and repaired in the early 1800s to add to the island's defences against Napoleon. In the vicinity of Les Pezeries, granite-paved slipways lead down to gullies on the beach and once enabled farmers to gain access to the shore to gather seaweed. The small, sheltered sandy beaches below the Imperial Hotel and by the harbour are well used for general beach recreation during the summer months.

Natural Environment

The Pleinmont headland is formed in the L'Erée Granite and the Pleinmont Metasediment, with areas of shattered angular rock fragments, sand and silt (known as "head") derived during the last glaciation, covering much of the outcrop. This material can be seen in the low cliff section to the west of Les Pezeries and infills the small gullies and valleys above Le Portelet. In places this material has slumped down to an 18m raised beach platform, which is clearly delineated by the change in slope towards the base of the cliff and upon which the road is constructed. This beach is thought to have formed during a period of higher sea level about 150,000 years ago.

The Pleinmont headland forms part of the Southern Cliffs and Cliff Valleys SNCI. The partially wooded slopes along this side of the Pleinmont headland provide shelter from the prevailing south-westerly winds and are well used by large numbers of migrant birds. In addition, they provide suitable breeding habitat for a number of species including long-eared owl. Floristically, this section is perhaps not as rich as other areas along the south coast, being dominated by bracken (*Pteridium aquilinum*), scrub and pockets of woodland, but rabbit-grazed and more open areas are likely to hold flora typical of this part of the island.

The intertidal area forms part of the L'Erée to Pezeries (Rocquaine Bay) SNCI. The variety of substrate types and different levels of exposure within the bay make this an important site for marine flora and fauna and wintering birds (see Section 3.4.4 for additional details).

Planning Policies

The entire coastal strip is an Area of Special Environmental Importance (Green Zone 1; covered by policy CE5) and is therefore subject to the relevant conservation and enhancement policies set out in the Rural Area Plan (Phase 2).

b) Key Interests within Unit

The following list highlights the main interests within the unit that have the potential to interact with, or be influenced by, coastal defence policies. They are:

- local access roads
- Portelet Harbour
- recreational value of the beach
- archaeological importance of Fort Pezeries.

c) Appraisal of Strategic Options

Do Nothing

If nothing is done to maintain or improve the defences between Pezeries Point and the Imperial Hotel, the following scenarios over the 50-year period covered by the strategy are envisaged:

i) In the short term, the continuing deterioration of the breakwater caused largely by wave action would lead to increased wave exposure within Portelet Harbour, resulting in beach erosion and damage to the masonry wall.

ii) In the medium term, the slipways would deteriorate as a result of wave attack leading to the loss of access to the beach and moorings.

iii) In the long term, the continuing erosion of the headland would result in the eventual loss of sections of the local access road.

The Do Nothing option would cause economic damage through the loss of the developed and undeveloped land, owing to the gradual retreat of the shoreline. The option of Do Nothing does not satisfy all the Objectives set out in Section 2.3.

For these reasons the option is rejected.

Do Something

From the above discussion it is evident that the Do Something option should be adopted if a viable scheme can be identified. Sustaining the man-made structures at their present standard would address the problems of deterioration of the breakwater and wall owing to wave action at Portelet Harbour. Therefore, there is no merit in improving the standard of the existing defences. Continued erosion of the undefended cliff line within the rest of the unit is not considered to be a major issue and therefore options to improve the standard by extending the existing defences are not considered.

d) Do Something Potential Scheme Options

The reasoning described in Section 5.3.3 (Possible Defence Methods) together with the problems and issues referred to above, results in the selection of one option for appraisal.

Technical and Environmental Appraisal

Option 1 – Continue Existing Practice (Sustain)

Option 1 comprises the following elements:

- continue existing practice by regular re-pointing of the masonry structures
- annual inspection of defences
- five-yearly inspections of the cliff section to assess levels of erosion and any impact on interests within the unit.

The continuing maintenance of the breakwater and wall should ensure their integrity over the duration of the strategy and hence the assets they protect.

Continuing with existing practice, including the maintenance of existing structures, is unlikely to have any significant impact on environmental interests within this unit. Continued erosion of the low cliffs, while potentially contributing to the limited coastal instability, does provide exposure of the cliff section through part of an 18m raised beach platform and in addition supplies sediment to the nearshore system. Access to properties along Rue de la Varde is unlikely to be affected given the protection to this section of road afforded by the wall in Portelet Harbour.

Significant sediment loss from the unit is unlikely to occur, particularly if limited erosion of the cliffs is allowed to continue. The beach in Portelet Harbour is therefore likely to be maintained and its recreational value safeguarded. Maintaining the breakwater should continue to provide sheltered mooring for small boats.

Fort Pezeries sits on a small rocky peninsula at the western end of the section, erosion of which would be very limited over the 50-year period covered by the strategy. However, the general condition of this area should be monitored on a five-yearly basis to ensure that no significant erosion is taking place. If required, any small-scale works to ensure the continued stability of the fort could be undertaken.

There is a risk, in the long term, that erosion of the cliffs could affect the access road west of Portelet Harbour. The risk to the road is not considered significant and works, therefore, have not been included within the strategy for the unit. Nevertheless, as part of the regular inspection of the cliffs the security of the access road should be monitored.

Economic Appraisal

Benefits

Table CU1.1 gives the estimated value of the assets protected by the defences within CU1.

Table CU1.1 Benefits

Assets	Area/Length	Value (£)
Flooding		
Developed Land	N/A	-
Undeveloped Land	N/A	-
Erosion		
Minor Road	400m	120,000
Coast Road	N/A	-
Ribbon Development	N/A	-
	Total	**120,000**
	Discounted Value	**50,000**

Notes: The following intangible benefits are not included in the above table :

- mooring benefit of Portelet Harbour
- recreational value of the beach
- archaeological importance of Fort Pezeries.

Therefore the benefits derived for CU1 are likely to be an underestimate of the actual value.

Costs

Table CU1.2 gives the estimated value of the costs associated with Option 1.

Table CU1.2 Costs

Option	Initial Capital Cost (£)	Future Costs (£)		Total Discounted Cost (£)
		Capital	Maintenance	
1	N/A	N/A	2,300/year	**38,000**

Results

Table CU1.3 gives the results of the economic appraisal for Option 1.

Table CU1.3 Results

Option	Benefit–Cost Ratio
1	1.3

e) Selection of Preferred Strategic Option

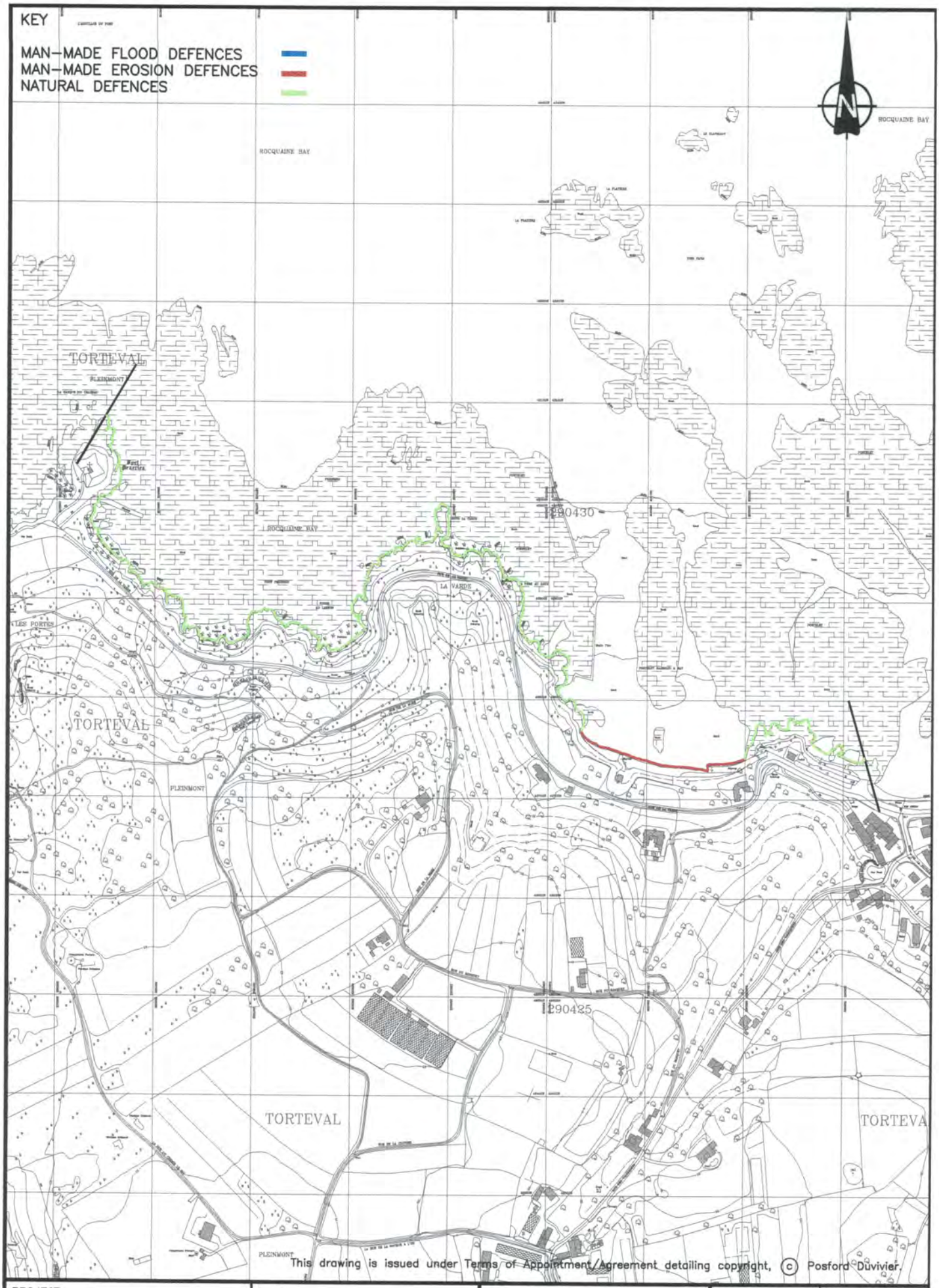
Table CU1.4 summarises the results of the appraisal process for CU1.

Table CU1.4 Summary of Appraisals

Option	Technical Appraisal	Environmental Appraisal	Economic Appraisal
1 • continue existing practice	• ensures integrity of defences	• no significant concerns	• viable

Option 1 is technically sound, environmentally acceptable and economically viable and is, therefore, selected as the appropriate strategy for CU1.

CU1



PROJECT	TITLE	CONSULTING ENGINEERS		
GUERNSEY STRATEGY FOR COASTAL DEFENCE AND BEACH MANAGEMENT	COASTAL UNIT 1 – Pezeries Point to Imperial Hotel	POSFORD DUVIVIER	DRAWN MDWP	SCALE 1:5,000
			DATE FEB'99	CHKD JEC
			DRG No. FIGURE 6.1	

CU2

6.2 Coastal Unit 2 – Imperial Hotel to Fort Grey

a) Attributes

Introduction

Coastal Unit 2 is located on the west side of the island and extends between the Imperial Hotel and Fort Grey (see Figure 6.2) and forms the southern end of Rocquaine Bay, a length of approximately 800m.

Coastal Processes and Beach Behaviour

The beach fronting the defences consists of a predominantly sandy foreshore with some localised pockets of shingle, particularly against the seawall. Rocky outcrops are present lower down the beach towards the low water mark. Towards the centre and northern end of the unit, rocky outcrops occur further up the beach towards the defences. The beach is sheltered by rocky headlands at either end.

Waves approach the frontage in a broadly normal direction because of the shelter provided by Pezeries Point and the many rocky outcrops within Rocquaine Bay. As a consequence there is limited longshore movement of sediment through the unit. There are, however, localised longshore effects on the beach plan shape brought about by rock outcrops. These outcrops tend to pull beach material into their lee and accentuate lower beach levels between the outcrops, exposing a greater depth of seawall in the centre of the unit. Generally the beach levels are relatively healthy. The beach levels are at such a level that the majority of the beach within the bay is above high water at the seawall.

Despite comparatively low longshore transport, the high wave energy that acts on the west coast, combined with the wave direction in Rocquaine Bay results in cross-shore movement of material during storm attack. The extent to which material drawn down the beach is permanently lost is not known.

Beach levels, however, do vary along the unit. In the autumn of 1998, two trial pits were dug, one at each end of the unit. These indicated over 1.0m of mobile sediment covering the clay layer at the western end of the unit but only 0.6m at the eastern end of the unit. The crest level of the beach was over 1.2m above MHWS level at the western end and about 0.6m above it at the eastern end. In the centre of the bay, beach levels are lower and the toe of the wall is exposed. These levels support the beach processes described above.

Coastal Defences

The entire frontage of this unit is protected by a vertical masonry wall. The section of wall to the north of the slipway at La Lagne has a sheet-pile and concrete toe protection at the base. A length of wall in the north of the unit has masonry faced toe protection. There are also discrete lengths of concrete toe protection within the unit, particularly in the centre.

Generally, the man-made defences are in good condition, having a residual life of between 10 and 25 years. The seawall within this section of Rocquaine Bay has at least 8m of freeboard between high water and the crest of the wall. As a result, overtopping is not a problem and the unit has a high standard of defence; sea level rise would not alter this situation.

In the centre of the bay the base of the wall is exposed. However, the wall is founded on rock so therefore it is considered that there is no immediate threat to the integrity of the defences.

These defences are identified in Figure 6.2 at the end of this sub-section.

Land Use and Human and Built Environment

The entire frontage along this section is developed with the coast road situated directly behind the existing coastal defences. The land use within the unit is dominated by residential properties and glasshouses. The Imperial Hotel, at the far western end of the unit, is one of the larger hotels on the island's west coast. There is a slipway providing access to the shore and a boat launching facility at La Lagne. The mainly sandy beach is a popular site for bathing, particularly at its northern end (Le Crocq du Sud) to the south of the Fort Grey causeway. The relative shelter of this section of Rocquaine Bay makes it a popular mooring area for small fishing and pleasure boats, particularly during the summer months.

Natural Environment

The geology of this unit comprises two separate formations. In the south the foreshore platform provides exposure of the L'Erée Granite, while to the north rocks of the Perelle Gneiss Group are exposed, the contact between the two being roughly opposite the car parking area along Route de La Lague.

The intertidal area forms part of the L'Erée to Pezeries (Rocquaine Bay) SNCI. The variety of substrate types and different levels of exposure within the bay make this an important site for marine flora and fauna and wintering birds (see Section 3.4.4 for additional details).

Planning Policies

Residential development situated behind the coast road is classified as a Built-Up Area (covered by policy CE9). Land that is of horticultural importance, i.e. glasshouses, is classified as an Area of Rural Character (Green Zone 3; covered by policy CE7). These areas are subject to the relevant conservation and enhancement policies set out in the Rural Area Plan (Phase 2).

b) Key Interests within Unit

The following list highlights the main interests within the unit that have the potential to interact with, or be influenced by, coastal defence policies. They are:

- residential and commercial properties
- coast road
- recreational value of the beach
- slipway to the beach
- mooring for small boats
- intertidal flora and fauna.

CU2

c) Appraisal of Strategic Options

Do Nothing

If nothing is done to maintain or improve the defences between the Imperial Hotel and Fort Grey, the following scenarios over the 50-year period covered by the strategy are envisaged:

i) In the short term, there would be no risk to the assets or defences within the unit.

ii) In the medium term, there would be a possible risk that the continuing exposure of the toe of the wall in the centre of the unit to wave attack would lead to failure of the foundations. This would result in the loss of localised sections of the coast road and damage to properties.

iii) In the longer term, structural failure of the entire seawall would occur owing to deterioration caused largely by wave action. Do Nothing would lead to loss of the coast road, damage to and loss of properties and loss of the slipway access to the beach.

The Do Nothing option would cause economic damage through the loss of the developed and undeveloped land through erosion. The gradual retreat of the shoreline caused by erosion would result in the loss of developed and undeveloped land. The option of Do Nothing does not satisfy all the Objectives set out in Section 2.3.

For these reasons the option is rejected.

Do Something

From the above discussion it is evident that the Do Something option should be adopted if a viable scheme can be identified. Sustaining the defences at their present standard would address the problems of undermining and structural failure of the man-made defences. Therefore options to improve the existing standard of defence are not considered.

d) Do Something Potential Scheme Options

The reasoning described in Section 5.3.3 (Possible Defence Methods) together with the problems and issues referred to above, results in the selection of one option for appraisal.

Technical and Environmental Appraisal

Option 1 – Continue Existing Practice (Sustain)

Option 1 comprises the following elements:

- continue existing practice by regular re-pointing of the masonry structure
- monitor toe protection of all defences after storm events and undertake repair works as necessary
- summer and winter beach surveys
- annual inspection of defences.

This option should ensure the integrity of the defence for the life of the strategy and hence the assets it defends. There are, however, uncertainties over the long-term behaviour of the beach and the future exposure of the toe of the seawall to wave attack. For this reason the beaches should be regularly surveyed and their behaviour determined.

Continued maintenance of the seawall is unlikely to have any significant impact on environmental interests within this unit. Toe protection to the seawall would need to take into account the recreational value of the beach as well as general aesthetics. Technical solutions that minimise the potential loss of available beach and do not detract from either people's ability to use or their perception of use would therefore be preferred. Such options include piling and the construction of masonry aprons. The use of rock revetments on recreational beaches is not considered appropriate.

Economic Appraisal

Benefits

Table CU2.1 gives the estimated value of the assets protected by the defences within CU2.

Table CU2.1 Benefits

Assets	Area/Length	Value (£)
Flooding		
Developed Land	N/A	-
Undeveloped Land	N/A	-
Erosion		
Minor Road	N/A	-
Coast Road	800m	720,000
Ribbon Development	800m	2,600,000
	Total	**3,320,000**
	Discounted Total	**1,385,000**

Notes: The following intangible benefits are not included in the above table:
- the vital communication link provided by the coast road
- recreational value of the beach
- mooring benefit to small boats.

Therefore the benefits derived for CU2 are likely to be an underestimate of the actual value.

Costs

Table CU2.2 gives the estimated value of the costs associated with Option 1.

Table CU2.2 Costs

Option	Initial Capital Cost (£)	Future Costs (£)		Total Discounted Cost (£)
		Capital	Maintenance	
1	N/A	N/A	3,600/year	**60,000**

Results

Table CU2.3 gives the results of the economic appraisal for Option 1.

Table CU2.3 Results

Option	Benefit–Cost Ratio
1	23

e) Summary of Preferred Strategic Option

Table CU2.4 summarises the results of the appraisal process for CU2.

Table CU2.4 Summary of Appraisals

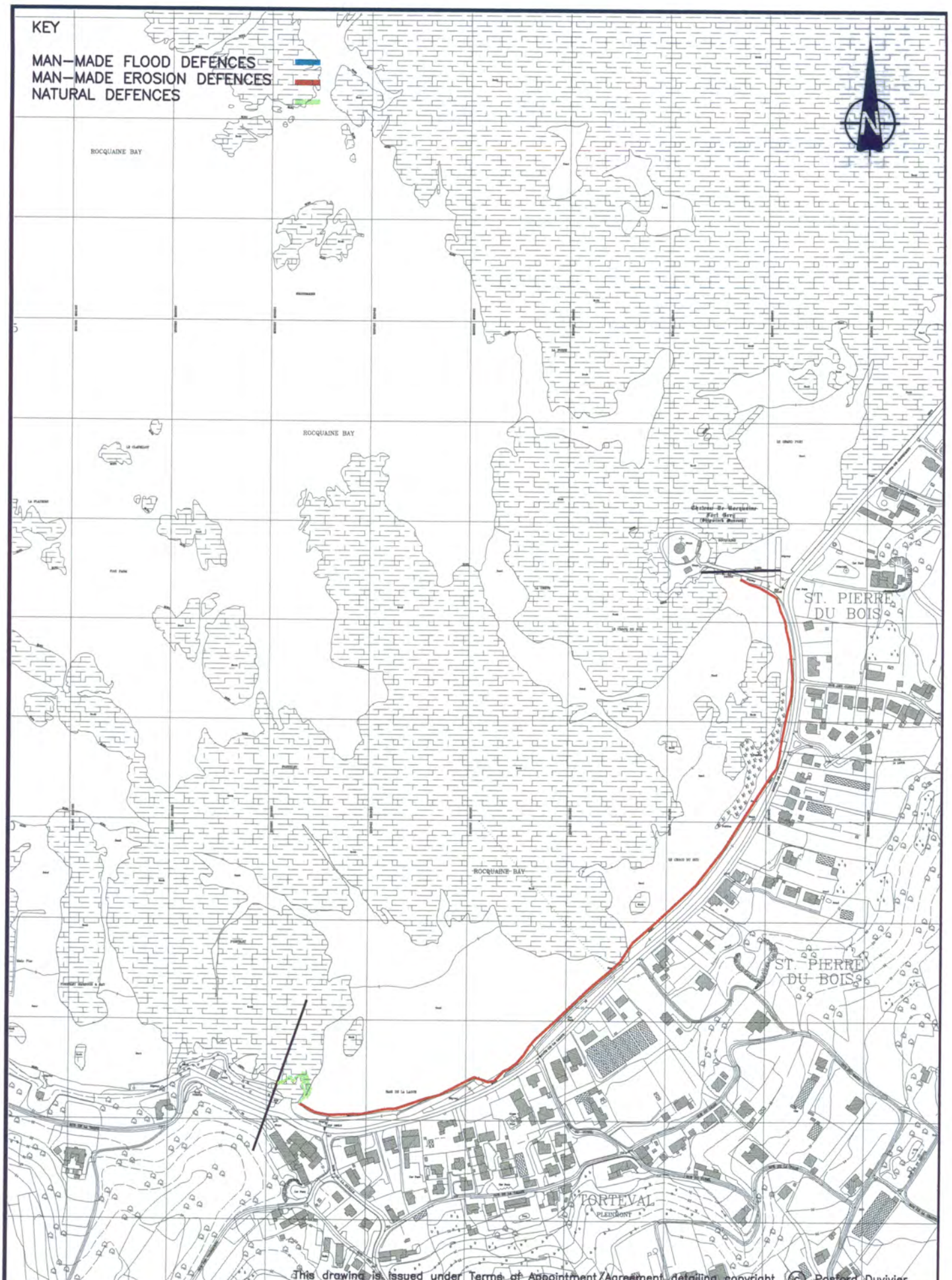
Option	Technical Appraisal	Environmental Appraisal	Economic Appraisal
1 • continue existing practice	• ensures integrity of defences	• no significant concerns	• viable

Option 1 is environmentally acceptable and economically viable. There is, however, a question over the long term technical viability of the option, as the trend of beach level changes within the bay is not known.

On this basis, the following is proposed:

- adopt Option 1 as the preferred option
- monitor the beaches so that a view can be taken on their behaviour
- review the appropriateness of the selected strategy in five years' time.

CU2



PROJECT GUERNSEY STRATEGY FOR COASTAL DEFENCE AND BEACH MANAGEMENT	TITLE COASTAL UNIT 2 – Imperial Hotel To Fort Grey	CONSULTING ENGINEERS POSFORD DUVIVIER	DRAWN MDWP	SCALE 1:5,000
			DATE FEB'99	CHKD JEC
			DRG No. FIGURE 6.2	

CU3

6.3 Coastal Unit 3 – Fort Grey to L'Erée headland (Rocquaine Bay and L'Erée Bay)

a) Attributes

Introduction

Coastal Unit 3 is located on the west side of the island and extends between Fort Grey and L'Erée headland (see Figure 6.3), forming Rocquaine Bay and L'Erée Bay, a length of approximately 1,900m.

Coastal Processes and Beach Behaviour

The beach fronting the defences consists of a predominantly sandy foreshore with some localised pockets of shingle, particularly against the seawall. Rocky outcrops are present lower down the beach towards low water mark but predominate in the southern to middle end of the unit. The beach is sheltered by rocky headlands at either end.

Waves approach the frontage approximately normal to the shoreline because of the shelter provided by the surrounding headlands and rocky outcrops within the bays. As a consequence there is limited longshore movement through the unit. There are, however, localised longshore effects on the beach plan brought about by the rock outcrops. These outcrops tend to hold beach material in their lee and this accentuates lower beach levels between the outcrops, i.e. where there is no rock protection, thus exposing a greater depth of seawall.

Generally the beach levels are low throughout the unit, particularly in the centre where exposure is greatest. It is not clear whether this is a continuing problem or whether it has reduced since the cessation of active beach mining in 1948. The outfalls on the foreshore indicate that beach levels have not dropped significantly since their construction as they still discharge at or about beach level. Data from a trial pit dug in autumn 1998 is discussed in the next section.

Despite comparatively low longshore transport, the high wave energy that acts on the west coast, combined with the wave direction in Rocquaine Bay, results in cross-shore movement of material during storm attack. The extent to which drawdown and permanent loss of beach material occurs is not known.

A channel exists in approximately the centre of the bay between two rocky outcrops. This deeper water allows larger waves to reach the wall, causing overtopping of the defences. The bay is effectively a sediment cell with a limited input to or loss of material from the unit.

Coastal Defences

The entire frontage of this unit is protected by man-made defences. Approximately two-thirds of the defences are vertical masonry walls. The remaining one-third consists of a variety of concrete walls, including some defences built during the Occupation of the island. A large slipway exists to the south of Brock Battery and there is one to the north. The beach levels are low throughout the unit, particularly within the central section.

It is evident that there has been an historic trend of beach lowering within this unit as shown by the various lengths of wall throughout the frontage that have additional toe protection, in the form of concrete or masonry aprons. Towards the north of the unit, a sloping masonry apron has a buttress and beam arrangement. The seawalls have been modified as the low beach levels do not provide adequate protection to the toe of the defences.

Generally, the man-made defences are in good condition, having a residual life of between 10 and 25 years. However, a section of wall approximately 500m from the southern end of the unit is suffering from undermining and therefore has a low residual life, estimated at between 0 and 10 years.

A trial pit dug in autumn 1998 in the vicinity of the undermining determined that the level of the beach was almost 4.0m below MHWS with about 0.6m of mobile sediment above decomposed granite. These levels support the beach processes described above.

Although the majority of the defences within the unit have at least 3m freeboard between high tide and the crest of the wall, overtopping is a problem, particularly within the centre of Rocquaine Bay where beach levels are particularly low. Modelling tests have indicated that the wall has a low standard of defence with regard to overtopping. The overtopping is known to cause the coast road to be closed, restricting direct access through the unit. It is unlikely that overtopping would seriously damage the seawall directly. However, it may cause failure of the road, and hence the paved surface directly behind the wall, under an extreme event.

These defences, together with the area at risk from flooding, are shown in Figure 6.3 at the end of this sub-section.

Land Use and Human and Built Environment

Land use behind the coast road comprises a mixture of residential development, glasshouses and general agriculture. The coast road, as along much of the west coast, adheres fairly closely to the perimeter of the bay, with only limited areas of semi-natural coastal habitat now remaining immediately behind the defences.

Fort Grey, known locally as the Cup and Saucer, is one of three Martello Towers built on the west coast in 1805 to defend against military attack. The fort was restored in 1975 and is now a maritime museum housing details of shipwrecks found in local waters.

Although not as important for recreational activity as some of the bays further to the north, Rocquaine Bay is still well used, particularly at its northern end. Here the sandy beach in the lee of the L'Erée headland provides safe swimming and is attractive for a wide range of beach activities. There is a large car park and picnic site located at the northern end of the unit opposite the L'Erée Hotel. Boat launching and access to the beach is well catered for, with four slipways situated at various points within the bay. The relative shelter provided by Fort Grey makes this a popular mooring area for small fishing and pleasure boats, particularly during the summer months.

Natural Environment

The geology of this unit comprises two separate formations. In the south the foreshore platform provides exposure of the Perelle Gneiss Group, while to the north rocks of the L'Erée Granite are exposed, the contact between the two being roughly at the position of Brock Battery.

CU3

There are two small areas of remnant dune grassland sandwiched between the coast road and coastal defences. These are located at the northern end of the unit in L'Erée Bay and approximately 200m to the south of Brock Battery. Both these areas comprise typical stabilised dune communities dominated by grasses, with some areas of short turf that support rarer species such as early sand grass (*Mibora minima*) for which Guernsey is important. Much of the northern area is now occupied by a large car park and picnic site, while the southern area is becoming overgrown with bramble (*Rubus fruitcosus*) and rough grassland vegetation.

The intertidal area forms part of the L'Erée to Pezeries (Rocquaine Bay) SNCI. The variety of substrate types and different levels of exposure within the Bay make this an important site for marine flora and fauna and wintering birds (see Section 3.4.4 for additional details).

Planning Policies

Residential development situated immediately behind the coast road at the southern end of the unit is classified as a Built-Up Area and as a Conservation Area (covered by policy CE8). Land that is of horticultural importance, i.e. glasshouses, is classified as an Area of Rural Character (Green Zone 3). These areas are subject to the relevant conservation and enhancement policies set out in the Rural Area Plan (Phase 2).

b) Key Interests within Unit

The following list highlights the main interests within the unit that have the potential to interact with, or be influenced by, coastal defence policies. They are:

- residential properties along the frontage
- coast road
- recreational value of the beach
- slipways to the beach
- moorings for small boats
- intertidal flora and fauna
- small pockets of stabilised dune habitat.

c) Appraisal of Strategic Options

Do Nothing

If nothing is done to maintain or improve the defences within Rocquaine Bay between Fort Grey and the L'Erée headland, the following scenarios over the 50-year period covered by the strategy are envisaged:

i) In the short term, overtopping of the seawall would continue to result in the temporary closure of the coast road every winter during extreme weather conditions. Undermining of the wall in the centre of Rocquaine Bay owing to toe scour caused by wave attack would result in failure of the wall leading to damage to the adjacent properties and the coast road from flooding.

ii) In the medium term, overtopping of the seawall would cause damage to the landward edge of further lengths of the coast road leading to the failure and eventual closure of the road.

iii) In the longer term, structural failure of the seawall would occur owing to deterioration caused largely by wave action. Do Nothing would lead to loss of the remainder of the coast road, damage to and loss of properties and loss of the slipway access to the beach.

The Do Nothing option would cause economic damage through the loss of the developed and undeveloped land through flooding and erosion. In total approximately 7 hectares of undeveloped and 7 hectares of developed land would be affected. This option of Do Nothing does not satisfy all the Objectives set out in Section 2.3.

For these reasons the option is rejected.

Do Something

From the above discussion it is evident that the Do Something option should be adopted if a viable scheme can be identified. Sustaining the defences at their present standard would solve the problem of the toe scour, however, it would not address the problems of overtopping causing localised flooding and closure of the coast road. Therefore options to improve the standard are also included under Do Something.

d) Do Something Potential Scheme Options

The reasoning described in Section 5.3.3 (Possible Defence Methods) together with the problems and issues referred to above, results in the selection of four options for appraisal.

Technical and Environmental Appraisal

Option 1 – Continue Existing Practice and Minor Works (Sustain)

Option 1 comprises the following elements:

- continue existing practice by regular re-pointing of the masonry structures
- minor toe protection to the short length of wall that is being undermined
- monitor toe protection of all defences after storm events and undertake repair works as necessary
- summer and winter beach surveys
- annual inspection of defences.

The continuing maintenance of and the minor repair works to the undermined section of the wall should assure the continued stability of the wall. It is envisaged that repair works would involve deepening the toe with a concrete or masonry apron. The option would ensure its integrity for the life of the strategy and hence the assets it defends.

Continued maintenance of the seawall including undertaking minor repairs, e.g. in the centre of Rocquaine Bay, is unlikely to have any significant impact on environmental interests within this unit. Identified Enhancement Target Areas along the frontage are unlikely to be affected by maintenance work and the continued functioning of the seawall. However, it should be ensured that suitable measures are taken during any proposed works to prevent damage to these areas and if possible opportunities for enhancement should be sought.

Toe protection to the seawall would need to take into account the recreational and amenity values of the beach as well as general aesthetics, particularly given the classification of much of the frontage as an Area of Special Environmental Importance. Technical solutions that minimise the potential loss of available beach and do not detract from either people's ability to use or their perception of use would therefore be preferred. Such options include piling and the construction of masonry aprons. The use of rock revetment on recreational beaches is not considered appropriate.

This option does not address the overtopping problems associated with the unit.

Option 2 – Raise Local Sections of Seawall (Improve)

Option 2 comprises the following elements:

- as Option 1
- raise local sections of seawall and backface protection to reduce the effects of overtopping.

Local raising of the seawall in areas of problem overtopping would reduce the instances of coast road closure owing to dangerous overtopping levels and protect the landward edge of the road from further deterioration.

Other technical issues are as discussed under Option 1.

Locally raising the seawall could reduce the frequency and severity of overtopping along some parts of the frontage. This would provide protection to the coast road and limit the potential inundation of low-lying areas, e.g. the area of agricultural land classified as an Enhancement Target Area just to the north of Brock Battery. Sections where residential properties are at risk from damage, or the coast road is likely to fail, should be given priority. Raising the seawall could have a visual impact for properties located landward of the coast road. The opinions of local residents on their preference between potentially obscured seaward views or continued flooding and closure of the coast road should be sought, as this could prove to be a significant determinant in the course of action taken.

The existing areas of coastal (terrestrial) ecological interest within the unit are unlikely to be affected by this option, although some species that are dependent on a significant saline influence could diminish.

Other environmental issues are as discussed under Option 1.

Option 3 – Beach Nourishment (Improve)

Option 3 comprises the following elements:

- continue existing practice by regular re-pointing of the masonry structures that are exposed
- beach nourishment with sand
- regular surveys of the newly nourished beach.

The continuing maintenance of the seawall would ensure its integrity for the life of the strategy and hence the assets it defends. The new beach would protect the toe of the seawall and there would no longer be a requirement for toe protection. It is likely that some beach nourishment material would be lost offshore during storm events. This would require periodic renourishment of the beaches in order to make good the losses and maintain the standard of defence.

Beach nourishment would need to be compatible with existing substrates within the unit and in particular with regard to areas of sandy beach that are of recreational importance, e.g. in the lee of the L'Erée headland. Nourishment with sand would enhance existing beaches and could in addition provide a significant increase in the overall area of sandy beach within the unit, with consequent benefits for recreational and tourism interests.

The volume of sediment required to significantly reduce overtopping is considerable and would have several detrimental impacts on environmental interests. Firstly, a relatively large area of upper intertidal foreshore would be directly covered by sand leading to the loss of the existing intertidal communities and rock and sediment exposures of geological interest. Secondly, over time, and without the emplacement of control structures, sand would naturally be re-distributed by existing coastal processes within the bay. This could lead to the smothering of rocky intertidal areas with a consequent change to, or even loss of, biological hard substrate communities and a potential reduction in available food resources to wintering waterfowl.

The creation of a high sandy beach within the bay may lead to problems with wind blown sand as the crest of the profile would remain dry at high water. If this becomes a nuisance, steps could be taken to manage the problem, e.g. placing sand fences on the beach.

Other environmental issues with regard to the continuing maintenance of the wall are as discussed under Option 1.

Option 4 – Beach Nourishment with Detached Breakwaters (Improve)

Option 4 comprises the following elements:

- as Option 3
- detached breakwaters.

The detached breakwaters would prevent most of the loss of beach nourishment material offshore during storm events. However, periodic renourishment of the beaches in order to make good the losses and maintain the standard of defence would still be required but to a lesser extent than in Option 3.

Other technical issues are as discussed under Option 3.

The placement of detached breakwaters within the bay could have several significant environmental impacts. These are as follows:

- visual intrusion into an important and aesthetic coastal landscape
- direct loss of the rocky intertidal area of interest for its maritime flora and fauna and the loss of this area for feeding to wintering waterfowl
- potential additional hazard to navigation for boats.

In conjunction with beach recharge, the benefits of this option with regard to providing a better beach for recreational activity would probably be outweighed by the predicted negative impacts on the natural environment and the coastal landscape.

Other environmental issues with regard to the continuing maintenance of the wall and the nourishment are as discussed under Option 3.

Economic Appraisal

Benefits

Table CU3.1 gives the estimated value of the assets protected by the defences within CU3.

Table CU3.1 Benefits

Assets	Area/Length	Value (£)
Flooding		
Developed Land	6.7 ha	8,710,000
Undeveloped Land	7.2ha	133,000
Erosion		
Minor Road	N/A	-
Coast Road	1,900m	1,710,000
Ribbon Development	700m	2,275,000
	Total	**12,828,000**
	Discounted Total	**6,668,000**

Notes: The following intangible benefits are not included in the above table:
- the vital communication link provided by the coast road
- recreational value of the beach
- slipways and mooring benefits to small boats
- intertidal flora fauna and dune habitats.

Therefore the benefits derived for CU3 are likely to be an underestimate of the actual value.

Costs

Table CU3.2 gives the estimated value of the costs associated with Options 1 to 4.

Table CU3.2 Costs

Option	Initial Capital Cost (£)	Future Costs (£)		Total Discounted Cost (£)
		Capital	Maintenance	
1	30,000	30,000/10 years	8,325/year	**187,000**
2	164,000	30,000/10 years	8,325/year	**287,000**
3	12,427,000	2,485,000/10 years	8,325/year	**11,545,000**
4	13,702,000	1,243,000/10 years	13,725/year	**11,528,000**

Results

Table CU3.3 gives the results of the economic appraisal for Options 1 to 4.

Table CU3.3 Results

Option	Benefit–Cost Ratio
1	36
2	23
3	0.6
4	0.6

e) Selection of Preferred Strategic Option

Table CU3.4 summarises the results of the appraisal process for CU3.

Table CU3.4 Summary of Appraisals

Option	Technical Appraisal	Environmental Appraisal	Economic Appraisal
1 • continue existing practice	• ensures integrity of defences • does not address overtopping problem • long-term commitment to toe repairs	• no significant concerns	• viable
2 • raise seawall	• ensures integrity of defences • reduces overtopping • long-term commitment to toe repairs	• affects views from coast road and properties	• viable
3 • beach nourishment	• ensures integrity of defences • reduces overtopping • protects toe of wall	• detrimental impacts on environmental interests • enhances beaches	• not viable
4 • beach nourishment • detached breakwaters	• ensures integrity of defences • reduces overtopping • protects toe of wall	• detrimental impacts on environmental interests • enhances beaches • visual intrusion	• not viable

Option 1 does not address the problems of overtopping within the unit. For this reason the option is rejected as a long-term option but could be considered as an interim measure.

Option 3 and Option 4 are not economically viable and are likely to remain so even if the amenity value of the beaches was taken into account. For this reason these options are rejected.

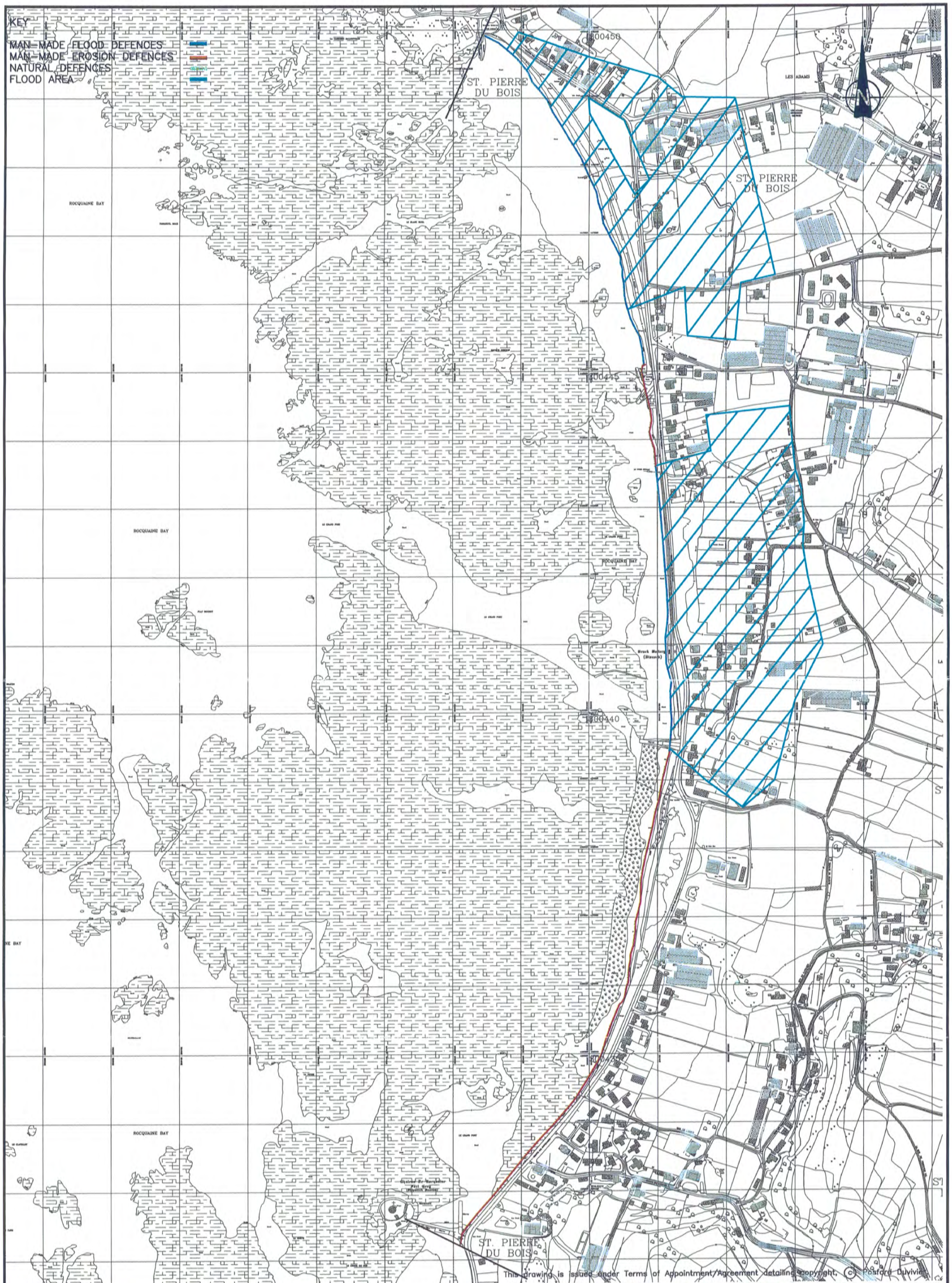
Option 2 is technically sound and should ensure the continued integrity of the defences and addresses the problem of overtopping within the unit. There are concerns over the effect that raising the seawall may have on the views from the coast road. These should be dealt with through local consultation and, if appropriate, improvements could be limited to strengthening the coast road from damage and washout.

CU3

Although Option 2 addresses the current problems within the unit, it means the adoption of a long-term commitment to toe strengthening. This is seen as an appropriate strategy if beach levels do not fall significantly in the future. If, however, levels fall it may become increasingly costly to continue with a long term programme of toe strengthening and the strategy may prove to be unsustainable.

On the basis of the above, the following is proposed for the unit:

- initially Option 1 is adopted as the preferred option and works are undertaken to the vulnerable lengths of wall, this assumes the disruption to the coast road is acceptable in the short term
- monitoring of the beaches commences immediately so a view can be taken over their behaviour in five years' time
- in five years' time a long-term strategy is selected for the unit. Option 2 would be preferred of beach levels are tolerably stable. If beach levels are falling, then further consideration would need to be give to either undertaking substantial improvements to the toe of the defences or, possibly, beach nourishment.



PROJECT GUERNSEY STRATEGY FOR COASTAL DEFENCE AND BEACH MANAGEMENT	TITLE COASTAL UNIT 3 Fort Grey to L'Eree Headland	CONSULTING ENGINEERS POSFORD DUVIVIER	DRAWN MDWP · SCALE 1:5,000 DATE FEB' 99 · CHKD JEC DRG No. FIGURE 6.3

6.4 Coastal Unit 4 – L'Erée headland and Lihou Island

a) Attributes

Introduction

Coastal Unit 4 is located on the west coast of the island and extends from the northern end of L'Erée Bay around the headland of Fort Saumarez and includes Lihou Island (see Figure 6.4), a total length of approximately 1,500m. The island is located approximately 400m off the headland, and island is accessible at low tide via a causeway.

Coastal Processes and Beach Behaviour

The L'Erée headland is a rocky outcrop facing westward towards Lihou Island. The foreshore to the headland comprises a rock platform over which there are very limited quantities of mobile sediments.

The headland is exposed to moderate attack from westerly and northerly waves but derives some shelter from Lihou Island. The beaches are effectively "swept clean" of sediment because of the exposed location of the headland and the strong tidal currents that run through the passage between Lihou Island and Guernsey.

Lihou Island is characterised by a rocky foreshore. There are, however, pocket shingle beaches trapped in a limited number of small sheltered bays formed between rock outcrops. In addition, a shingle bank exists between the main part of the island and Lissroy peninsula (extending from the southern corner of the island).

The coastal processes around Lihou island are similar in character to those at the L'Erée headland, with exposed rock platforms forming the foreshore. The exposed nature of the island results in few mobile sediments being evident on the foreshore.

Coastal Defences

The L'Erée headland is defended by natural rocky outcrops. Erosion of the soft upper cliffs is occurring along the exposed southern and eastern edges of the headland.

The only built defences on Lihou Island are located in front of Lower House (adjacent to the point where the causeway meets the island) and in front of the priory. The defences at Lower House are constructed from rock boulders and protect the slipway access to the island and assets connected with the property (the boundary wall to the property is approximately 5m from the crest of the rock protection). The rock protection adjacent to the priory protects the remains of the priory church. The residual life of the defences is estimated to be 10 to 25 years. Erosion of the soft upper cliff is evident at various locations around the island.

These defences are shown in Figure 6.4 at the end of this sub-section.

CU4

Land Use and Human and Built Environment

The L'Erée headland is perhaps one of the more prominent and historically important areas along the west coast of Guernsey. As with the majority of the western headlands, it is largely undeveloped apart from a couple of residences and glasshouses. A minor road provides access to car parking at the western end of the headland opposite Lihou Island. Limited car parking is also available off the main coast road where it turns sharply to the east at the north-eastern end of the headland.

The well-preserved Megalithic passage tomb, Le Creux és Faies, situated towards the centre of the headland, is well outside the influence of coastal processes but provides an indication of the archaeological importance of the area. This is further enforced by the presence of an important prehistoric site on the southern side of the headland. The low cliff at the rear of the beach contains layers of sediment that yield large quantities of pottery and flint and traces of stone and post-built structures. Pottery from a lower layer appears to date from Neolithic times (c. 3,500 BC) while higher up the sequence, pottery of Beaker type is dated at about 2000 BC. Potentially, this site may be one of the more important Neolithic sites in western Europe. The low cliff yielding the pottery is presently prone to coastal erosion and important archaeological remains are being lost. Fort Saumarez, located on the northern side of the headland is one of the best-known landmarks on the west coast of Guernsey. The fort was one of three Martello Towers built in 1805 to ward off potential coastal attack at a time when there was mounting Franco-British tension. During World War II, the Germans fortified the entire headland and added the lofty and prominent direction-finding tower on top of the original Martello Tower.

Lihou Island occupies the most westerly point of the Channel Islands, being situated 400m off the west coast of the L'Erée headland. It can be reached via a causeway at low water that has been used for a number of centuries, during which time it has been of great importance to vraic (seaweed) gatherers. Lihou is an important archaeological site and has certainly been settled since the 12th century when the Priory Church of St Marie de Lihou was founded by the great Abbey of Mont St Michel in Normandy. The Priory continued in use until the 16th century when it was converted into a farmhouse. Only parts of the walls remain, the rest of the church having been destroyed during the Napoleonic War and by German troops in World War II. The one house on the island is owned by the States Board of Administration and is currently used for residential visits by schools and other parties.

Natural Environment

Both the L'Erée headland and the majority of Lihou Island are formed in the L'Erée Granite. The low cliffs at the western end of the headland in the vicinity of the slipway provide good exposure through the 8m raised beach and overlying loess deposits.

The main part of the L'Erée headland is covered by scrub, bracken (*Pteridium aquilinum*) and rough maritime grassland vegetation. The flora around the fringes of the rocky shores is typical of this type of habitat and includes species such as thrift (*Armeria maritima*) and rock samphire (*Crithmum maritimum*). The slopes below Fort Saumarez are partially wooded with Scots pine and cultivated shrubs.

Lissroy, at the southern end of Lihou Island, is a bird reserve and is an important nesting area for species such as oyster-catchers and turnstone. There is also a small breeding common tern colony, which is protected during the breeding season by the erection of ropes and a warning sign. In addition, Lihou's position on the west coast make it one of the first landfalls for migrating birds, and over 100 species have been recorded in the last 30 years.

Species-rich maritime grassland covers much of the central spine and western and northern flanks of Lihou Island. A large part of this used to be intensively grazed by sheep and is still partially grazed by the resident rabbit population. Species to note include a large population of autumn squill (*Scilla autumnalis*), dwarf pansy (*Viola kitaibeliana*), sand quillwort (*Isoetes histrix*) and small adder's tongue fern (*Ophioglossum azoricum*).

At low water, an extensive rocky intertidal zone, considered to be the largest of its kind in western Europe, is revealed. Its size is reflected by the fact that, in a survey conducted in 1961, no less than 118 species of seaweed were recorded, five of which were the only records in the Channel Islands.

Planning Policies

The entire unit is classified as an Area of Special Environmental Importance (Green Zone 1). The south-eastern side of the L'Erée headland is an identified Enhancement Target Area (covered by policies CE10 and CE11). These areas are subject to the relevant conservation and enhancement policies set out in the Rural Area Plan (Phase 2).

b) Key Interests within Unit

The following list highlights the main interests within the unit that have the potential to interact with, or be influenced by, coastal defence policies. They are:

- slipway access onto the Lihou Island causeway
- Lower House (Lihou Island)
- archaeological interests of the headland and Lihou areas
- intertidal flora and fauna.

c) Appraisal of Strategic Options

Do Nothing

If nothing is done to maintain or improve the defences on L'Erée headland and Lihou Island, the following scenarios over the 50-year period covered by the strategy are envisaged:

i) In the short term, the continuing erosion of the soft upper cliffs owing to wave action could result in the loss of archaeological remains on the southern side of L'Erée headland.

ii) In the medium term, the slipway on L'Erée headland would fail. This would result in the loss of vehicular access to Lihou Island from the headland.

iii) In the long term, the rock protection on Lihou Island would fail resulting in erosion of the soft upper cliffs. This would result in the loss of the slipway and vehicular access to the island, the loss of land connected to Lower House and damage to the remains of the priory.

The Do Nothing option would result in economic damage through the loss of vehicular access to Lihou Island, and deterioration of the defences on the island would result in erosion of the coastal edge. This option of Do Nothing does not satisfy all the Objectives set out in Section 2.3.

For these reasons the option is rejected.

Do Something

From the above discussion it is evident that the Do Something option should be adopted if a viable scheme can be identified. Sustaining the man-made structures at their present standard would address the problems of deterioration. For the majority of the undefended cliff line, continued erosion is not considered a major issue. However, on the south coast of the headland it would result in the loss of the important archaeological resource. For this reason options to improve the standard of defence are also included under the Do Something option.

d) Do Something Potential Scheme Options

The reasoning described in Section 5.3.3 (Possible Defence Methods) together with the problems and issues referred to above, results in the selection of two options for appraisal.

Technical and Environmental Appraisal

Option 1 – Continue Existing Practice (Sustain)

Option 1 comprises the following elements:

- continue existing practice by limited tipping of rock to the existing rock protection
- annual inspections of the defences.

Continuing existing practice and regular inspections of the rock protection would ensure that the defences protect the assets of the unit for the life of the strategy.

Continued maintenance of existing coastal defences within the unit is unlikely to have any significant impact on environmental interests, apart from the archaeological assets on the headland, and would provide adequate protection to ensure continued access to Lihou Island and protection to the Lower House.

The continued erosion on the southern side of the L'Erée headland, would lead to the loss of important archaeological remains. This option would not provide sufficient protection to this resource.

Option 2 – Excavation and/or Protection of Archaeological Resource (Improve)

Option 2 comprises the following elements:

- as Option 1
- excavation and/or protection of archaeological resource.

CU4

Continuing existing practice and regular inspections of the rock protection in conjunction with the protection of the archaeological resource, by either the construction of temporary defences or the immediate excavation of the area at risk, would ensure that the defences protect the assets of the unit for the life of the strategy.

Ensuring that the interest of the archaeological site on the south coast of the headland is maintained is a priority. This important archaeological resource is presently threatened by coastal erosion, which could result in the loss of valuable artefacts, information and knowledge. Two basic solutions are available to deal with this issue. Firstly, survey work to determine the overall extent of the area of interest and then, depending upon the results of this work, detailed excavation of those sections/areas at most risk from erosion. Secondly, protection of the cliff section to ensure that the loss of archaeological interest through erosion is limited. This second solution would need careful planning, ideally with an initial survey to determine the extent of interest, to ensure that any proposed works did not in themselves cause more damage to the site than that caused by coastal erosion. One possible solution would be to construct an access ramp down the low cliff, to one side of the section, down which materials could be transported and then placed in front of the eroding cliff section. A rock revetment could provide a suitable level of protection.

Economic Appraisal

Benefits

Table CU4.1 gives the estimated value of the assets protected by the defences within CU4.

Table CU4.1 Benefits

Assets	Area/Length	Value (£)
Flooding		
Developed Land	N/A	-
Undeveloped Land	N/A	-
Erosion		
Minor Road	N/A	-
Coast Road	N/A	-
Ribbon Development	200m	650,000
	Total	**650,000**
	Discounted Total	**271,000**

Notes: The following intangible benefits are not included in the above table:

- archaeological interests of the headland and Lihou areas
- intertidal flora and fauna.

Therefore the benefits derived for CU4 are likely to be an underestimate of the actual value.

Costs

Table CU4.2 gives the estimated value of the costs associated with Options 1 and 2.

Table CU4.2 Costs

Option	Initial Capital Cost (£)	Future Costs (£)		Total Discounted Cost (£)
		Capital	Maintenance	
1	N/A	N/A	270/year	**4,500**
2	60,000	N/A	720/year	**72,000**

Results

Table CU4.3 gives the results of the economic appraisal for Option 1.

Table CU4.3 Results

Option	Benefit–Cost Ratio
1	60
2	3.8

e) Selection of Preferred Strategic Option

Table CU4.4 summarises the results of the appraisal process for CU4.

Table CU4.4 Summary of Appraisals

Option	Technical Appraisal	Environmental Appraisal	Economic Appraisal
1 • continue existing practice	• ensures integrity of defences	• loss of archaeology	• viable
2 • excavate/protect archaeology	• ensures integrity of defences	• no loss of archaeology	• viable

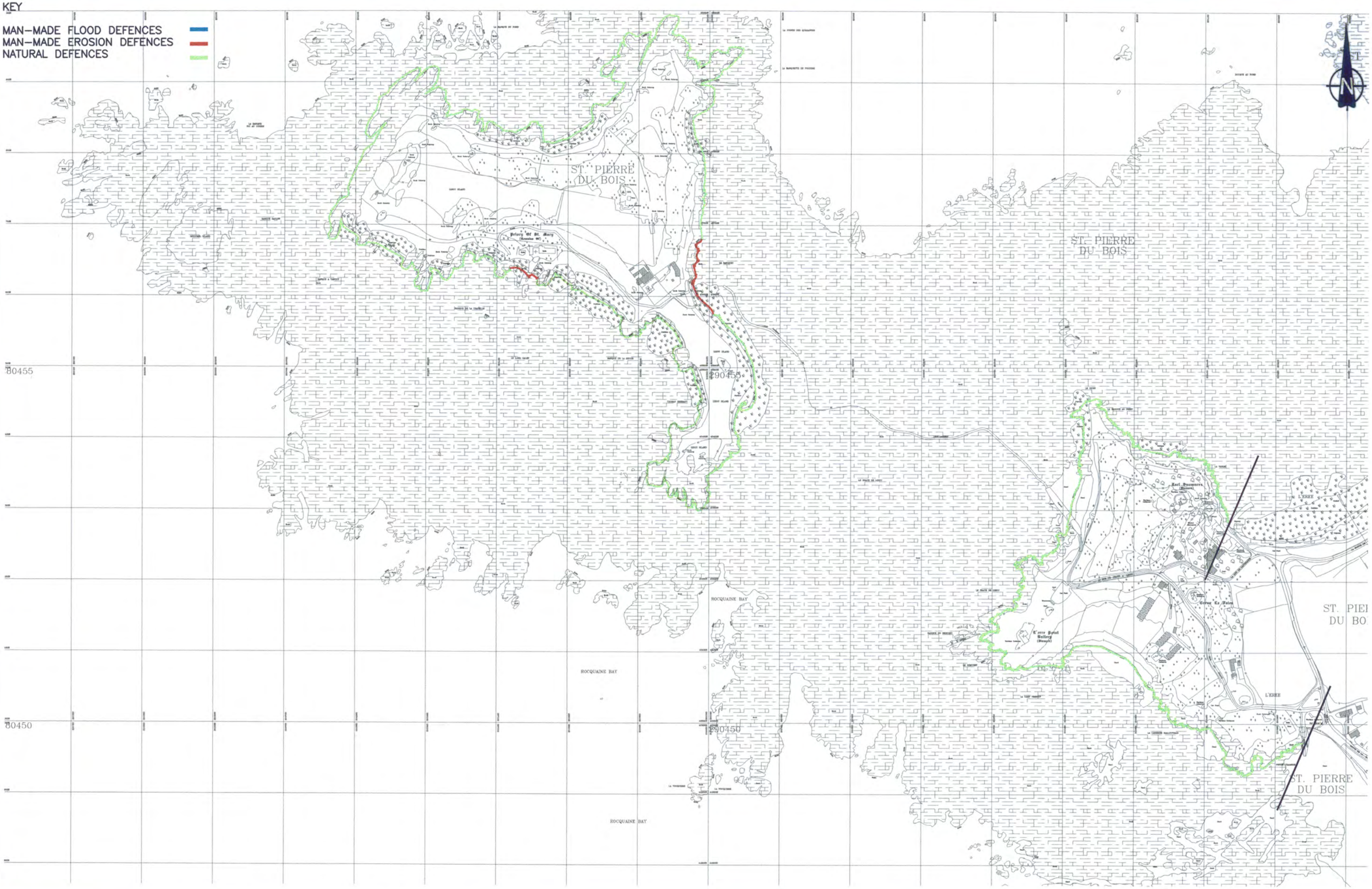
Option 1 is not environmentally acceptable because it would result in the loss of the archaeological assets on the south coast of L'Erée Headland.

Option 2 is technically sound, environmentally acceptable and economically viable and is, therefore, selected as the appropriate strategy for the unit.

As noted under the description of Option 2, two solutions are available to overcome the threat to the archaeological resource on the south coast of the L'Erée Headland. The Option 2 costs given in Table CU4.2 assume rock protection is provided, however, an alternative would be to use the money that would be spent on defending the headland to fund an archaeological excavation.

KEY

MAN–MADE FLOOD DEFENCES
MAN–MADE EROSION DEFENCES
NATURAL DEFENCES



PROJECT: GUERNSEY STRATEGY FOR COASTAL DEFENCE AND BEACH MANAGEMENT	TITLE: COASTAL UNIT 4 — L'Eree Headland and Lihou Island	CONSULTING ENGINEERS: POSFORD DUVIVIER	Job No. E3309	DATE FEB'99	SCALE 1:5,000
			ACAD Ref.	CHECKED JEC	PASSED AJS
			DRAWN MDWP	DRG No. FIGURE 6.4	REV

6.5 Coastal Unit 5 – Fort Saumarez to Le Catioroc

a) Attributes

Introduction

Coastal Unit 5 is located on the west side of the island and extends from Fort Saumarez to Le Catioroc (see Figure 6.5) and is approximately 1,000m in length. The unit comprises two frontages: one facing north west, known as Les Anguillières; and one facing north, referred to as La Haute Banque.

Coastal Processes and Beach Behaviour

A shingle beach characterises much of the unit. Intermittent pockets of sand are found at the eastern end of the north-west facing frontage, Les Anguillières. The extreme eastern end of the unit comprises a rocky foreshore.

The unit is protected from westerly waves by Lihou Island and L'Erée headland. Waves from the north and north east are "funnelled" into the unit by the outcrops of rock that lie offshore and, as a result, approach the frontage in a broadly normal direction.

As waves do not, in general, approach the shoreline at an oblique angle there is only limited longshore movement of sediment through the unit. The frontage is, however, subject to considerable offshore sediment movements during storms leading to significant profile changes within the shingle bank and exposure of the toe protection to the seawall. The extent to which drawdown and permanent loss of material occurs is not known.

Coastal Defences

The unit comprises a combination of natural and man-made defences. There is a short length of rock protection defending a bank in the south-western end of the unit. A natural shingle bank, Les Anguillières, which was formed when the last ice age ended, protects the low-lying hinterland along approximately half of the north-west facing coast. The shingle bank is actively managed.

A length of rock revetment protects a man-made embankment in the centre of the north-west facing coast, and a masonry wall with a beam and buttress arrangement defends the eastern end of the north-west facing frontage. La Haute Banque is protected by a vertical masonry wall with a sloping masonry apron. The apron is exposed at the western end, adjacent to the slipway. A short length of rock revetment defends the eastern end of the unit.

Generally, the defences are in good condition, having a residual life of between 10 and 25 years. The shingle bank, however, has insufficient volume to be able to respond to storm waves without endangering the crest and has a residual life of between 0 and 10 years. The loss of the crest could lead to a breach and flooding of the low-lying land behind. This occurred most recently in early 1999. In coastal defence terms, the bank provides a low standard of defence against overtopping.

These defences, together with the area at risk from flooding, are shown in Figure 6.5 at the end of this sub-section.

CU5

Land Use and Human and Built Environment

The coast road runs directly behind the shingle ridge and coastal defences in the northern section of the unit. Landward of the shingle ridge, within the south-western half of the unit, land use is agricultural (pasture) with some rough grassland/scrub. This land is occasionally used to site public events, e.g. at the time of the site inspection visit (September 1998) a circus was present in the south-western field. To the north-east, land behind the coast road is either in agricultural or horticultural production with a number of residential properties and glasshouses.

Due to the rocky foreshore and shingle shoreline recreational use within the unit is limited to walking. A slipway provides access to the rocky shore at the north-eastern end of the shingle ridge.

No sites of archaeological interest have been identified in this environmental review.

Natural Environment

The shingle ridge at Les Anguillières represents the remnants of a storm beach pushed up as sea levels rose following the end of the last glaciation some 10,000 years ago. The brackish lagoon trapped behind the ridge gradually infilled with peat deposits leading to the formation of La Claire Mare. The area is now a nature reserve. The shingle bank acts as natural sea defence providing protection to the northern end of La Claire Mare. The bank is jointly managed by the Board of Administration and La Société Guernesiaise, and is one of Guernsey's unique habitats supporting a diverse range of plants. On the landward side of the bank some of the more interesting species include wild leek (*Allium ampeloprasum*), compact broom (*Cytisus scoparius* subsp. *maritimus*), Greek sand spurrey (*Spergula bocconii*) and yellow vetch (*Vicia lutea*). Sea kale (*Crambe maritima*), sea beet (*Beta vulgaris* spp. *maritima*) and sea sandwort (*Honkenya peploides*) occur on the seaward side of the ridge.

La Claire Mare Nature Reserve behind the shingle ridge (and coast road) is one of the more important wildlife areas on the island. It comprises of three main habitat types; open grassland, reed beds and open water, all of which provide wintering and breeding habitat for a diverse number of birds, including the rare aquatic warbler (*Acrocephalus paludicola*). In addition the fields support an interesting flora including large numbers of loose-flowered orchid (*Orchis laxiflora*) and common adder's tongue fern (*Ophioglossum vulgatum*). Both the shingle ridge and La Claire Mare are included within the L'Erée SNCI.

The variety of substrate types within the unit make this an important site for marine flora and fauna (see Section 3.4.4 for additional details).

Planning Policies

The entire coastal frontage is an Area of Special Environmental Importance (Green Zone 1). The majority of the land situated landward of the coast road along the north-eastern half of the unit is classified as Areas of Landscape Value (Green Zone 2; covered by policy CE6) or Areas of Rural Character (Green Zone 3). These areas are subject to the relevant conservation and enhancement policies set out in the Rural Area Plan (Phase 2).

CU5

b) Key Interests within Unit

The following list highlights the main interests within the unit that have the potential to interact with, or be influenced by, coastal defence policies. They are:

- residential properties
- coast road
- shingle ridge at Les Anguillières
- La Claire Mare Nature Reserve.

b) Appraisal of Strategic Options

Do Nothing

If nothing is done to maintain or improve the defences between Fort Saumarez and Le Catioroc, the following scenarios over the 50-year period covered by the strategy are envisaged:

i) In the short term, successive damage to the shingle bank caused by wave action would result in a breach (or breaches) and flooding of the coast road and low-lying agricultural land behind.

ii) In the short to medium term, storms would gradually widen the breach (or breaches) in the shingle bank leading to regular flooding of the coast road and agricultural land.

iii) In the medium to long term, the shingle bank would be lost through erosion owing to wave action, together with the coast road. Elsewhere within the unit, structural failure of the seawall and rock revetment would occur leading to loss of the coast road, damage to and loss of properties and loss of the slipway access to the beach.

The Do Nothing option would result in economic damage through the loss of the developed and undeveloped land through flooding and erosion. In total approximately 26 hectares of undeveloped land, 6 hectares of developed land and the coast road would be affected. This option of Do Nothing does not satisfy all the Objectives set out in Section 2.3.

For these reasons the option is rejected.

Do Something

From the above discussion it is evident that the Do Something option should be adopted if a viable scheme is identified. Sustaining the defences at their present standard would not address the problems of overtopping of the shingle bank, which causes localised flooding and closure of the coast road. Therefore options to improve the standard of defence are also included under Do Something.

e) Do Something Potential Scheme Options

The reasoning described in Section 5.3.3 (Possible Defence Methods) together with the problems and issues referred to above, results in the selection of four options for appraisal.

CU5

Technical and Environmental Appraisal

Option 1 – Continue Existing Practice (Sustain)

Option 1 comprises the following elements:

- continue existing practice by re-profiling of the shingle bank after storm events, limited tipping of rock to the existing rock protection and regular re-pointing of the masonry structures
- monitor toe protection of man-made defences after storm events and undertake repair works as necessary
- annual inspection of defences.

Continuing the existing practice of maintaining the seawalls should ensure their integrity for the life of the strategy. The existing practice of periodically re-profiling the shingle bank would not reduce the risk of a breach and flooding of the coast road and low-lying land.

Continued breaching and re-profiling of the shingle ridge would, over time, result in the development of a much impoverished shingle flora community. The vegetation on the landward side has developed under partially stabilised conditions and is in some respects not representative of a true saline-influenced coastal shingle substrate. Many of the species present here would disappear through continued re-profiling work owing to the additional substrate mobility this would impart, disturbance caused by the activity itself and through the potential increase in frequency of saline overtopping.

Similarly, a potential increase in the inundation of low-lying land behind the shingle ridge and adjacent defences would detrimentally impact upon the existing ecological interest of La Claire Mare Nature Reserve. Freshwater and open grassland habitats would be lost in the long term and would deteriorate in quality and extent over the short to medium term. However, these habitats would be replaced by different habitats, e.g. saline lagoon, saltmarsh and brackish grassland, that would also be of ecological value.

Undertaking repairs to the existing seawalls would not have any detrimental impact on the identified environmental interests.

Option 2 – Beach Nourishment (Improve)

Option 2 comprises the following elements:

- as Option 1, except no re-profiling of the shingle bank
- beach nourishment with shingle
- regular surveys of the newly nourished beach.

Nourishment of the shingle bank would increase the volume of the ridge and allow the bank to adjust its profile under storm conditions without endangering the continuity of the crest. This would reduce the risk of overtopping leading to the closure of the coast road and flooding of low-lying land. The scheme would address the problem of overtopping within the unit.

Other technical issues are as discussed in Option 1.

During storms, shingle beaches have a tendency to move landward and develop ridges. If the ridges are close to the crest of the defences, there is a possibility that shingle overtopping will occur. The careful design of the nourishment should, however, largely eliminate potential problems.

Potentially, beach nourishment could overcome virtually all the adverse environmental impacts associated with overtopping and inundation of low-lying land, as identified for Option 1.

In addition, nourishment would enable a more natural shingle ridge to develop, with consequent benefits for its overall ecological interests. The initial nourishment operation could have a detrimental impact on the existing flora. However, over a relatively short period of time re-colonisation of the areas affected by shingle placement would occur. Allowing some dynamic movement of the ridge would also benefit the overall floral community and prevent succession on the landward side to a more scrub dominated flora.

Movement of shingle out onto the rocky intertidal area could have some impact on existing hard substrate communities. This area is of known importance for its intertidal ecology and further information on the ecology of the intertidal platform would be required to provide a reasonable assessment of the potential impacts of beach nourishment. Nourishment with shingle is compatible with existing substrate conditions and is therefore unlikely to impact upon the limited recreational beach activity that takes place within the bay. However, it should be ensured that nourishment did not interfere with the use of the slipways within the unit.

Undertaking repairs to the existing seawalls would not have any detrimental impact on the identified environmental interests.

Option 3- Rock Revetment (Improve)

Option 3 comprises the following elements:

- as Option 1, except no re-profiling of the shingle bank
- rock revetment along shingle ridge.

The construction of a rock revetment would eliminate the profile changes that occur on the upper section of the shingle bank during storms. This would ensure the continuity of the crest and reduce the level of overtopping and the risk of a breach occurring. The scheme would address the problem of overtopping within the unit.

Other technical issues are as discussed in Option 1.

The emplacement of a rock revetment could overcome virtually all the adverse environmental impacts associated with overtopping and inundation of low-lying land, as identified for Option 1.

However, a rock revetment along the seaward edge of the ridge would destroy the existing shingle ecology of this area. In addition, the landward side of the ridge would become stabilised resulting in the loss of species adapted to a more mobile shingle substrate and the establishment of a different community with fewer specialist species. In ecological terms, this could represent a loss to the biodiversity of the island.

Undertaking repairs to the existing seawalls would not have any detrimental impact on the identified environmental interests.

Option 4 – Reinforced Concrete or Masonry Wall (Improve)

Option 4 comprises the following elements:

- as Option 1, except no re-profiling of the shingle bank
- reinforced concrete or masonry wall along shingle ridge.

The construction of a concrete or masonry seawall along the crest of the shingle bank would ensure the continuity of the crest. This would reduce the level of overtopping and the risk of a breach occurring. The construction of a seawall would increase the mobility of the bank and lead to a loss of material. A substantial toe would, therefore, be needed to prevent the seawall being undermined. The scheme would address the problem of overtopping within the unit.

Other technical issues are as described in Option 1.

Undertaking repairs to the existing seawalls would not have any detrimental impact on the identified environmental interests.

The construction of a concrete or masonry seawall could overcome virtually all the adverse environmental impacts associated with overtopping and inundation of low-lying land, as identified for Option 1.

However, a seawall of the size required to prevent overtopping and to prevent undermining would effectively destroy the existing shingle bank and its associated ecological interests.

Option 5 – Inland Flood Bank (Retreat)

Option 5 comprises the following elements:

- as Option 1, except no re-profiling of the shingle bank
- abandonment of the shingle bank defences
- construction of an inland flood bank
- realignment of the coast road.

The abandonment of the shingle bank would lead to regular breaching and, in the medium to long term, the loss of the entire bank. To prevent flooding of the residential areas of St Pierre du Bois, a set back flood bank would be constructed across the agricultural land to the south of the shingle bank. The majority of this bank could be constructed from clay fill, however, at the point where it ties into the existing seawall, rock protection would be required. The coast road would also be realigned so as to run behind (landward of) the new flood bank.

With regular breaching and saline inundation of land behind the ridge, this option would result in the permanent loss of an area of land currently used for agricultural purposes (permanent pasture) and occasionally used for public events. The section of coast road behind the ridge would be lost, resulting in increased traffic flow through the more residential areas to the rear of La Claire Mare. However, with the provision of a new road behind the flood bank access to the north and onto the Fort Saumarez headland, would be maintained, although ease of access to the fort for visitors, many of whom park at the western end of the ridge, could be compromised. Set back of the road behind a flood bank would prevent the disruption to traffic that is presently caused during overtopping of the shingle ridge.

Abandoning the shingle ridge would allow it to adopt a more natural profile. However, as a result, the existing floral community on the landward side of the ridge would be significantly altered. Only those species that are tolerant of repeated saline inundation, e.g. during overtopping, would remain. In the longer term, as the shingle moved landward, the flora would succeed to resemble that of the existing seaward face and comprise species such as sea kale and sea sandwort.

With the natural re-profiling of the shingle ridge, there would be a significant increase in the saline inundation of the existing open grassland habitat behind the ridge. This area of habitat (and agricultural land) would be lost in the long term, and would deteriorate in quality and extent over the short-medium term. However, retreat could also offer some ecological benefit with the grassland being replaced by coastal habitats such as saline lagoon or saltmarsh. In addition, the construction of the flood bank could protect existing open grassland and freshwater habitats from saline intrusion.

Economic Appraisal

Benefits

Table CU5.1 gives the estimated value of the assets protected by the defences within CU5.

Table CU5.1 Benefits

Assets	Area/Length	Value (£)
Flooding		
Developed Land	5.9ha	7,670,000
Undeveloped Land	26.3ha	487,000
Erosion		
Minor Road	N/A	-
Coast Road	1,000m	900,000
Ribbon Development	N/A	-
	Total	**9,057,000**
	Discounted Total	**6,471,000**

Notes: 1. The following intangible benefits are not included in the above table:
- the vital communication link provided by the coast road
- shingle ridge at Les Anguillières
- La Claire Mare Nature Reserve.

Therefore the benefits derived for CU5 are likely to be an underestimate of the actual value.

2. The discounted benefits for Option 5 reduce to £6,395,000 because of the loss of undeveloped land.

Costs

Table CU5.2 gives the estimated value of the costs associated with Options 1 to 4.

Table CU5.2 Costs

Option	Initial Capital Cost (£)	Future Costs (£)		Total Discounted Cost (£)
		Capital	Maintenance	
1	N/A	N/A	4,725/yr	**79,000**
2	1,052,000	210,000/10yrs	4,725/yr	**1,216,000**
3	1,264,000	N/A	6,390/yr	**1,051,000**
4	1,850,000	N/A	6,390/yr	**1,489,000**
5	560,000	N/A	4,725/yr	**497,000**

Results

Table CU5.3 gives the results of the economic appraisal for Options 1 to 4.

Table CU5.3 Results

Option	Benefit–Cost Ratio
1	82
2	5
3	6
4	4.3
5	13

It should be noted that the economic appraisal over estimates the benefit–cost ratio for Option 1, as no account has been taken of the significant residual damages that would occur in this case (i.e. sustaining the defences at the current low standard would mean that the regular closure of the coast road, and flooding of the low-lying land, would continue).

e) Selection of Preferred Strategic Option

Table CU5.4 summarises the results of the appraisal process for CU5.

Table CU5.4 Summary of Appraisals

Option	Technical Appraisal	Environmental Appraisal	Economic Appraisal
1 • continue existing practice	• does not address breaching and overtopping problems	• detrimental impacts on environmental interests	• viable
2 • beach nourishment	• addresses breaching and overtopping problems	• no significant concerns	• viable
3 • rock revetment	• addresses breaching and overtopping problems	• detrimental impacts on foreshore environmental interests	• viable
4 • concrete/masonry wall	• addresses breaching and overtopping problems	• detrimental impacts on foreshore environmental interests	• viable
4 • inland flood bank	• addresses breaching and overtopping problems	• no significant concerns	• viable

Option 1 does not address the issues of breaching and overtopping within the unit and, in addition, has detrimental effects on the environmental interest of the shingle bank. For these reasons the option is rejected.

Options 2, 3, 4 and 5 are all technically sound and economically viable. However, Option 3 and Option 4 would have detrimental impacts on the shingle bank and foreshore ,whereas Option 2 and Option 5 could have ecological benefits. For this reason Option 3 and Option 4 are rejected.

On economic grounds, Option 5 is more attractive than Option 2.

Option 5 is technically sound, economically viable and, potentially, environmentally acceptable. However, there remain a number of environmental issues that need to be investigated before this option could be adopted.

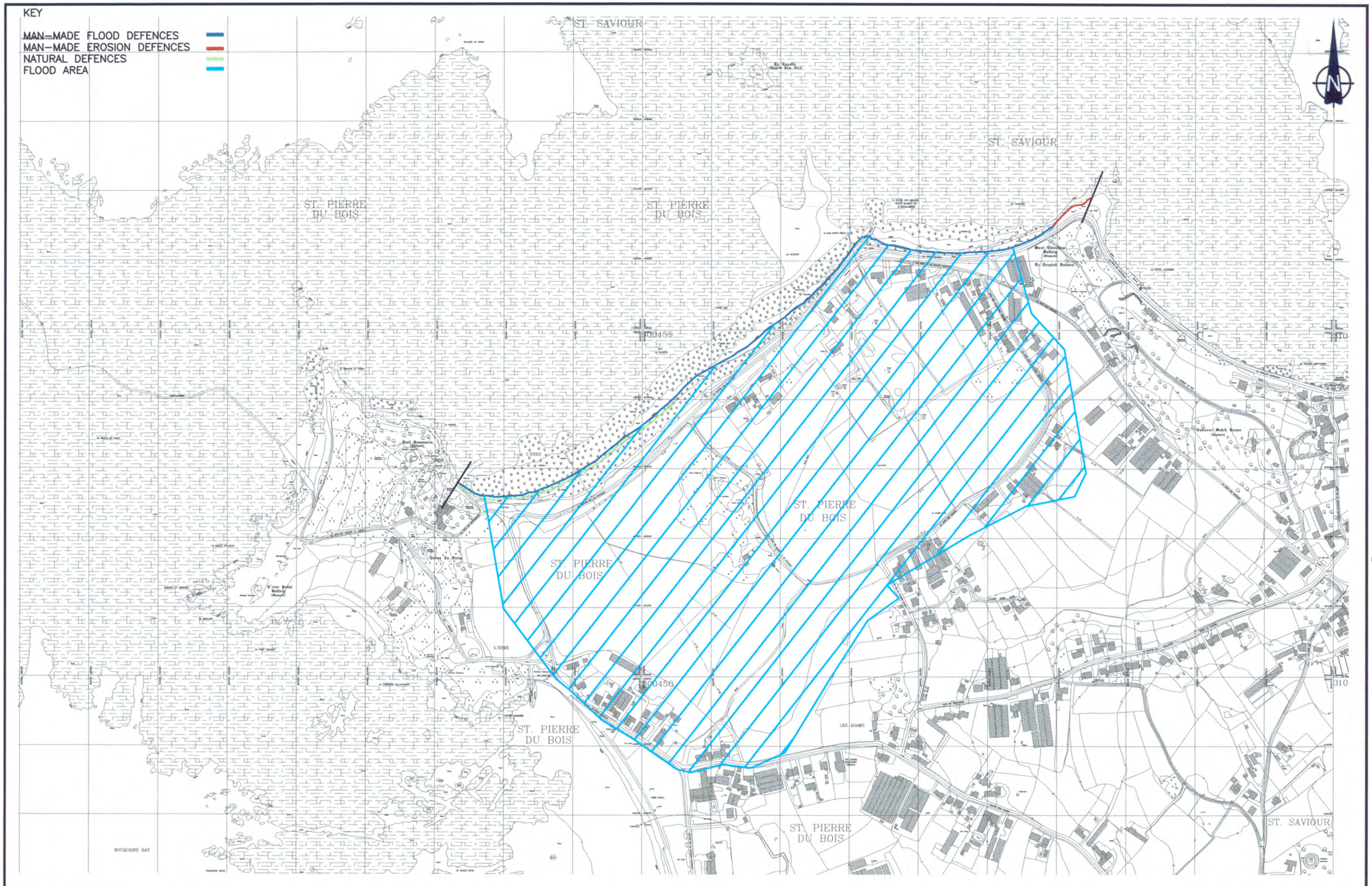
CU5

On the basis of the above, the following is proposed for the unit:

- initially, Option 1 is adopted as the preferred option.
- studies are undertaken to confirm the environmental viability of Option 5.
- on completion of the above studies, a decision is taken as to whether to adopt Option 5. If this option proves to be unacceptable, further consideration should be given to Option 2.

As noted, the long-term behaviour of the beach fronting the seawalls (east of the shingle bank) is not known and there is a possibility that, in the future, additional toe protection may be required. The condition of the toe protection to the seawall should be carefully monitored during an annual inspection of the defences and selected strategy reviewed in five years' time.

The selection of Option 5 (inland flood bank) is a significant departure from the existing defence methods within the unit. Before implementing the preferred strategy, further detailed studies into the issues associated with beach nourishment should be undertaken.



PROJECT	TITLE	CONSULTING ENGINEERS		
GUERNSEY STRATEGY FOR COASTAL DEFENCE AND BEACH MANAGEMENT	COASTAL UNIT 5 Fort Saumarez to Le Catioroc	POSFORD DUVIVIER	Job No. E3309 ACAD Ref. DRAWN MDWP	DATE FEB'99 CHECKED JEC DRG No. FIGURE 6.5
			SCALE 1:5,000 PASSED AJS REV	

6.6 Coastal Unit 6 – Le Catioroc to Fort Richmond (Perelle Bay)

a) Attributes

Introduction

Coastal Unit 6 is located on the west coast of the island (see Figure 6.6) and extends the length of Perelle Bay (a distance of 1,200m), between Le Catioroc Point and the Fort Richmond headland.

Coastal Processes and Beach Behaviour

The bay comprises a rocky foreshore with a small sand and shingle beach against the seawall.

Le Catioroc Point and the Fort Richmond headland, together with rock outcrops within Perelle Bay, tend to "funnel" the waves into the bay. As a consequence, waves approach broadly normal to the shoreline and there is limited longshore movement of sediment through the bay. There are, however, localised longshore effects on the beach plan shape brought about by rock outcrops.

Despite comparatively low longshore transport, the high wave energy that acts on the west coast, combined with the wave direction in Rocquaine Bay results in cross-shore movement of material during storm attack. The extent to which drawdown and permanent loss of material occurs is not known.

The plan shape of the storm beach is dictated by the outcropping rocks within the bay, which appear to pull sediment into their lee and accentuate the low beach levels between these outcrops, exposing the toe of the seawall. In addition, the plan shape is affected by the offshore movement of sediment during storms, which can further lower the beaches along the exposed lengths between the rock outcrops.

Coastal Defences

The entire bay is protected by a vertical masonry seawall. In the south west and north east corners of the bay the wall protects the coastline (and adjacent road) from erosion. In the central section the land is low lying and the seawall prevents both erosion of the foreshore and flooding. Generally, the residual life of the defences within the bay is between 10 and 25 years.

A length of beach in the centre of the bay has been reduced to the underlying clay and peat layer and the toe of the seawall is exposed. The exposure of the toe would lead to a failure of the seawall through continuing erosion of the clay and peat and undermining of the foundations. This length of wall is estimated to have a residual life of less than 10 years.

Trial pits dug in autumn 1998 indicated that in the centre of Perelle Bay there was less than 0.3m of mobile sediment above the clay layer and the beach level was approximately level with MHWS. Towards the northern end of the unit there was about 1.5m of mobile sediment above the peat layer and the beach level was approximately 0.4m above MHWS. These levels support the beach processes described above.

Mathematical modelling has demonstrated that the present standard of defence with regard to overtopping is medium. Overtopping rates are such that closure of the coast road, and localised flooding of the properties within Perelle Village, occurs regularly during winter months. Low beach levels enable larger waves to be propagated at high tide right up to the seawall, resulting in overtopping. However, even under extreme conditions, overtopping quantities are unlikely to be sufficient to result in a breach through wash out of the rear face of the wall.

These defences, together with the area at risk from flooding, are shown in Figure 6.6 at the end of this sub-section.

Land Use and Human and Built Environment

Perelle is one of the smaller bays on the west coast and can effectively be split into two distinct areas. The western third of the bay is backed by a partially wooded escarpment that forms a spur of land running down to the headland of Le Catioroc. The rest of the bay is backed by low-lying land, formerly one of the west coast mares. This land is now in residential and horticultural (glasshouses) use, forming part of the settlements of St Saviour and Richmond. The coast road runs immediately landward of the existing coastal defences along the perimeter of the bay before turning to the east at the southern end of the Richmond headland. Car parking is available at Le Catioroc.

In comparison with the main bays of the west coast, such as Rocquaine and Vazon, Perelle Bay is less important from a recreational perspective. This reflects the lack of an extensive sandy beach, although it is probably important as a boat launching/landing area as shown by the three slipways located within the bay.

There are two important archaeological sites on the southern side of the Bay. Chemin-Le-Roi, once the King's Highway, runs along the spur of land down to Le Catioroc headland. This route is of medieval origin and its course around the island included loop roads to particular promontories in the south and west. At the western end of the headland is the megalithic burial chamber of Le Trepiéd, one of about 15 that remain on the island. The location of both sites on the ridge on the southern side of the bay precludes them from any likely impacts resulting from either coastal processes or coastal defence works.

Natural Environment

As for a large part of the west coast, the main interest at Perelle Bay relates to the shallow marine habitats provided by the intertidal reefs and flats. The wide variety of substrate types support a range of marine flora and fauna for which the west coast is particularly important (see Section 3.4.4).

At low water, the intertidal flats also provide one of the more important feeding areas for waders on the west coast. After storms or rough weather large amounts of seaweed can be brought into the bay. As this rots down it provides a large food resource for a diverse range of littoral organisms such as sandhoppers, which in turn are important prey for wading birds like turnstone The relatively sheltered waters of the bay provide refuge and feeding for marine bird species such as divers, grebe and sea-duck.

Coastal habitats are restricted to an area of rough grassland at Le Catioroc headland.

CU6

Planning Policies

The entire coastal frontage is an Area of Special Environmental Importance (Green Zone 1). The majority of the developed land situated landward of the coast road is classified as a Built-Up Area. These areas are subject to the relevant conservation and enhancement policies set out in the Rural Area Plan (Phase 2).

b) Key Interests within Unit

The following list highlights the main interests within the unit that have the potential to interact with, or be influenced by, coastal defence policies. They are:

- Perelle Village
- coast road
- slipway access to the beach
- intertidal fauna and flora.

c) Appraisal of Strategic Options

Do Nothing

If nothing is done to maintain or improve the defences within Perelle Bay, the following scenarios over the 50-year period covered by the strategy are envisaged:

i) In the short term, failure of a length of seawall within the centre of the bay as the foundations are undermined through erosion of the clay/peat caused by wave action would result in the loss of sections of the coast road and damage to properties along the frontage.

ii) In the medium to long term, failure of the entire seawall would occur owing to deterioration caused largely by wave action. Do Nothing would lead to loss of the remaining coast road, damage to and loss of properties.

The Do Nothing option would result in economic damage through the loss of the developed and undeveloped land through flooding and erosion. In total approximately 6 hectares of undeveloped and 2 hectares of developed land would be affected. This option of Do Nothing does not satisfy all the Objectives set out in Section 2.3.

For these reasons the option is rejected.

Do Something

From the above discussion it is evident that the Do Something option should be adopted if a viable scheme can be identified. Sustaining the defences at their present standard would not address the problems of overtopping causing localised flooding and closure of the coast road. Therefore options to improve the standard of defence are also included under Do Something.

d) Do Something Potential Scheme Options

The reasoning described in Section 5.3.3 (Possible Defence Methods) together with the problems and issues referred to above, results in the selection of four options for appraisal.

Technical and Environmental Appraisal

Option 1 – Continue Existing Practice (Sustain)

Option 1 comprises the following elements:

- continue existing practice by regular re-pointing of the masonry structures
- toe protection to the short length of wall that is being undermined
- monitor toe protection of the man-made defences after storm events and undertake repair works as necessary
- annual inspection of defences (in particular condition of the foundations).

The continuing maintenance of the seawall should ensure its integrity for the life of the strategy and hence the assets it defends. Undertaking works to the toe of the wall within the centre of the bay would ensure its stability. These works could comprise either a sheet-piled extension to the existing toe, a masonry apron or a rock revetment. Regular monitoring of the remaining lengths of wall would ensure that works are planned and undertaken before the condition of the wall becomes critical.

Continued maintenance of the seawall, including undertaking minor repairs, is unlikely to have any significant impact on environmental interests within this unit.

Toe protection to the seawall would need to take into account the recreational and amenity value of the beach as well as general aesthetics, particularly given the classification of much of the frontage as an Area of Special Environmental Importance. Technical solutions that minimise the potential loss of available beach and do not detract from either people's ability to use or their perception of use would therefore be preferred. Such options include piling and the construction of masonry aprons. A rock revetment could potentially be used within the bay, given its limited recreational use in comparison with the major west coast bays.

The final choice of toe protection type should be made following a more detailed consideration of the technical and environmental issues.

This option does not address the overtopping problems associated with the unit.

Option 2- Raise Local Sections of Seawall (Improve)

Option 2 comprises the following elements:

- as Option 1
- raise local sections of seawall to reduce the effects of overtopping.

The continuing maintenance of the seawall should ensure its integrity for the life of the strategy and hence the assets it defends. Undertaking works to the toe of the wall within the centre of the bay would ensure the stability of the local section of wall. Regular monitoring of the remaining lengths of wall would ensure that works can be planned and undertaken before the condition of the wall becomes critical. Raising the level of the seawall in local sections would reduce the frequency and amount of overtopping and hence improve the standard of the defence.

Environmental interests are as for Option 1 with regard to continued practice.

Locally raising the seawall could reduce the frequency and severity of overtopping along some parts of the frontage. This would provide protection to the coast road and limit the potential inundation of residential property and land in agricultural or horticultural use. Raising the seawall could have a visual impact for properties located landward of the coast road. The opinions of local residents on their preference between potentially obscured seaward views or continued flooding and closure of the coast road should be sought, as this could prove to be a significant determinant in the course of action taken.

Option 3- Beach Nourishment (Improve)

Option 3 comprises the following elements:

- continue existing practice
- beach nourishment with shingle
- regular surveys of the newly nourished beach
- annual inspection of defences.

Nourishing the beach would reduce the overtopping of the wall by forcing the waves to break further away from the wall thus improving the standard of defence. Beach nourishment would also protect the toe of the wall from further attack, therefore no further toe protection works would be required. The continuing maintenance of the seawall would ensure its integrity for the life of the strategy and hence the assets it defends. It is likely that some beach material will be lost offshore during storm events. Periodic renourishment of the beach would be required in order to make good this loss and maintain the standard of defence.

During storms, shingle beaches have a tendency to move landward and develop ridges. If the ridges are close to the crest of the seawall there is a possibility that shingle overtopping may occur. The careful design of the nourishment should, however, largely eliminate this potential problem.

Environmental interests are as for Option 1 with regard to continued practice.

Nourishment with shingle could lead to a relatively large area of upper intertidal foreshore being directly covered by sediment, causing the loss of or a change to the existing intertidal communities. The extent of this would depend upon the amount of material required to reduce overtopping. In addition, without the emplacement of control structures, shingle could naturally be re-distributed by coastal processes within the bay. The impact of this on existing intertidal communities is difficult to predict. Potentially, a significant increase in the amount of sediment moving around on the platform could have an adverse impact on both infauna and attached flora and fauna, with the loss of some species adapted to the present conditions. In addition, changes to intertidal communities could have an adverse impact upon the available food resources to wintering waterfowl. Further information on the ecology of the intertidal platform would be required in order to provide a reasonable assessment of the potential impacts of beach recharge within this unit.

It is possible that storm ridges formed in the shingle beach may partly obscure seaward views from the coast road.

Nourishment with shingle is compatible with existing substrate conditions and is therefore unlikely to impact upon the limited recreational beach activity that takes place within the bay. However, it would need to be planned so that it did not interfere with the use of the slipways within the unit.

Option 4 – Beach Nourishment and Detached Breakwaters (Improve)

Option 4 comprises the following elements:

- as Option 3
- detached breakwaters.

The detached breakwaters would limit the loss of beach nourishment material offshore during storm events. However, periodic renourishment of the beaches in order to make good the losses and maintain the standard of defence would still be required but to a lesser extent than in Option 3.

Other technical issues are as for Option 3.

Environmental interests are as for Option 3.

In addition, the placement of detached breakwaters within the bay could have several significant environmental impacts. These are as follows:

- visual intrusion into an important and aesthetic coastal landscape
- direct loss of rocky intertidal area of interest for its maritime flora and fauna and the loss of this area for feeding to wintering waterfowl
- change in intertidal substrate conditions owing to sediment build up on intertidal platform
- potential additional hazard to navigation for boats.

CU6

Economic Appraisal

Benefits

Table CU6.1 gives the estimated value of the assets protected by the defences within CU6.

Table CU6.1 Benefits

Assets	Area/Length	Value (£)
Flooding		
Developed Land	1.7ha	2,210,000
Undeveloped Land	6.3ha	117,000
Erosion		
Minor Road	N/A	-
Coast Road	1,200m	1,080,000
Ribbon Development	600m	1,950,000
	Total	**5,357,000**
	Discounted Total	**3,003,000**

Notes: The following intangible benefits are not included in the above table:
- the vital communication link provided by the coast road
- slipway access to the beach
- intertidal fauna and flora.

Therefore the benefits derived for CU6 are likely to be an underestimate of the actual value.

Costs

Table CU6.2 gives the estimated value of the costs associated with Options 1 to 4.

Table CU6.2 Costs

Option	Initial Capital Cost (£)	Future Costs (£)		Total Discounted Cost (£)
		Capital	Maintenance	
1	603,000	151,000/10 years	4,500/year	**655,000**
2	647,000	151,000/10 years	4,500/year	**687,000**
3	2,082,000	416,000/10 years	4,500/year	**1,986,000**
4	3,843,000	208,000/10 years	8,100/year	**3,184,000**

Results

Table CU6.3 gives the results of the economic appraisal for Options 1 to 4.

Table CU6.3 Results

Option	Benefit–Cost Ratio
1	4.6
2	4.4
3	1.5
4	0.9

b) Selection of Preferred Strategic Option

Table CU6.4 summarises the results of the appraisal process for CU6.

Table CU6.4 Summary of Appraisals

Option	Technical Appraisal	Environmental Appraisal	Economic Appraisal
1 • continue existing practice	• ensures integrity of defences • does not address overtopping problem • long-term commitment to toe protection	• no significant concerns	• viable
2 • raise seawall	• ensures integrity of defences • reduces overtopping • long-term commitment to toe protection	• affects views from coast road and properties	• viable
3 • beach nourishment	• ensures integrity of defences • reduces overtopping • protects toe of wall	• detrimental impacts on environmental interests • enhances beaches	• viable
4 • beach nourishment • detached breakwaters	• ensures integrity of defences • reduces overtopping • protects toe of wall	• detrimental impacts on environmental interests • enhances beaches • visual intrusion	• not viable

Option 1 does not address the problems of overtopping within the unit. For this reason the option is rejected.

Option 3 and Option 4 are technically sound as they ensure the integrity of the defences and address the problem of overtopping within the unit. However, Option 3 and Option 4 are not economically attractive (in fact Option 4 is not viable) and, with the limited tourist and recreational use of the beach, it is unlikely that these intangible benefits would justify economically the selection of these options over Option 2. It is, however, likely that these additional benefits would make Option 4 economically viable.

There are, however, serious concerns over the long term technical viability of Option 2. The condition of the beaches is such that the underlying peat and clay layers are now regularly exposed. Strengthening the toe would not prevent the exposure and erosion of this layer (and may actually increase erosion rates), resulting in an ongoing commitment to deepening the foundations of the wall as the clay/peat levels fall. In fact, within the life of the strategy, there is likely to be a risk that the sucessive deepening of the foundations would no longer be practicable and a major reconstruction of the seawall would be required.

Taking the above points into consideration, Option 3 is selected as the preferred option. There are, however, a number of environmental issues relating to the intertidal platform that require further investigation.

The selection of beach nourishment is a significant departure from the existing defence methods within the unit and would require a major investment of capital. Before implementing the preferred strategy, further detailed studies into the technical and economic issues associated with beach nourishment should be undertaken alongside the environmental investigations identified above.

CU6

PROJECT	TITLE	CONSULTING ENGINEERS		
GUERNSEY STRATEGY FOR COASTAL DEFENCE AND BEACH MANAGEMENT	COASTAL UNIT 6 Le Catioroc to Fort Richmond	POSFORD DUVIVIER	Job No. E3309 ACAD Ref. DRAWN MDWP	DATE FEB'99 CHECKED JEC DRG No. FIGURE 6.6

SCALE	1:5,000
PASSED	AJS
REV	

CU7

6.7 Coastal Unit 7 – Richmond Fort to Fort le Crocq

a) Attributes

Introduction

Coastal Unit 7 is located on the west side of the island. The unit forms a headland and extends between Fort Richmond and Fort le Crocq (see Figure 6.7), a length of approximately 1,600m.

Coastal Processes and Beach Behaviour

The frontage comprises a rocky foreshore around the headland with little mobile sediments. The headland provides shelter to Perelle Bay and Vazon Bay on either side.

The coastline is exposed to severe wave attack from the west and north. The exposed nature of the island results in few mobile sediments being evident on the foreshore. The headland effectively forms a drift divide between the bays.

Coastal Defences

The majority of frontage is undefended. There are short lengths of shoreline where rubble has been tipped to protect the eroding edge. The headland is exhibiting signs of erosion, particularly where the soft cliff is exposed.

These defences are shown in Figure 6.7 at the end of this sub-section.

Land Use and Human and Built Environment

This major headland between Perelle Bay and Vazon Bay is the only headland on the west coast that has been developed. The majority of development is centred on an access track that runs along the central spine of the headland, and comprises glasshouses with residential properties. The immediate coastal strip is undeveloped. Two slipways provide access to the shingle and cobble beach surrounding the northern part of the headland.

Fort Richmond, located on the low hill overlooking the western side of the headland, was constructed following a resurgence in French power only 25 years after Waterloo. Constructed in the 1840s as one of a number of coastal fortifications, it served as barracks to provide accommodation for troops defending the relatively exposed coastline. At the northern end of the headland are the remains and site of Fort le Crocq.

The western side of the Richmond headland is an identified Area of Archaeological Importance.

Natural Environment

Richmond headland is formed in the Perelle Gneiss and represents the northernmost extension of the western outcrop of this rock type on the island.

The rocky foreshore and connected sandy areas form a mosaic of habitats that allows feeding and roosting birds, especially waders, to be relatively undisturbed. The area accumulates considerable amounts of seaweed, which attracts many species to feed on the invertebrate fauna that this supports. The rocky platforms and reefs provide ideal conditions for roosting, particularly during high tide. These factors, together with the rich marine life, make this the premier site in Guernsey for waders, with 22 species having been recorded. Flocks of turnstone and dunlin (*Calidris alpina*), with up to 170 birds of each species present, visit in January and February.

The offshore outcrops provide valuable roosting sites for curlew, grey plover, grey heron and little egret, and many other species stop off for varying periods during migration. Whimbrel and bar-tailed godwit can be present with flocks of over 50 birds passing through. A feature in late summer is the presence of adult and immature terns, including both local and migrating birds.

The headland in the vicinity of Fort le Crocq is a privately managed SNCI.

Planning Policies

The shoreline and immediate landward edge is an Area of Special Environmental Importance (Green Zone 1). The northern end and north-western side of the headland is an identified Enhancement Target Area. These areas are subject to the relevant conservation and enhancement policies set out in the Rural Area Plan (Phase 2).

b) Key Interests within Unit

The following list highlights the main interests within the unit that have the potential to interact with, or be influenced by, coastal defence policies. They are:

- vehicular access tracks
- slipways
- use of the headland and offshore islets as major roosting sites and feeding areas by wading birds.

c) Appraisal of Strategic Options

Do Nothing

If nothing is done to maintain or improve the defences between Richmond Fort and Fort le Crocq, the following scenarios over the 50-year period covered by the strategy are envisaged:

i) In the short term, the limited erosion of the soft cliff sediments overlying the rock platform around the headland will continue owing largely to wave action.

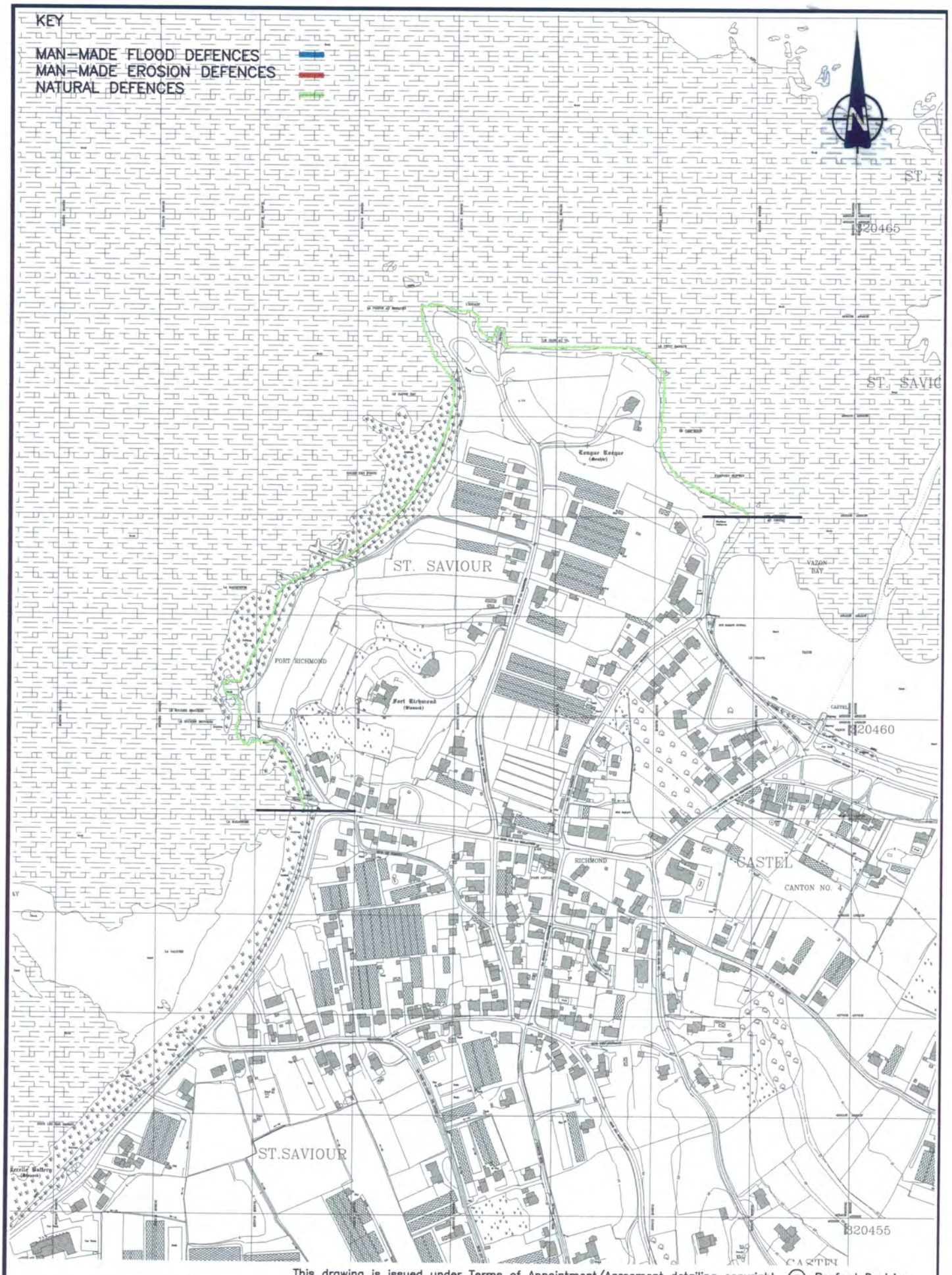
ii) In the medium and long term, the slipways around the headland may become unusable.

The gradual erosion of the soft cliff sediment would, in the medium to long term, require minor repairs to be made to the slipways if they are to remain usable. No other assets would be affected. Given the large number of slipways in adjacent coastal units, the potential impact of the loss of the slipways around the headland may not be serious.

Do Nothing within the unit would provide sediment to the nearshore system through the continued erosion of the low cliffs and maintain the biological interest of the headland, in particular, the use of the area by feeding and roosting waterfowl would continue.

For these reasons, and the fact that the minor repairs to the slipways are not strictly coastal defence activities, the Do Nothing options is selected for the unit.

CU7



PROJECT GUERNSEY STRATEGY FOR COASTAL DEFENCE AND BEACH MANAGEMENT	TITLE COASTAL UNIT 7 – Richmond Fort to Fort Le Crocq	CONSULTING ENGINEERS POSFORD DUVIVIER	DRAWN MDWP SCALE 1:5,000 DATE FEB'99 CHKD JEC DRG No. FIGURE 6.7

6.8 Coastal Unit 8 – Fort le Crocq to Fort Hommet (Vazon Bay)

a) Attributes

Introduction

Coastal Unit 8 is located on the west side of the island and extends between the headlands of Fort le Crocq and Fort Hommet, forming Vazon Bay (see Figure 6.8), a length of approximately 2,300m.

Coastal Processes and Beach Behaviour

The beach fronting the defences consists of a predominantly sandy foreshore with some localised pockets of shingle, particularly against the seawall. The foreshore at the extreme western end of the bay is dominated by rocky outcrops and boulders. A rock outcrop that extends up the beach to the defences is present in the centre of the bay. The soft peat and clay underlying the beach is exposed in several areas of the bay. The beach is sheltered by rocky headlands at either end.

The waves approach this frontage in a broadly normal direction to the coast because of the shelter provided by the headlands surrounding the bay and the rock outcrops within the bay. As a consequence, the predominant wave direction is normal to the foreshore and longshore transport of sediment is limited within the bay. This restriction of wave direction constrains the amount of longshore transport of sediment as can be seen by the limited difference in beach height either side of the various slipways in Vazon Bay. The bay is effectively a sediment cell with limited input or loss of sediment from the unit.

Despite comparatively low longshore transport, the high wave energy that acts on the west coast, combined with the wave direction in Vazon Bay results in significant cross-shore movements of material during storm attack. The extent to which material drawn down the beach is permanently lost is not known.

The waves are effectively channelled into the bay through the two major breaks in the rock outcrops in the centre of the bay. This leads to areas of low beach at the base of the seawall. As a result of the increased exposure to wave attack, overtopping occurs causing the coast road to be closed on a regular basis, particularly during the winter months.

Generally, beach levels are low throughout the unit particularly in the centre where exposure is greatest. It is not clear whether levels are continuing to drop or have stabilised following the cessation of active beach mining. The outfalls on the foreshore indicate that beach levels have not dropped significantly in recent years as they discharge at or about beach level.

Coastal Defences

The extreme western end of Vazon Bay is defended by an *ad hoc* arrangement of tipped rubble placed against the soft headland. The remainder of the unit is defended by a combination of concrete and masonry walls.

The headland at the southern end of the bay is vulnerable to erosion. The beach levels at the western and eastern ends of the unit appear to be reasonably healthy, whereas in the centre of the unit, particularly to the west of the rock outcrop, the beach levels are lower.

Trial pits dug in autumn 1998 indicated that at the western end of Vazon Bay, there was about 2.4m of mobile sediment overlying the peat bed and the beach level was approximately 1.5m above MHWS. In the centre of the bay, there was approximately 0.6m of mobile sediment above the peat layer and the beach level was at about 1m below MHWS. At the eastern end of Vazon Bay, there was about 2.4m of mobile sediment overlying the clay layer and the beach level was about 0.4m above MHWS.

Thus, as a result of the increased exposure of the central part of the bay, there is a significantly reduced sand covering layer to the underlying peat and clay. As beach levels are also well below the high water level, the central part of the bay is vulnerable to total drawdown thus exposing the peat and clay to repeated and ongoing attrition and hence lowering. Additionally, the exposed seawall will reflect waves thus leading to further agitation and creating conditions under which sand is unlikely to settle and accumulate.

It is evident that, over this century, there has been an historic trend of beach lowering within this unit as the various lengths of wall throughout the frontage have additional toe protection, in the form of concrete or masonry aprons.

To the east of the rock outcrop there are the remains of several timber groynes. It is unlikely that these groynes ever had any positive effect on the sediment levels adjacent to the defences. This is because the groynes would have been completely covered by water at high tide and for groynes to be effective in trapping sediment they must extend from above the high water line to below the low water line.

Generally, the defences are in reasonably good condition with a residual life of between 10 and 25 years. There is a length, however, where urgent work is required to ensure the stability of the defences. The toe of the wall in the centre of the bay, to the west of the rock outcrop, is exposed and the wall is being undermined as the soft layer on which it is founded is eroding. This section has a residual life of between 0 and 10 years. The headland at the southern end of the bay is eroding and in the medium term continued erosion could lead to damage and possible loss of the properties located there.

Overtopping is a problem within Vazon Bay, particularly towards the centre. Mathematical modelling has demonstrated that the present standard of defence with regard to overtopping is low. Low beach levels enable larger waves to be propagated at high tide right up to the seawall, resulting in overtopping.

The defences (both man-made and natural) also protect further low-lying land in Vazon Bay and Albecq Bay (CU9) as the flooding compartments of the two units are linked. Any failure of the defences within this unit would result in flooding of CU9.

These defences, together with the area at risk from flooding, are shown in Figure 6.8 at the end of this sub-section.

Land Use and Human and Built Environment

The wide sweep of Vazon Bay represents one of the most distinctive landscape elements along the west coast. The majority of the bay is backed by low-lying land, the reclaimed remnants of La Grande Mare, one of the former west coast mares. This land is now in agricultural, horticultural (glasshouses) and residential use. The coast road runs immediately landward of the existing coastal defences along the perimeter of the bay.

CU8

Thanks to its extensive sandy beaches, Vazon Bay is probably the most popular recreational beach on the island. Car parking is provided at six points along the frontage. Windsurfing occurs in the bay throughout the year and some surfing when conditions are suitable. La Grande Mare Hotel, located towards the central part of the bay, is the island's premier hotel and has its own 18-hole golf course, built on low-lying land that was formerly part of La Grande Mare.

Situated adjacent to the coast road, just to the north of La Grande Mare Hotel, is a loopholed pre-Martello Tower (No. 12). A total of 15 were originally built between 1778 and 1779 in prime defensive positions around the coast of Guernsey, 12 still remain. These defences were designed primarily to prevent the landing of troops on nearby beaches.

No sites of archaeological interest have been identified as part of this environmental review.

Natural Environment

Vazon Bay provides exposure through three rock formations. The central part of the bay is formed in the Icart Gneiss Group, and here represents the northern extension of the main mass that forms the rugged southern cliffs. The Perelle Gneiss outcrops on the western side of the bay and forms Richmond headland, while to the east, the Fort Hommet headland provides exposure through the southern part of the Cobo Granite.

Due to the construction of coastal defences, the coast road and provision of car parks, little now remains of the extensive dune system that originally fringed the bay. Within the southern half of the bay, a strip of semi-stabilised dune habitat (up to about 15m in width) occurs between the seawall and the coast road. This is largely well vegetated, although some areas of bare sand are maintained through its use as a footpath. The vegetation comprises dune grassland with typical west coast species including small hare's ear (*Bupleurum baldense*), sea bindweed (*Calystegia soldanella*), sand crocus (*Romulea columnae*), wild clary (*Salvia verbenaca*) and fennel (*Foeniculum vulgare*). In areas where saline influence is greatest, species such as sea sandwort (*Honkenya peploides*) and prickly saltwort (*Salsola kali*) occasionally occur. Some dune vegetation remains around the fringes of the main car parks and landward of the coast road within the central part of the bay.

Towards the north-eastern end of the bay (southern end of the Fort Hommet headland) there is a relatively extensive area of maritime grassland and scrub. Adjacent to the seawall, where the saline influence is greatest probably owing to periodic overtopping, the vegetation includes some characteristic saltmarsh and coastal species such as sea purslane (*Halimone portulacoides*) and sea milkwort (*Glaux maritima*) among others. This area is a nature reserve.

The intertidal zone and relatively sheltered waters of the Bay provide refuge and feeding for marine bird species such as divers, grebe and sea-duck. During winter months, the extensive sand flats appear to be an important feeding area for wintering waders, including dunlin (*Calidris alpina*) and knot (*Calidris canutus*). The short-snouted seahorse (*Hippocampus hippocampus*) has been recorded from within the bay. Vazon Bay is a SNCI, managed by the Board of Administration.

CU8

Planning Policies

The immediate coastal strip, including the coast road is designated as an Area of Special Environmental Importance (Green Zone 1). Land behind the coast road is largely classified as an Area of Landscape Value (Green Zone 2), which is in horticultural/agricultural production, with a narrow strip of Green Zone 1 land in the central part of the bay. Two small residential areas, adjacent to La Grande Mare Hotel and on the eastern side of the Richmond headland are classified as Built-Up Areas. These areas are subject to the relevant conservation and enhancement policies set out in Rural Area Plans Phase 1 and Phase 2, the bay being split between the two plan areas.

b) Key Interests within Unit

The following list highlights the main interests within the unit that have the potential to interact with, or be influenced by, coastal defence policies. They are:

- residential and commercial properties
- coast road
- recreational value of the beach
- slipway access to the beach
- golf course
- intertidal flora and fauna.

c) Appraisal of Strategic Options

Do Nothing

If nothing is done to maintain or improve the defences within Vazon Bay, the following scenarios over the 50-year period covered by the strategy are envisaged:

i) In the short term, overtopping would continue resulting in the temporary closure of the coast road. Failure of the central section of seawall, owing to undermining of the west of the rock outcrop by wave action, would lead to erosion of the "Bank", damage to the coast road and eventual flooding of the golf course and adjacent properties.

ii) In the medium term, the continuing erosion of the headland at the southern end of the bay would result in the loss of properties on the headland.

iii) In the long term, structural failure of sections of the seawall would occur owing to deterioration caused largely by wave action. Do Nothing would lead to the loss of the remainder of the coast road and properties. Assets within CU9 would also be placed at risk from flooding.

The Do Nothing option would result in economic damage through the loss of the developed and undeveloped land through flooding and erosion. In total approximately 67 hectares of undeveloped and 43 hectares of developed land would be affected. This option of Do Nothing does not satisfy all the Objectives set out in Section 2.3.

For these reasons the option is rejected.

Do Something

From the above discussion it is evident that the Do Something option should be adopted if a viable scheme can be identified. Sustaining the defences at their present standard would solve the problem of the undermining of the defences but would not address the problems of overtopping causing localised flooding and closure of the coast road. Therefore options to improve the standard of defence are also included under Do Something.

d) Do Something Potential Scheme Options

The reasoning described in Section 5.3.3 (Possible Defence Methods) together with the problems and issues referred to above, results in the selection of four options for appraisal.

Technical and Environmental Appraisal

Option 1 – Continue Existing Practice and Minor Works (Sustain)

Option 1 comprises the following elements:

- continue existing practice by regular re-pointing of the masonry structures
- minor toe protection to the length of wall that is being undermined
- monitor toe protection of all defences after storm events and undertake repair works as necessary
- summer and winter beach surveys
- annual inspection of defences.

Undertaking repair works to the toe of the wall within the centre of the bay would ensure its stability. It is envisaged that repair works would involve deepening the toe a with a concrete or masonry apron. Regular monitoring of the remaining lengths of wall should be undertaken so that works can be planned before the condition of the wall becomes critical. Continuing maintenance of the seawall should ensure its integrity for the life of the strategy and hence the assets it defends.

Continued maintenance of the seawall is unlikely to have any significant impact on environmental interests within this unit. Areas of stabilised dune habitat along the frontage, i.e. behind the existing seawall, are unlikely to be affected by maintenance work and the continued functioning of the seawall. However, it should be ensured that suitable measures are taken during any proposed works to prevent damage to these areas and, if possible, opportunities for enhancement should be sought.

Toe protection to the seawall would need to take into account the recreational and amenity values of the beach as well as general aesthetics. Technical solutions that minimise the potential loss of available beach and do not detract from either people's ability to use or their perception of use would therefore be preferred. Such options include piling and the construction of masonry aprons. The use of rock revetments on recreational beaches is not considered appropriate.

This option does not address the problem of overtopping of the defences or the erosion of the eastern side of Richmond headland and the potential loss of property.

Option 2 – Raise Local Sections of Seawall (Improve)

Option 2 comprises the following elements:

- as Option 1
- raise local sections of seawall to reduce the effects of overtopping
- rock protection to undefended length.

Raising the level of the seawall in local sections would reduce the frequency and amount of overtopping and hence improve the standard of the defence. Providing rock protection to the eastern side of Richmond headland would reduce the risk of damage and loss of properties due to erosion.

Other technical issues are as discussed in Option 1.

Locally raising the seawall, to reduce the frequency and severity of overtopping, would reduce potential damage to the coast road and the number of occasions on which it becomes impassable. In addition, the inundation of low-lying areas, e.g. La Grande Mare, would be significantly reduced. Raising sections of the seawall where residential properties are at risk or the coast road is likely to be damaged through overtopping, would be given priority. Potentially, raising the seawall could have a visual impact upon properties located landward of the coast road. The opinions of local residents on their preference between potentially obscured seaward views or continued flooding and closure of the coast road should be sought, as this could prove to be a significant determinant in the course of action taken.

The existing areas of stabilised dune habitat within this unit would not be adversely affected by selective raising of the seawall, although some species that are dependant on a significant saline influence could diminish in abundance. Overtopping of the seawall at the northern end of the bay, behind the stepped concrete wall, has led to the development of a small area of brackish grassland, with some characteristic saltmarsh plant species. Unless this overtopping poses a significant risk to the maintenance of the coast road or the coastal defences themselves, it should be allowed to continue.

Environmental interests on the eastern side of the Richmond headland, at the western end of the unit, are limited. While the limited erosion of this section of low cliff provides some sediment input into the bay, continued erosion could lead to damage to residential property. Reducing the rate of erosion through the placement of rock protection would alleviate this.

Environmental considerations are as for Option 1 with regard to continued maintenance and toe protection works.

Option 3 – Beach Nourishment (Improve)

Option 3 comprises the following elements:

- continue existing practice by regular re-pointing of the masonry structures that are exposed
- beach nourishment with sand
- regular surveys of the newly nourished beach
- annual inspection of the defences.

Beach nourishment would prevent further deterioration of the base of the wall as it would no longer be exposed to wave action, by forcing the waves to break further away from the wall thus improving the standard of the defence. It is likely that some beach nourishment material would be lost offshore during storm events. Periodic renourishment of the beaches would be required to make good these losses and maintain the standard of defence. The continuing maintenance of the seawall would ensure its integrity for the life of the strategy and hence the assets it defends. This option would also provide protection to the eastern side of Richmond headland.

Other technical issues as discussed under Option 1.

Beach nourishment within the unit would need to be compatible with existing substrates within the unit and in particular with regard to areas of sandy beach that are of recreational importance, e.g. the northern end of bay in particular. Nourishment with sand would enhance existing beaches and could in addition provide a significant increase in the overall area of sandy beach within the unit, with consequent benefits for recreational and tourism interests.

The volume of sediment required to significantly reduce overtopping is considerable and could have a detrimental impact on environmental interests. Firstly, a significant area of upper intertidal foreshore would be directly covered by sand leading to the loss of or change to existing intertidal communities. Secondly, over time, and without the emplacement of control structures, sand would naturally be re-distributed by existing coastal processes within the bay. This could lead to sediment accumulation over rocky intertidal areas within parts of the bay, with a consequent change to, or even loss of, biological hard substrate communities and a potential reduction in available food resources to wintering waterfowl.

Potentially, beach nourishment could provide enough protection to reduce erosion of the low cliffs along the eastern side of the Richmond headland. The placement of rock protection, as put forward in Option 2, would therefore not be required.

The creation of a high sandy beach within the bay may lead to problems with wind blown sand as the crest of the profile would remain dry at high water. If this becomes a nuisance, steps could be taken to manage the problem, e.g. by placing sand fences on the beach.

Environmental considerations are as for Option 1 with regard to continued maintenance of the seawall, and as for Option 2 with regard to reducing overtopping.

Option 4 – Beach Nourishment with Detached Breakwaters (Improve)

Option 4 comprises the following elements:

- as Option 3
- detached breakwaters.

The detached breakwaters would prevent most of the loss of beach nourishment material offshore during storm events. However, periodic renourishment of the beaches in order to make good the losses and maintain the standard would still be required but to a lesser extent than in Option 3.

Other technical issues are as discussed under Option 3.

The placement of detached breakwaters within the bay could have several significant environmental impacts. These are as follows:

- visual intrusion into an important and aesthetic coastal landscape
- direct loss of rocky intertidal area of interest for its maritime flora and fauna and the loss of this area for feeding to wintering waterfowl
- potential additional hazard to navigation for boats.

In conjunction with beach nourishment the benefits of this option with regard to providing a better beach for recreational activity could be far outweighed by the predicted negative impacts on the natural environment and the coastal landscape.

Other environmental issues are as discussed under Option 3.

CU8

Economic Appraisal

Benefits

Table CU8.1 gives the estimated value of the assets protected by the defences within CU8.

Table CU8.1 Benefits

Assets	Area/Length	Value (£)
Flooding		
Developed Land	*42.7ha	*55,510,000
Undeveloped Land	*66.9ha	*1,238,000
Erosion		
Minor Road	N/A	-
Coast Road	2,000m	1,800,000
Ribbon Development	N/A	-
	Total	**58,548,000**
	Discounted Total	**43,157,000**

Notes: The following intangible benefits are not included in the above table:
- the vital communication link provided by the coast road
- recreational value of the beach
- slipway access to the beach
- intertidal fauna and flora

Therefore the benefits derived for CU8 are likely to be an underestimate of the actual value.
* Also note that CU8 and CU9 share the flooding benefits.

Costs

Table CU8.2 gives the estimated value of the costs associated with Options 1 to 4.

Table CU8.2 Costs

Option	Initial Capital Cost (£)	Future Costs (£)		Total Discounted Cost (£)
		Capital	Maintenance	
1	156,000	16,000/10 years	10,000/year	**297,000**
2	512,000	156,000/10 years	10,000/year	**683,000**
3	6,536,000	1,307,000/10 years	10,000/year	**6,166,000**
4	9,177,000	654,000/10 years	16,000/year	**7,582,000**

Results

Table CU8.3 gives the results of the economic appraisal for Options 1 to 4.

Table CU8.3 Results

Option	Benefit–Cost Ratio
1	145
2	63
3	7
4	6

e) Selection of Preferred Strategic Option

Table CU8.4 summarises the results of the appraisal process for CU8.

Table CU8.4 Summary of Appraisals

Option	Technical Appraisal	Environmental Appraisal	Economic Appraisal
1 • continue existing practice	• ensures integrity of defences • does not address overtopping problem • long-term commitment to toe protection	• no significant concerns	• viable
2 • raise seawall	• ensures integrity of defences • reduces overtopping • long-term commitment to toe protection	• affects views from coast road and properties	• viable
3 • beach nourishment	• ensures integrity of defences • reduces overtopping • protects toe of wall	• detrimental impacts on environmental interests • enhances beaches	• viable
4 • beach nourishment • detached breakwaters	• ensures integrity of defences • reduces overtopping • protects toe of wall	• detrimental impacts on environmental interests • enhances beaches • visual intrusion	• viable

Option 1 does not address the problems of damage at Richmond headland or overtopping within the unit. For this reason the option is rejected as a long-term course of action but could be considered as an interim measure.

Options 2, 3 and 4 are technically sound as they ensure the integrity of the defence and address the problem of overtopping within the unit. There is, however, a question over the long-term viability of Option 2 as it would mean a long-term commitment to toe strengthening. At this stage, it is not clear whether beach levels are continuing to fall or whether levels have stabilised. If levels are falling, then Option 2 would require an ongoing programme of foundation deepening throughout the bay.

Option 2 and Option 3 are environmentally acceptable, subject to consultation with local residents over seawall raising (Option 2) and consideration of the impacts of beach nourishment on the intertidal habitats (Option 3). Option 4 is rejected because of the impacts that the detached breakwaters would have on the natural environment and coastal landscape.

Although Option 2 and Option 3 are economically viable, it is acknowledged that there is a significant difference in costs between the two options. It should, however, be noted that the economic appraisal for Option 3 does not include the significant (intangible) benefits to tourists of improved beaches.

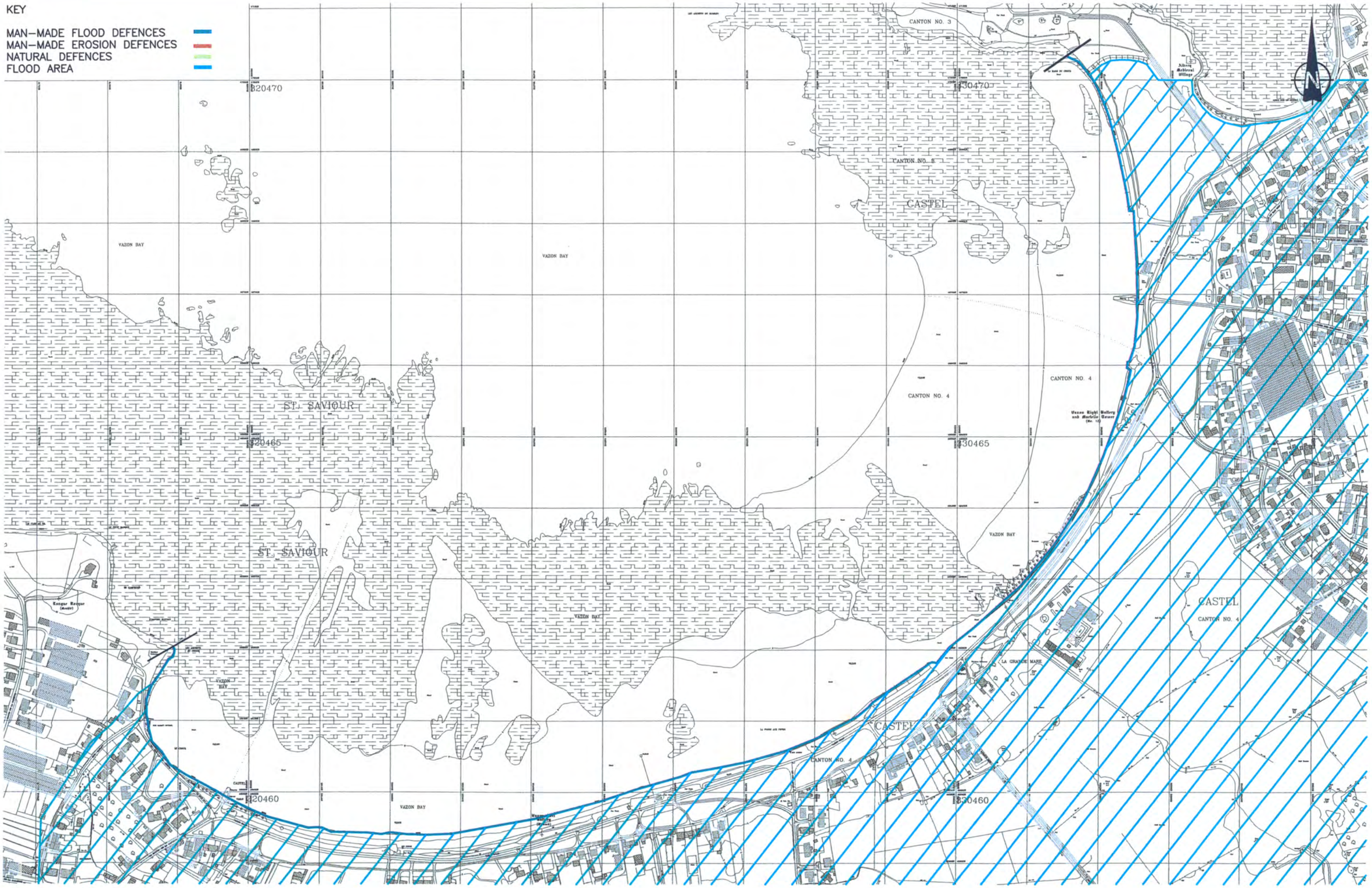
On the basis of the above, the following is proposed for the unit:

- initially, Option 1 is adopted as the preferred option and works are undertaken to the vulnerable length of seawall in the centre of the bay, this assumes that the temporary closures of the coast road from overtopping are acceptable in the short term.
- monitoring of the beaches commences immediately so that a view can be taken over their behaviour in five years' time.
- in five years' time a long-term strategy is selected for the unit. Option 2 would be preferred if beach levels are tolerably stable and Option 3 if beach levels are continuing to fall.

CU8

KEY

MAN–MADE FLOOD DEFENCES
MAN–MADE EROSION DEFENCES
NATURAL DEFENCES
FLOOD AREA



PROJECT

GUERNSEY STRATEGY FOR COASTAL DEFENCE AND BEACH MANAGEMENT

TITLE

COASTAL UNIT 8

Fort Le Crocq to Fort Hommet

CONSULTING ENGINEERS

POSFORD DUVIVIER

Job No.	E3309	DATE	FEB'99	SCALE	1:5,000
ACAD Ref.		CHECKED	JEC	PASSED	AJS
DRAWN	MDWP	DRG No.	FIGURE 6.8		REV

6.9 Coastal Unit 9 – Fort Hommet to Le Guet

a) Attributes

Introduction

Coastal Unit 9 is located on the west side of the island and extends between Fort Hommet and Le Guet, including Albecq Bay (see Figure 6.9), a total length of approximately 2,300m.

Coastal Processes and Beach Behaviour

The frontage comprises a rocky foreshore around the headland of Fort Hommet, the shingle and sand covered foreshore of Albecq and the rocky foreshore between Lion Rock and Portelet.

The headland is exposed to severe wave attack and provides shelter to the eastern end of Vazon Bay and to Albecq. Due to its enclosed and sheltered nature, there is little transport of mobile sediment within Albecq. To the east of Albecq, at Portelet, the foreshore is rocky. The headland effectively forms a drift divide between Vazon Bay and Cobo Bay.

Coastal Defences

The headland of Fort Hommet is undefended. A masonry wall in Albecq protects the coast road that runs at the back of the bay from erosion. A length of rock protection exists on the eastern shore of Albecq defending the coastal edge. There are short lengths of wall defending the coast road from erosion in Portelet.

Generally, the man-made defences within this unit are in good condition, having residual lives of between 10 and 25 years. The beach in Albecq protects the toe of the seawall. At the time of inspection of the defences there were no specific problems. The low unconsolidated cliffs on the headland are eroding.

The defences (both man-made and natural) also protect further low-lying land in Vazon Bay (CU8) as the flooding compartments of the two units are linked. Any failure of the defences within this unit would result in flooding of CU8.

These defences, together with the area at risk from flooding, are shown in Figure 6.9 at the end of this sub-section.

Land Use and Human and Built Environment

The Fort Hommet headland is largely undeveloped and comprises rough maritime grassland with some scrub vegetation. The headland is popular with walkers and visitors as it provides an excellent viewpoint of Vazon Bay to the south west and Cobo Bay to the north east. A small spur road from the coast road runs up the headland to a relatively large car park just to the east of the fort. Fort Hommet, at the western end of the headland, is one of three Martello Towers built in 1805 against coastal attacks, although the fortifications here date back to the 16th century. Additional fortifications were added later in the 19th century and during the German occupation.

Albecq, on the eastern side of the headland, is a small enclosed embayment with the coast road running along its southernmost edge. It contains a small shingle and cobble beach. Land behind the coast road is developed and comprises residential property and glasshouses. Chateau d'Albecq on the small rock promontory on the eastern side of the embayment is a site of archaeological importance.

Natural Environment

The orangey-pink colour of the rocks forming the headland and rock promontories within this unit indicates that this area provides exposure of the Cobo Granite. The joint system within the granite as well as the crystalline nature of the rock can be easily observed around Albecq Bay. In addition, there is a small exposure of the 8m raised beach overlain by head material on the western side of the bay.

There are a range of coastal habitats present on the Fort Hommet headland, from rough grassland and maritime heath to sheltered rocky shore and strand line. Consequently, the site supports a diverse flora largely typical of much of the west coast and including rarer species such as sand crocus (*Romulea columnae*), least adder's tongue fern (*Ophioglossum lusitanicum*), little robin (*Geranium purpureum*) and small hare's ear (*Bupleurum baldense*) among others. The small rocky spur on the eastern side of Albecq supports a small area of rough maritime grassland.

Planning Policies

Apart from a small area of residential land immediately adjacent to the coast road at the back of Albecq, the entire headland and coastal strip is classified as an Area of Special Environmental Importance (Green Zone 1). This area is subject to the relevant conservation and enhancement policies set out in the Rural Area Plan (Phase 1).

b) Key Interests within Unit

The following list highlights the main interests within the unit that have the potential to interact with, or be influenced by, coastal defence policies. They are:

- residential properties
- coast road
- archaeological interests of the Fort Hommet headland and Chateau d'Albecq.

c) Appraisal of Strategic Options

Do Nothing

If nothing is done to maintain or improve the defences between Fort Hommet and Le Guet, the following scenarios over the 50-year period covered by the strategy are envisaged:

i) In the short term, the headland would continue to erode owing largely to wave action with the potential loss of archaeological interest.

ii) In the medium term, structural failure of sections of the seawall would occur caused largely by wave action. Do Nothing would lead to the loss of the coast road and properties.

iii) In the long term, the coastline would erode and place the residential properties in CU8 at risk from flooding.

The Do Nothing option would result in economic damage owing to the loss of the developed and undeveloped land through the gradual erosion of the shoreline. The option of Do Nothing does not satisfy all the Objectives set out in Section 2.3.

For these reasons the option is rejected.

Do Something

From the above discussion it is evident that the Do Something option should be adopted if a viable scheme can be identified. Sustaining the defences at their present standard would address the problems of structural failure of the man-made defences and hence the problems of erosion and flooding. Options to improve the existing standard of defence, therefore, are not considered.

d) Do Something Potential Scheme Options

The reasoning described in Section 5.3.3 (Possible Defence Methods) together with the problems and issues referred to above, results in the selection of one option for appraisal.

Technical and Environmental Appraisal

Option 1 – Continue Existing Practice (Sustain)

Option 1 comprises the following elements:

- continue existing practice by regular re-pointing of the masonry structures and limited tipping of rock onto existing rock protection
- annual inspection of the defences.

Continuing existing practice of maintaining the lengths of seawalls and rock protection would ensure the integrity of the defences for the life of the strategy and thus protect the assets they defend.

The maintenance of existing structures within the unit is unlikely to have any detrimental impact on environmental interests. Ensuring that the seawall at the back of Albecq is maintained in a structurally sound condition is important as this provides protection from erosion to the coast road and residential property. Although alternative routes are available, closure of the coast road at this point would be detrimental to the island's transport network, both in terms of local and tourist use and increased traffic flow through residential areas.

Continued erosion of the Hommet headland is not considered to be a significant problem, although there could be some loss of archaeological interest. No property or infrastructure would be at risk from continued erosion during the lifetime of the strategy.

CU9

Economic Appraisal

Benefits

Table CU9.1 gives the estimated value of the assets protected by the defences within CU9.

Table CU9.1 Benefits

Assets	Area/Length	Value (£)
Flooding		
Developed Land	*42.7ha	*55,510,000
Undeveloped Land	*66.9ha	*1,238,000
Erosion		
Minor Road	500m	150,000
Coast Road	500m	450,000
Ribbon Development	120m	390,000
	Total	**57,738,000**
	Discounted Total	**42,819,000**

Notes: The following intangible benefits are not included in the above table:
- the vital communication link provided by the coast road
- archaeological interests of the Fort Hommet headland and Chateau d'Albecq.

Therefore the benefits derived for CU9 are likely to be an underestimate of the actual value.
* Also note that CU8 and CU9 share the flooding benefits.

Costs

Table CU9.2 gives the estimated value of the costs associated with Option 1.

Table CU9.2 Costs

Option	Initial Capital Cost (£)	Future Costs (£)		Total Discounted Cost (£)
		Capital	Maintenance	
1	N/A	N/A	1,575/year	**26,000**

Results

Table CU9.3 gives the results of the economic appraisal for Option 1

Table CU9.3 Results

Option	Benefit–Cost Ratio
1	1,647

e) Selection of Preferred Strategic Option

Table CU9.4 summarises the results of the appraisal process for CU9.

Table CU9.4 Summary of Appraisals

Option	Technical Appraisal	Environmental Appraisal	Economic Appraisal
1 • continue existing practice	• ensures integrity of defences	• no significant concerns	• viable

Option 1 is technically sound, environmentally acceptable, economically viable and, therefore, is selected as the appropriate strategy for CU9.

There could be some loss of archaeological interest as erosion of the largely unconsolidated sediments forming the low cliffs overlying the rock platform would continue. Periodic monitoring of the area for any evidence of archaeological artefacts or structures should be carried out. If significant finds are made, then either excavation should be undertaken or protection from further erosion provided.

These measures, however, have not been included within Option 1.

CU9

KEY

MAN-MADE FLOOD DEFENCES
MAN-MADE EROSION DEFENCES
NATURAL DEFENCES
FLOOD AREA

PROJECT: GUERNSEY STRATEGY FOR COASTAL DEFENCE AND BEACH MANAGEMENT	TITLE: COASTAL UNIT 9 — Fort Hommet to Le Guet	CONSULTING ENGINEERS: POSFORD DUVIVIER	Job No. E3309	DATE FEB'99	SCALE 1:5,000
			ACAD Ref.	CHECKED JEC	PASSED AJS
			DRAWN MDWP	DRG No. FIGURE 6.9	REV

CU10

6.10 Coastal Unit 10 – Le Guet to Grandes Rocques (Cobo Bay and Saline Bay)

a) Attributes

Introduction

Coastal Unit 10 is located on the west side of the island and extends between Le Guet and Grande Rocques (see Figure 6.10). The unit is approximately 1,900m in length and includes Cobo Bay and Saline Bay.

Coastal Processes and Beach Behaviour

The beach fronting the defences in the south western end of the unit is rocky with little mobile sediment. As the orientation of the bay alters to a more north-south alignment the foreshore becomes sandy. There are two large outcrops that break up the sandy beach. The northernmost one forms the boundary between Cobo Bay and Saline Bay. The foreshore of the extreme northern end of Saline Bay is rocky.

The waves are effectively channelled into the bay through the two major breaks in the rock outcrops in the centre of the bay. This leads to increased exposure to wave attack, low beaches and overtopping of the seawall causing the coast road to be closed on a regular basis, particularly during the winter months.

Changes in beach levels occur primarily through cross-shore transport during storms when material is drawn down to the lower foreshore. The extent to which material drawn down the beach is permanently lost is not known. There is limited longshore movement of sediment throughout the bays with the exception of local effects brought about by rock outcrops on the foreshore. Historically, there has been a trend of beach lowering within the unit. It is, however, not clear whether levels are continuing to drop or have now stabilised following the cessation of beach mining and activities during World War II.

Coastal Defences

A variety of defences front the south western end of the unit. Lengths of concrete wall, rock revetment and masonry wall defend the coast road from erosion. A large German bunker marks the beginning of Cobo Bay proper. The seaward wall of the bunker shows signs of movement, possibly through settlement of the foundations. The hinterland of the bay is protected from flooding and erosion by a masonry wall with sheet-piled toe protection over most of its length. The masonry wall between the rock outcrops does not have any toe protection. The frontage north of the slipway in Saline Bay is defended from erosion by rock protection placed against the coastal edge. The remaining length of the unit is defended by natural dunes covered in grasses.

Three trial pits were dug during autumn 1998 within this unit. The first, dug at the south western end indicated less than 0.2m of mobile sediment covering the base of the wall and the beach level being more than 2.5m below MHWS. The second pit was sited near the junction of La Route de Cobo and the coast road. However, the excavation was waterlogged and no levels were recorded. The third pit, between the rock outcrops, indicated about 2.7m of mobile sediment above the base of the wall, beach levels being approximately 2.0m above MHWS. These levels support the beach processes described above.

Generally, the defences within the unit are in good condition, having a residual life of between 10 and 25 years. At the south-western end the low beach levels coincide with a length of wall founded on rock and, therefore, the toe is not vulnerable to undermining. Within Cobo Bay, a 20m length of concrete toe beam has minor cracks and exposed reinforcement has a residual life of less than 10 years. The movement in the wall of the German bunker at the southern end of Cobo Bay does not appear to have occurred recently.

Overtopping is a problem within Cobo Bay, particularly towards the centre where waves are channelled between the rock outcrops. Mathematical modelling has demonstrated that the present standard of defence against overtopping is low. Low beach levels enable larger waves to be propagated at high tide right up to the seawall, resulting in overtopping.

These defences, together with the area at risk from flooding, are shown in Figure 6.10 at the end of this sub-section.

Land Use and Human and Built Environment

Together these two bays form one of the most picturesque sections of coastline on the island. The southern end of the bay is dominated by the wooded slopes of Le Guet and Le Guet Quarry, which was quarried in the 19th century for building stone (Cobo Granite). Residential properties occupy the lower slopes of the hill, immediately adjacent to the coast road. Within the majority of the bay the coast road runs through a narrow strip of stabilised dune grassland, except at Cobo itself, where the road and residential properties come right up to the existing defence line. A mixture of residential, horticultural and agricultural land use occurs landward of the coast road throughout the unit.

The sandy beach is probably the most popular beach on the island and provides excellent conditions for bathing and windsurfing, except in the clearly marked area at the northern end where currents can be strong. Car parking is available at two locations in Cobo Bay, on the seaward side of the coast road, and at the southern end of Saline Bay. Cobo Bay is well used by small craft for mooring and boat launching/landing facilities are provided by two slipways located in the southern half of the bay.

No sites of archaeological interest have been identified as part of this environmental review.

Natural Environment

The Bordeaux Diorite Complex, which forms the bulk of the northern part of the island outcrops within the central part of the bay, forming the reef between Cobo Bay and Saline Bay. Either side of this, the reefs and low rocky promontories from Portelet north eastwards and within Saline Bay and the southern end of Les Grand Rocques are formed in the distinctive Cobo Granite.

As for a large part of the west coast, one of the main interests within this unit relates to the shallow marine habitats provided by the intertidal reefs and flats. The wide variety of substrate types support a range of marine flora and fauna for which the west coast is particularly important (see Section 3.4.4).

At low water the intertidal flats also provide a feeding area for waders. After storms or rough weather large amounts of seaweed can be brought into the bay. Under calm conditions the waters of the Bay can provide refuge and feeding for marine bird species such as divers, grebe and sea-duck.

CU10

At the northern end of Saline Bay, the southern part of the Grande Rocques headland comprises maritime dune grassland, which gives way on its seaward edge to partially mobile dunes with marram grass (*Ammophila arenaria*). This section, along with Port Soif (CU11), represents one of the few significant remaining areas of this habitat on the island. In addition there are some small areas of stabilised remnant dune grassland located between the existing defences and the coast road, e.g. south of the Rockmount Hotel, although the majority of these areas are now occupied by car parks and associated facilities.

Planning Policies

Cobo Village, in the centre of the unit, is classified as a Built-Up Area. Land on either side of the village is classified as an Area of Special Environmental Importance (Green Zone 1), with the residential area at the base of Le Guet being classified as a Conservation Area. These areas are subject to the relevant conservation and enhancement policies set out in the Rural Area Plan (Phase 1).

b) Appraisal of Strategic Options

The following list highlights the main interests within the unit that have the potential to interact with, or be influenced by, coastal defence policies. They are:

- residential and commercial properties
- coast road
- recreational and amenity value of beach.

Do Nothing

If nothing is done to maintain or improve the defences between Fort Hommet and Le Guet, the following scenarios over the 50-year period covered by the strategy are envisaged:

i) In the short term, the overtopping of the seawall would continue to result in the temporary closure of the coast road during winter storms.

ii) In the medium term, the problems with the toe protection and German bunker wall in Cobo Bay would result in the failure of short lengths of the seawall largely through wave action. This would cause localised flooding and loss of lengths of the coast road.

iii) In the long term, structural failure of the entire defences would occur largely caused by wave action. Do Nothing would lead to loss of the coast road, damage to and loss of properties and loss of slipway access to the beaches.

The Do Nothing option would cause economic damage through the loss of the developed and undeveloped land through flooding and erosion. In total approximately 22 hectares of undeveloped and 15 hectares of developed land would be affected. The option of Do Nothing does not satisfy all the Objectives set out in Section 2.3.

For these reasons the option is rejected.

Do Something

From the above discussion it is evident that the Do Something option should be adopted if a viable scheme can be identified. Sustaining the defences at their present standard would solve the problem of deterioration of the defences leading to structural failure but would not address the problems of overtopping causing localised flooding and closure of the coast road. Therefore options to improve the standard of defence are also included under Do Something.

d) Do Something Potential Scheme Options

The reasoning described in Section 5.3.3 (Possible Defence Methods) together with the problems and issues referred to above, results in the selection of four options for appraisal.

Technical and Environmental Appraisal

Option 1 – Continue Existing Practice and Minor Works (Sustain)

Option 1 comprises the following elements:

- continue existing practice by regular re-pointing of the masonry structures
- minor toe protection repairs to the length of wall that is being undermined
- monitor toe protection of all defences after storm events and undertake repair works as necessary
- summer and winter beach surveys
- annual inspection of the defences.

Undertaking repair works to the toe of the wall within the centre of the bay would ensure its stability. It is envisaged that repair works would involve deepening the toe a with a concrete or masonry apron. Regular monitoring of the remaining lengths of wall would be undertaken so that works can be planned before the condition of the wall becomes critical. The continuing maintenance of the seawall should ensure its integrity for the life of the strategy and hence the assets it defends.

Continued maintenance of the existing seawall and minor repairs to toe protection is unlikely to have any significant impact on environmental interests within this unit. Providing additional toe protection to the seawall would need to take into account the recreational value of the beach as well as general aesthetics. Technical solutions that minimise the potential loss of available beach and do not detract from either people's ability to use or their perception of use would therefore be preferred. Such options include piling and the construction of masonry aprons. The use of rock revetments on recreational beaches is not considered appropriate.

This option does not address the problem of overtopping of the defences associated with the unit.

Option 2 – Raise Local Sections of Seawall (Improve)

Option 2 comprises the following elements:

- as Option 1
- raise local sections of seawall to reduce the effects of overtopping.

Raising the level of the seawall in local sections would reduce the frequency and amount of overtopping and hence improve the standard of the defence.

Other technical issues are as discussed in Option 1.

Environmental interests are as for Option 1with regard to maintenance of the existing structures.

Locally raising the seawall could reduce the frequency and severity of overtopping along some parts of the frontage. In conjunction with protecting the landward verge, this would provide protection to the coast road. Sections where residential properties are at risk from damage, e.g. Cobo Bay, or where the coast road is likely to fail, should be given priority. Raising the seawall could have a visual impact for properties located landward of the coast road. The opinions of local residents on their preference between potentially obscured seaward views or continued flooding and closure of the coast road should be sought, as this could prove to be a significant determinant in the course of action taken.

This option would address the problem of overtopping of the defences associated with this unit.

Option 3 – Beach Nourishment (Improve)

Option 3 comprises the following elements:

- continue existing practice by regular re-pointing of the masonry structures that are exposed
- beach nourishment with sand.

Beach nourishment would prevent further deterioration of the base of the wall, as it would no longer be exposed to wave action wall by forcing the waves to break further away from the wall thus improving the standard of defence. It is likely that some beach nourishment material would be lost offshore during storm events. This would require periodic renourishment of the beaches to make good the losses and maintain the standard of defence. The continuing maintenance of the seawall would ensure its integrity for the life of the strategy and hence the assets it defends.

Other technical issues are as discussed under Option 1.

Environmental interests are as for Option 1 with regard to maintenance of the existing structures.

Beach nourishment would need to be compatible with existing substrates within the unit and in particular with regard to areas of sandy beach that are of recreational importance. Nourishment with sand would enhance existing beaches and in addition could provide a significant increase in the overall area of sandy beach within the unit, with consequent benefits for recreational and tourism interests.

The volume of sediment required to significantly reduce overtopping is considerable and could have a detrimental impact on intertidal ecology. Over time, and without the emplacement of control structures, sand would naturally be re-distributed by existing coastal processes within the bay. This could lead to the smothering of rocky intertidal areas with a consequent change to, or even loss of, biological hard substrate communities and a potential reduction in available food resources to wintering waterfowl. Further information on the ecology of the intertidal platform would be required in order to provide a reasonable assessment of the potential impacts of beach recharge within this unit.

It should be ensured that beach nourishment did not interfere with the use of the slipways within the unit.

The creation of a high sandy beach within the bay may lead to problems with wind blown sand as the crest of the profile would remain dry at high water. If this becomes a nuisance, steps could be taken to manage the problem, e.g. by placing sand fences on the beach.

This option would address the problem of overtopping of the defences. It would also provide additional protection to the toe of the seawall.

Option 4 – Beach Nourishment with Detached Breakwaters (Improve)

Option 4 comprises the following elements:

- as Option 3
- detached breakwaters.

The detached breakwaters would prevent most of the loss of beach nourishment material offshore during storm events. However, periodic renourishment of the beaches to make good the losses and maintain the standard of defence would still be required but to a lesser extent than in Option 3.

Other technical issues are as discussed under Option 3, particularly with regard to the maintenance of the seawall and beach nourishment.

The placement of detached breakwaters within the bay could have several significant environmental impacts. These are as follows:

- visual intrusion into an important and aesthetic coastal landscape
- direct loss of intertidal area of interest for its maritime flora and fauna and the loss of this area for feeding to wintering waterfowl
- potential additional hazard to navigation for boats.

In conjunction with beach recharge, the benefits of this option with regard to providing a better beach for recreational activity could be outweighed by the predicted impacts on the natural environment and the coastal landscape.

CU10

This option would address the problem of overtopping of the defences. It would also provide additional protection to the toe of the seawall.

Economic Appraisal

Benefits

Table CU10.1 gives the estimated value of the assets protected by the defences within CU10.

Table CU10.1 Benefits

Assets	Area/Length	Value (£)
Flooding		
Developed Land	15.0ha	19,500,000
Undeveloped Land	21.6ha	400,000
Erosion		
Minor Road	1,900m	570,000
Coast Road	-	-
Ribbon Development	500m	1,625,000
	Total	**22,095,000**
	Discounted Total	**9,220,000**

Notes: The following intangible benefits are not included in the above table:
- the vital communication link provided by the coast road
- recreational value of the beach.

Therefore the benefits derived for CU10 are likely to be an underestimate of the actual value.

Costs

Table CU10.2 gives the estimated value of the costs associated with Options 1 to 4.

Table CU10.2 Costs

Option	Initial Capital Cost (£)	Future Costs (£)		Total Discounted Cost (£)
		Capital	Maintenance	
1	5,000	80,000/10 years	8,550/year	**180,000**
2	130,000	80,000/10 years	8,550/year	**232,000**
3	4,250,000	850,000/10 years	8,550/year	**2,287,000**
4	4,644,000	425,000/10 years	14,000/year	**2,357,000**

Results

Table CU10.3 gives the results of the economic appraisal for Options 1 to 4.

Table CU10.3 Results

Option	Benefit–Cost Ratio
1	51
2	40
3	4.0
4	3.9

e) Summary of Preferred Strategic Option

Table CU10.4 summarises the results of the appraisal process for CU10.

Table CU10.4 Summary of Appraisals

Option	Technical Appraisal	Environmental Appraisal	Economic Appraisal
1 • continue existing practice	• ensures integrity of defences • does not address overtopping problem • long-term commitment to toe protection	• no significant concerns	• viable
2 • raise seawall	• ensures integrity of defences • reduces overtopping • long-term commitment to toe protection	• affects views from coast road and properties	• viable
3 • beach nourishment	• ensures integrity of defences • reduces overtopping • protects toe of wall	• detrimental impacts on environmental interests • enhances beaches	• viable
4 • beach nourishment • detached breakwaters	• ensures integrity of defences • reduces overtopping • protects toe of wall	• detrimental impacts on environmental interests • enhances beaches • visual intrusion	• viable

Option 1 does not address the problems of overtopping within the unit. For this reason the option is rejected as a long-term course of action but could be considered as an interim measure.

Options 2, 3 and 4 are technically sound as they ensure the integrity of the defence and address the problem of overtopping within the unit. There is, however, a question over the long-term viability of Option 2 as it would mean a long-term commitment to toe strengthening. The coastal defence survey completed for the study indicated that beach levels within the bay are not critical (in terms of exposure of the foundations to the seawall), suggesting that toe strengthening may be sustainable. However, the survey is very much a "snap shot" in time and it is not clear whether there is a long-term trend of beach lowering within the unit.

Option 2 and Option 3 are environmentally acceptable, subject to consultation with local residents over seawall raising (Option 2) and consideration of the impacts of beach nourishment on the intertidal habitats (Option 3). Option 4 is rejected because of the impacts that detached breakwaters would have on the natural environment and coastal landscape.

Although Option 2 and Option 3 are economically viable it is acknowledged that there is a significant difference in the costs between the two options. It should, however, be noted that the economic appraisal for Option 3 does not include the significant (intangible) benefits to tourists of improved beaches.

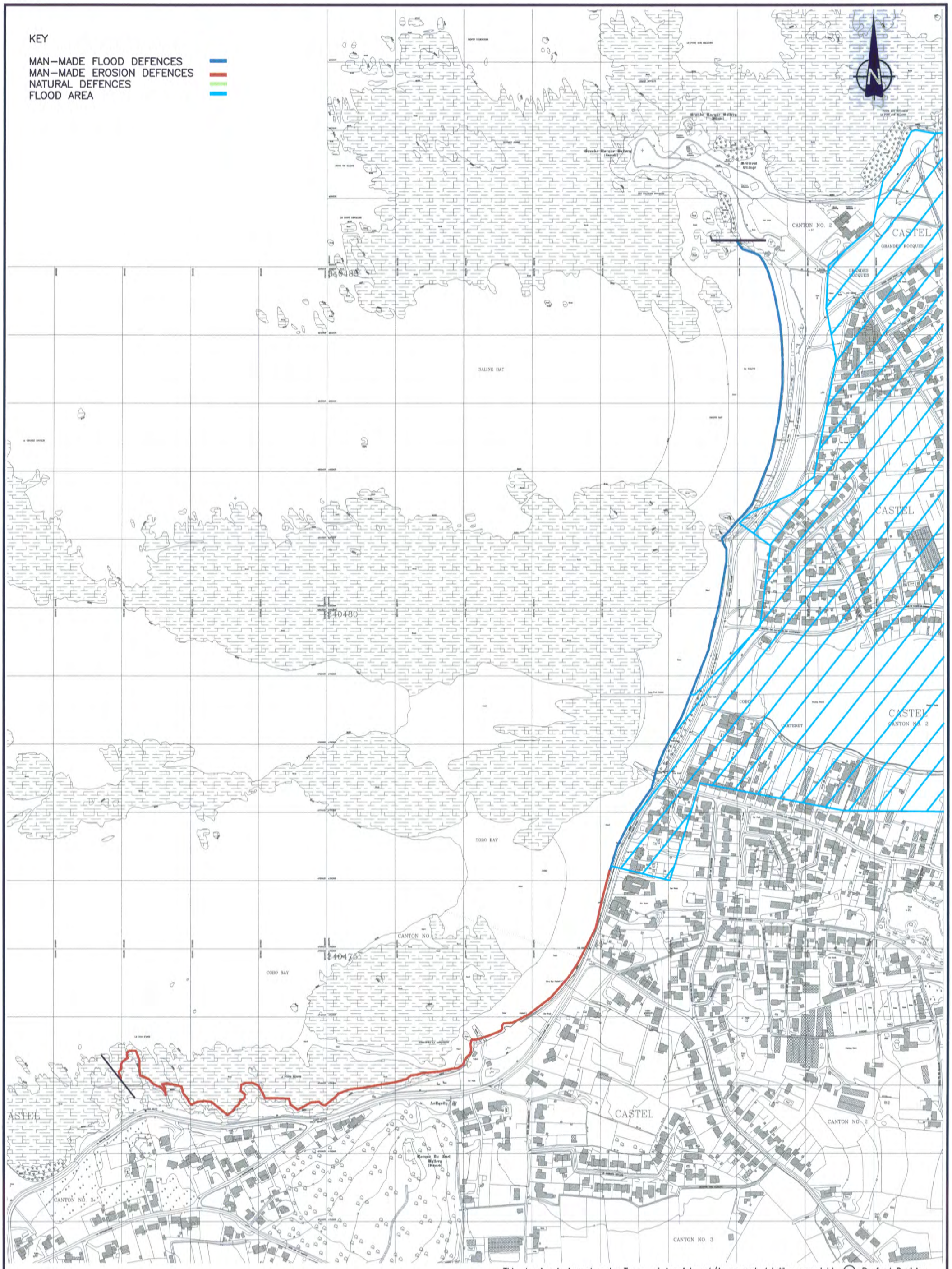
On the basis of the above, the following is proposed:

- initially, Option 1 is adopted as the preferred option and works are undertaken to the vulnerable length of seawall in the centre of the bay, this assumes that the temporary closures of the coast road from overtopping are acceptable in the short term.
- monitoring of the beaches commences immediately so that a view can be taken on their behaviour in five years' time.
- in five years' time a long-term strategy is selected for the unit. Option 2 would be preferred if beach levels are tolerably stable and Option 3 if beach levels are continuing to fall.

CU10

KEY

MAN–MADE FLOOD DEFENCES
MAN–MADE EROSION DEFENCES
NATURAL DEFENCES
FLOOD AREA



PROJECT GUERNSEY STRATEGY FOR COASTAL DEFENCE AND BEACH MANAGEMENT	TITLE COASTAL UNIT 10 Le Guet to Grandes Rocques	CONSULTING ENGINEERS POSFORD DUVIVIER	DRAWN MDWP | SCALE 1:5,000 DATE FEB' 99 | CHKD JEC DRG No. FIGURE 6.10

6.11 Coastal Unit 11 – Grandes Rocques to Rousse

a) Attributes

Introduction

Coastal Unit 11 is located on the west side of the island and extends between Grandes Rocques and Rousse (see Figure 6.11), a length of approximately 6,500m.

Coastal Processes and Beach Behaviour

This unit consists of a series of small bays separated by rocky headlands. The bays tend to be dominated by rocky foreshores with pockets of sand or shingle. Port Soif consists of a sandy foreshore, rocky outcrops being visible as the tide retreats.

The headlands within this unit are exposed to severe wave attack and, as a result, there is little mobile sediment on the foreshore. Wave attack within the bays along this frontage is broadly normal to the coastline because of the sheltering effects of the headlands and rocky outcrops. There is little evidence of longshore drift within or between the bays. During storms sediment is drawn down the beaches within the bays potentially exposing the defences to increased wave attack. However, the sheltering effects of the headlands suggest that the material is not permanently lost from the bays by tidal or wave action. The beaches are, therefore, able to rebuild after the storm has passed.

Coastal Defences

The majority of the bays along this frontage contain lengths of rock protection against the soft edges of the dunes. Several of the headlands also have rock protection, such as between Baie des Pêqueries and Baie de Pulias and de Port Grat. There is a short length of masonry wall adjacent to the slipway at the west end in Baie de Port Grat where the coast road abuts the coastal edge. Shingle ridges protect the coastal edge in Portinfer and Baie des Pêqueries.

Generally, all the man-made defences within this unit are in satisfactory condition, having residual lives of between 10 and 25 years. At the time of the site inspection of man-made defences there were no specific problems. The soft upper cliffs around the headlands are eroding.

These defences, together with the areas at risk from flooding, are shown in Figure 6.11 at the end of this sub-section.

Land Use and Human and Built Environment

This section of coast marks the change from the large bays and headlands of the west coast that are backed by the higher ground of the central plateau, to the bays and lower rocky headlands of the north coast that are backed by a more low-lying landscape. The coastal area is still, in general, open and undeveloped and contrasts with the densely populated hinterland.

CU11

This unit comprises a series of small embayments and rocky headlands, each of which is slightly different in character, reflecting changes in geology, aspect and land use. Unlike some of the larger bays to the south west, the coast road does not completely adhere to the immediate coastline and instead tends to take a slightly more inland route, so that at some points it is about 200–250m from the shore. Development is largely confined to the landward side of the coast road, except at Portinfer and Rousse where there has been some residential and horticultural development out onto the low headlands. At Baie des Pêqueries the coast road runs close to the back of the bay, with residential development and land in horticultural or agricultural use on its landward side.

The shallow horseshoe-shaped bay of Port Soif is backed by a sandy beach and small area of sand dunes, making it a popular recreational site for beach activities. Recreation elsewhere within the unit is largely limited to walking and general sightseeing. Visitors and tourists are well catered for with eight car parks and associated facilities. There is a slipway in Baie de Port Grat.

All the headlands within the unit have been identified as being of archaeological interest.

Grande Rocques Battery, at the western end of the headland, was a strongpoint established in the early 19th century as part of a comprehensive scheme for insular defence, mounted in response to the threat of attack from the French. Modifications and additions were made to the fortifications by the Germans during World War II. Of further archaeological importance are the remains of a medieval fishing settlement, which were uncovered on the headland in an excavation in 1985. The imposing Château des Grandes Rocques on the north-eastern side of the headland was formerly a school and hotel but is now a private residence.

On Port Soif Common, between Port Soif and Portinfer, there are the remains of Neolithic and Bronze Age settlement, remnants of which can be seen in the form of a small stone cist or burial chamber.

At Rousse, at the eastern end of the unit, the most prominent feature is the Napoleonic loopholed tower and adjoining open battery, built on the summit of the headland. This pre-Martello Tower is the 11th coastal defence tower of a series of 15 built around the coast between 1778 and 1779 in response to the threat of attack by the French.

Natural Environment

The Grandes Rocques headland and adjacent coastline round into Port Soif, is formed in the distinctive orangey-pink Cobo Granite. From Port Soif Bay, the coast to the north east is formed in the Bordeaux Diorite Complex, the contact between the two formations occurring towards the centre of the small bay.

Both Portinfer and Baie des Pêqueries provide suitable intertidal feeding areas for a range of wading birds, but in particular oyster-catchers and turnstone, species which prefer the more pebbly substrate of these small coves. The relatively sheltered shingle shoreline within both these bays supports a typical strandline flora with species such as sea sandwort (*Honkenya peploides*) and sea beet (*Beta vulgaris* ssp. *maritima*), which grades landward into stabilised coastal grassland with marram grass, wild carrot (*Daucus carota*) and various species of coastal grasses.

Further to the north east, Pulias Pond is a small shallow pond immediately behind the storm beach at the back of Baie de Pulias, and often receives saline water at high tide. The site, which is a SNCI, provides suitable feeding for a number of bird species including little egret, little stint and occasionally night heron.

The small headland of Grandes Rocques is a SNCI managed by the Board of Administration. The maritime grassland is typical of this west coast habitat and includes species such as round-leaved cranesbill (*Geranium rotundifolium*), sea campion (*Silene maritima*) and common adder's tongue fern (*Ophioglossum vulgatum*).

Port Soif Bay is also a SNCI and constitutes Guernsey's only active area of sand dune habitat, and is one of the few remaining areas of established dune grassland on the north-west coast. This is an important wildlife habitat, and offers a glimpse of the coast before development led to the loss of this habitat, which originally would have fringed the majority of the west coast. Marram grass (*Ammophila arenaria*) dominates the seaward edge of the dunes, along with some gorse (*Ulex europeaus*) scrub, and gives way to rabbit-grazed maritime grassland with some bare areas of sand. This habitat supports a great variety of plant life including many of the island's speciality and rarer species such as bee orchid (*Ophrys apifera*), sand crocus (*Romulea columnae*), smaller tree mallow (*Lavatera cretica*), white-flowered burnet rose (*Rosa pimpinellifolia*) and long-stalked cranesbill (*Geranium columbinum*). The dunes also act as a stopover for migrant birds such as wheatear, while the scrub vegetation supports breeding species like stonechat and linnet.

Between Port Soif and Portinfer is a Port Soif Common, an area of rough maritime grassland with some scrub. This is a nature conservation area and supports a flora and fauna typical of stabilised dune grassland.

Planning Policies

The entire coastal frontage, including the headlands, is an Area of Special Environmental Importance (Green Zone 1). The mixture of land use landward of the coast road and on the Rousse headland is reflected by its inclusion as an Area of Landscape Value (Green Zone 2), an Area or Rural Character (Green Zone 3) and as a classified Built-Up Area. The headlands on either side of the Baie des Pêqueries, and the bay itself, are identified Enhancement Target Areas. All these areas are subject to the relevant conservation and enhancement policies set out in the Rural Area Plan (Phase 2).

b) Key Interests within Unit

The following list highlights the main interests within the unit that have the potential to interact with, or be influenced by, coastal defence policies. They are:

- coast road
- recreational value of the beaches
- properties including the Grandes Rocques Hotel
- mobile dune habitat at Port Soif
- Pulias Pond SNCI.

c) Appraisal of Strategic Options

Do Nothing

If nothing is done to maintain or improve the defences between Grandes Rocques and Rousse, the following scenarios over the 50-year period covered by the strategy are envisaged:

i) In the short term, there would be little or no risk.

ii) In the medium term, wave attack would lead to the deterioration of man-made defences and result in damage to the coast road, localised flooding and erosion of the soft coastal edge.

iii) In the long term, the structural failure of the man-made defences would occur, caused largely by wave action, and lead to widespread flooding within this unit and CU10, erosion of the coastal edge, localised losses of the coast road where it is close to the coastal edge, loss of property and landward migration of the dune ridge.

The Do Nothing option would cause economic damage through the loss of the developed and undeveloped land through erosion and flooding. In total approximately 24 hectares of undeveloped and 8 hectares of developed land would be affected. The option of Do Nothing does not satisfy all the Objective set out in Section 2.3.

For these reasons the option is rejected.

Do Something

From the above discussion it is evident that the Do Something option should be adopted if a viable scheme can be identified. Sustaining the defences at their present standard would address the future problems of erosion and flooding associated with the unit. Therefore options to improve the existing standard of defence are not considered.

d) Do Something Potential Scheme Options

The reasoning described in Section 5.3.3 (Possible Defence Methods) together with the problems and issues referred to above, results in the selection of one option for appraisal.

Technical and Environmental Appraisal

Option 1 – Continue Existing Practice (Sustain)

Option 1 comprises the following elements:

- continue existing practice by limited tipping of rock to the existing rock protection and regular re-pointing of the masonry structures
- annual inspections of the defences.

Continuing the existing practice of maintaining the length of seawall and rock protection will ensure the integrity of the defences for the life of the strategy and thus protect the assets they defend.

The environmental consequences of adopting this option are relatively limited, as in effect the existing situation would be largely maintained. It is therefore considered that in general there is unlikely to be any significant adverse impacts on existing coastal habitats, human activity or residential development over the lifetime of the strategy.

Economic Appraisal

Benefits

Table CU11.1 gives the estimated value of the assets protected by the defences within CU11.

Table CU11.1 Benefits

Assets	Area/Length	Value (£)
Flooding		
Developed Land	7.5ha	9,750,000
Undeveloped Land	23.5ha	435,000
Erosion		
Minor Road	N/A	-
Coast Road	4,000m	3,600,000
Ribbon Development	250m	813,000
	Total	**14,598,000**
	Discounted Total	**6,091,000**

Notes: The following intangible benefits are not included in the above table:
- the vital communication link provided by the coast road
- recreational value of the beaches
- mobile dune habitat at Port Soif
- Pulias Pond SNCI.

Therefore the benefits derived for CU11 are likely to be an underestimate of the actual value.

Costs

Table CU11.2 gives the estimated value of the costs associated with Option 1.

Table CU11.2 Costs

Option	Initial Capital Cost (£)	Future Costs (£)		Total Discounted Cost (£)
		Capital	Maintenance	
1	N/A	N/A	9,900/year	**165,000**

Results

Table CU11.3 gives the results of the economic appraisal for Option 1.

Table CU11.3 Results

Option	Benefit–Cost Ratio
1	37

e) Selection of Preferred Strategic Option

Table CU11.4 summarises the results of the appraisal process for CU11.

Table CU11.4 Summary of Appraisals

Option	Technical Appraisal	Environmental Appraisal	Economic Appraisal
1 • continue existing practice	• ensures integrity of defences	• no significant concerns	• viable

Option 1 is technically sound, environmentally acceptable and economically viable and is, therefore, selected as the appropriate strategy for CU11.

Although not considered within the appraisal of Option 1, there are a number of areas where there are opportunities for environmental enhancement and these are discussed below.

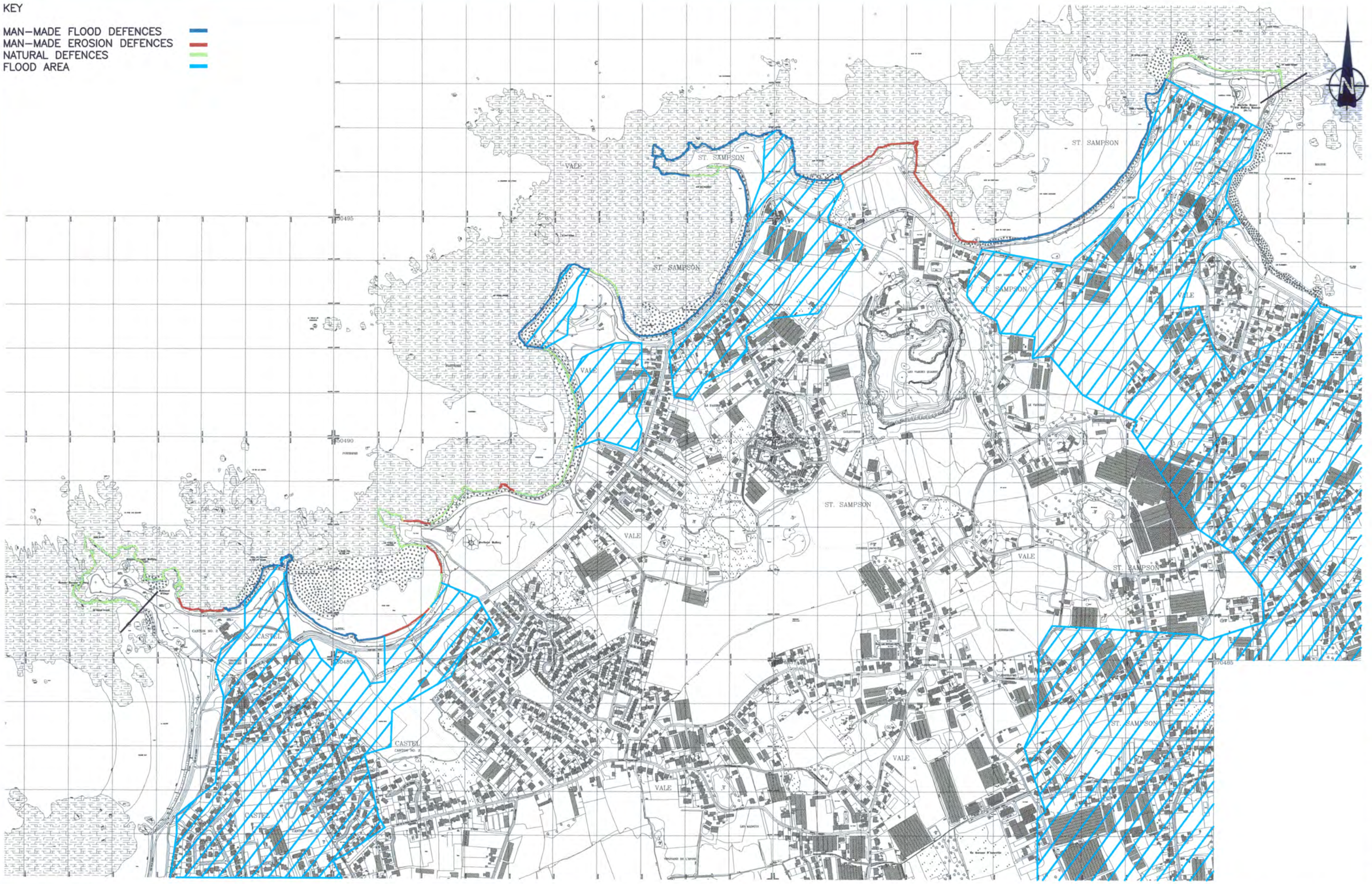
The dune system within Port Soif could be left undefended, as it represents the only area of semi-mobile dune habitat on Guernsey. Some landward retreat of the dune line would be expected over the lifetime of the strategy, although it is difficult to forecast its rate and extent. If retreat causes problems with the use of the coast road to the rear of the bay, dune management techniques should be used (e.g. additional planting of marram grass or use of sand traps) in preference to the use of hard defences (e.g. rock revetments) to provide some measure of stabilisation. In addition, the emplacement of hard defences within the bay could also detract from the existing recreational use and importance of the site.

All the headlands are recognised for their archaeological importance. While much of this interest is located on the resistant and higher parts of the headlands, there could be some loss of archaeological interest as erosion of the largely unconsolidated sediments forming the low cliffs overlying the rock platform continues. Periodic monitoring of the area for any evidence of archaeological artefacts or structures could be carried out. If significant finds are made, then either excavation could be undertaken or protection from further erosion provided. No property or infrastructure would be at risk from continued erosion during the lifetime of the strategy.

Areas of stabilised dune and maritime grassland along the frontage, e.g. Grandes Rocques, are unlikely to be affected by maintenance work and the continued functioning of existing defences. However, suitable measures should be taken during any proposed works to prevent damage to these areas and, if possible, opportunities for enhancement should be sought.

KEY

MAN–MADE FLOOD DEFENCES
MAN–MADE EROSION DEFENCES
NATURAL DEFENCES
FLOOD AREA



PROJECT

GUERNSEY STRATEGY FOR COASTAL DEFENCE AND BEACH MANAGEMENT

TITLE

COASTAL UNIT 11

Grandes Rocques to Rousse

CONSULTING ENGINEERS

POSFORD DUVIVIER

Job No.	E3309	DATE	FEB'99	SCALE	1:8,000
ACAD Ref.		CHECKED	JEC	PASSED	AJS
DRAWN	MDWP	DRG No.	FIGURE 6.11		REV

CU12

6.12 Coastal Unit 12 – Rousse to Chouet (Le Grande Havre and Ladies Bay)

a) Attributes

Introduction

Coastal Unit 12 is located on the west side of the island and extends between Rousse and Chouet, forming Le Grande Havre and Ladies Bay (see Figure 6.12), a length of approximately 3,500m.

Coastal Processes and Beach Behaviour

The beach fronting this unit varies. Generally the upper beach is made up of cobbles and shingle overlying sand, which extends down the foreshore to rock outcrops. From Rousse to just west of Picquerel headland the beach is almost entirely made up of cobble/shingle material with localised pockets of sand.

The lower foreshore to the south of Picquerel consists of sand with the upper beach dominated by shingle interspersed with boulders. The southern shore of Ladies Bay is made up entirely of sand. The west-facing shore is similar in composition to that south of Picquerel, comprising an upper beach of shingle and a sandy foreshore. This distribution of sediments on the foreshore continues into Ladies Bay to the point where the man-made defences exist. The beach in front of the defences comprises sand.

There are two large rock outcrops present within this unit, one separating Le Grande Havre and Ladies Bay, creating Amarreurs Harbour, the other in the centre of Ladies Bay, which has pulled sediment into its lee joining it to the foreshore.

The Ladies Bay beaches are the most exposed to direct wave attack and are the most heavily defended. Waves approach the Ladies Bay frontage broadly normal to the coast because of the shelter afforded by the headlands surrounding the unit. As a consequence, longshore transport of sediment is limited in Ladies Bay. During storms, the beaches are susceptible to drawdown potentially exposing the defences to increased wave attack. However, the sheltering effect of the headlands suggests that beach material is not permanently lost from the bay by tidal or wave action. The beaches are, therefore, able to rebuild after the storm has passed.

Le Grande Havre Bay is more sheltered than Ladies Bay, as waves are diffracted round the Rousse headland to the beaches. There is little evidence of significant longshore or cross-shore movement of sediment within Le Grande Havre.

The unit is effectively a sediment cell with limited input to or loss of material from the unit.

Coastal Defences

The frontage of this unit is defended by a combination of man-made and natural defences. On the length of coastline from Rousse to Picquerel, there is a short length of rock protection against the soft coastal edge. Natural defences in the form of a shingle ridge then dominate until just beyond the slipway. Dunes covered in grasses protect the coastal edge to Picquerel headland, which also has rock protection defences.

A short length of low masonry wall protects the southern edge of Picquerel headland. The remainder of Le Grande Havre is defended by short lengths of rock protection interspersed with natural dune defences to Amarreurs Harbour. A breakwater extends from the rock outcrop to form Amarreurs Harbour at the border between Le Grande Havre and Ladies Bay.

There is rock protection to the coastal edge around the small headland of Amarreurs, and it extends into the southern end of Ladies Bay. The defence then changes to a rock revetment with a masonry faced concrete toe. The remainder of the unit, up to Chouet, is defended by intermittent lengths of rock revetment against the dunes. Generally, the residual life of the man-made defences is between 10 and 25 years.

Generally, the coastal edge of Le Grande Havre and Ladies Bay is not exhibiting signs of erosion and the piecemeal defences of rock protection and masonry walls are providing adequate protection to the coastal edge. However, a length of the masonry faced toe protection to the rock revetment in Ladies Bay is deteriorating and a short section is missing. The rock revetment above this toe does not appear to be adversely affected.

These defences, together with the areas at risk from flooding, are shown in Figure 6.12 at the end of this sub-section.

Land Use and Human and Built Environment

Together Le Grande Havre and Ladies Bay form the largest and most sheltered bay on the north coast of the island. Land use is varied with residential development predominating at the southern end of the bay, limited horticultural use at La Garenne to the south east and the western side of L'Ancresse Common, which is largely occupied by an 18-hole links golf course, backing Ladies Bay. The main coast road runs close to the shoreline along the south-eastern and southern edges of the bay, but veers inland at La Garenne, towards Vale. A minor road runs halfway along the eastern side of the bay to the car parking and associated facilities opposite Amarreurs Harbour. Parking is also available at the eastern end of Piquerel Beach and just to the south of Le Chouet headland.

The sheltered nature of the southern half of the bay, particularly in the lee of the Rousse headland, provides ideal mooring conditions for small boats. There are four slipways, two on the eastern side of the Rousse headland and two in Ladies Bay. Surprisingly, despite the sheltered nature of the bay and the sandy beaches along its eastern side, the bay is not as popular a recreational beach as others areas along the west coast such as Vazon Bay, or Pembroke Beach to the east.

Amarreurs Harbour, between Le Grand Havre and Ladies Bay, built in the 1800s as part of the enclosure of the Clos du Valle, was intended to keep the livestock that grazed here from wandering off the islet. Today, the harbour provides sheltered mooring for a number of small boats.

L'Ancresse Common is an important archaeological site, as highlighted by the presence of a number of dolmens of Neolithic age and the Megalithic passage grave at La Varde. In addition to these is the ancient monument of Les Fouaillages. Dated at about 6,000 years old, this long mound is probably the oldest known stone structure in Europe. A large number of artefacts have been recovered from the site following its excavation in the late 1970s, indicating that occupation of the site, and possibly the area, occurred over a period of nearly 4,000 years.

Natural Environment

The entire bay is formed in the Bordeaux Diorite Complex, although prominent exposures of this formation only occur on the eastern side of the Rousse headland and southern side of Le Chouet headland.

The extensive intertidal mud and sand areas of the bay represent the most important habitat within the unit and are used by many shorebirds for feeding and bathing. Both ringed plover and sanderling flocks number over 50 birds in late winter. This site also has smaller numbers of dunlin (*Calidris alpina*), turnstone and grey plover. Common terns have attempted to breed on at least one of the larger rocky islets in the middle of the bay. Herring gulls and lesser black-backed gulls (*Larus fuscus*) use the freshwater stream emptying into the bay from Vale Pond for bathing. A roost of over 250 black-headed gulls is present in winter. Divers, including great northern diver and grebes, make use of the calmer conditions found in the centre of the bay during periods of rough winter weather.

Around Le Grande Havre and Ladies Bay, where the rock revetment does not completely cover the seaward edge of the low head and blown sand cliff line, rough maritime grassland typical of stabilised sand dune habitat dominates with marram grass (*Ammophila arenaria*), wild carrot (*Daucus carota*), ribwort plantain (*Plantago lanceolata*) and dune fescue (*Vulpia fasciculata*). In areas where stability is most pronounced, e.g. Picquerel, this habitat supports scrub species such as gorse (*Ulex europeaus*) and bramble (*Rubus fruiticosus*). In addition, the shingle beach at Piquerel provides a suitable foothold for strandline species such as sea beet (*Beta vulgaris* ssp. *maritima*).

L'Ancresse Common, which borders the eastern side of the bay, is an area of rolling dune grassland punctuated by rocky hougues. Despite the development of the golf course, the Common retains areas of semi-natural habitat, particularly immediately adjacent to the coast. Here, species such as dwarf pansy (*Viola kitaibeliana*), sea spurge (*Euphorbia paralias*), quillwort (*Isoetes histrix*) and orange birds-foot (*Ornithopus pinnatus*) can be found. L'Ancresse is the only site in the north of the island where Dartford warbler (*Sylvia undata aremorica*) occur, and at least five pairs of stonechat also breed in the dense sections of gorse. The position of the area on the north coast makes it an important landfall site for migrating birds, particularly species such as redstart, wheatear, whinchat and yellow wagtail.

Both the bay and L'Ancresse Common are identified SNCIs.

Planning Policies

The entire coastal frontage, and L'Ancresse Common on the eastern side of the bay, is an Area of Special Environmental Importance (Green Zone 1). Residential land at the southern end of the bay is classified as a Built-Up Area. Horticultural land bordering the minor coast road just to the south of the disused quarry at La Garenne is classified as an Area of Landscape Value (Green Zone 2) and an Enhancement Target Area. These areas are subject to the relevant conservation and enhancement policies set out in the Rural Area Plan (Phase 2).

b) Key Interests within Unit

The following list highlights the main interests within the unit that have the potential to interact with, or be influenced by, coastal defence policies. They are:

- residential properties
- coast road
- golf course
- recreational and amenity values of beaches
- small boat mooring facilities
- coastal habitats and archaeological interest of L'Ancresse Common.

c) Appraisal of Strategic Options

Do Nothing

If nothing is done to maintain or improve the defences within Le Grande Havre and Ladies Bay, the following scenarios over the 50-year period cover by the strategy are envisaged:

i) In the short term, there would be little or no risk to the assets.

ii) In the medium term, the deterioration of the man-made defences in Ladies Bay, caused largely by wave action, would lead to erosion of the coastal edge.

iii) In the long term, the structural failure of the defences within Ladies Bay would occur owing to deterioration caused largely by wave action, which would lead to further erosion of the coastal edge, threatening part of the golf course and residential properties. Do Nothing within Le Grande Havre would result in the flooding of the low-lying reclaimed land at Braye du Valle and erosion of the surrounding higher coastal edge leading to the loss of sections of the coast road and residential properties.

The Do Nothing option would cause economic damage through the loss of the developed and undeveloped land owing to flooding and erosion. In total approximately 75 hectares of undeveloped and 36 hectares of developed land would be affected. This option of Do Nothing does not satisfy all the Objectives set out in Section 2.3.

For these reasons the option is rejected.

Do Something

From the above discussion it is evident that the Do Something option should be adopted if a viable scheme can be identified. Sustaining the defences at their present standard would address the future problems of erosion and flooding associated with the unit. Therefore options to improve the existing standard of defence are not considered.

d) Do Something Potential Scheme Options

The reasoning described in Section 5.3.3 (Possible Defence Methods) together with the problems and issues referred to above, results in the selection of two options for appraisal.

Technical and Environmental Appraisal

Option 1 – Continue Existing Practice (Sustain)

Option 1 comprises the following elements:

- continue existing practice by limited tipping of rock into the existing rock protection structures and regular re-pointing of the masonry wall
- annual inspection of the defences.

Continuing the existing practice of maintaining the lengths of man-made defences will ensure the integrity of the defences for the life of the strategy and thus protect the assets they defend. The ongoing maintenance routine may include repairs to the toe protection within Ladies Bay.

The environmental consequences of adopting this option are relatively limited, as the existing situation would be largely maintained. It is therefore considered that in general there is unlikely to be any significant adverse impacts on existing coastal habitats, human activity or development over the lifetime of the strategy. However, in relation to some interests, the following qualifications to this statement can be applied.

In those areas where there is presently no rock protection to the low cliff line, e.g. sections of the Rousse headland and L'Ancresse Common, there could be some loss of archaeological interest as erosion of the largely unconsolidated sediments forming the low cliffs takes place. Periodic monitoring of the area for any evidence of archaeological artefacts or structures could be carried out. If significant finds are made, then either excavation should be undertaken or protection from further erosion provided.

Areas of stabilised dune and maritime grassland along the frontage are unlikely to be affected by maintenance work and the continued functioning of existing defences. However, it should be ensured that suitable measures are taken during any proposed works to prevent damage to these areas and, if possible, opportunities for enhancement should be sought.

Option 2 – Removal of Rock Protection (Sustain)

Option 2 comprises the following elements:

- selective removal of rock protection
- selective beach nourishment (dune creation)
- annual inspection of defences.

This second option is viewed as a means of holding, or perhaps in places slightly retreating, the existing defence line, through so-called "soft" engineering methods, but effectively still providing the same level of protection.

Rock protection at various locations within the unit is effective in stabilising the coastline but prevents the natural development of a dune ridge at the back of the bay. Originally, a semi-mobile dune ridge would have occurred around much of the bay, particularly along its eastern side. This has now been stabilised or lost through extraction and development, although remnants of it still exist. There are some sections where a semi-mobile ridge could be re-instated, notably around Amarreurs, and this would provide an opportunity to enhance the overall level of this important habitat on the island.

This option would need to be further investigated but consideration should be given to its applicability when maintenance work to sections of the existing rock protection is required. Basic removal of rock protection would not be acceptable as potentially erosion could have an adverse impact on existing interests such as the golf course. Removal would have to be combined with stabilisation measures, such as the planting of marram grass or the emplacement of sand traps. In addition, beach nourishment with sand to feed the upper shore may be required as this is probably the major factor presently constraining any dune development within the bay.

Potentially, this option could also provide enhancements with regard to the recreational value of the sandy beaches within the bay.

Economic Appraisal

Benefits

Table CU12.1 gives the estimated value of the assets protected by the defences within CU12.

Table CU12.1 Benefits

Assets	Area/Length	Value (£)
Flooding		
Developed Land	36.0ha	46,800,000
Undeveloped Land	74.8ha	1,383,000
Erosion		
Minor Road	1,200m	360,000
Coast Road	1,500m	1,350,000
Ribbon Development	450m	1,463,000
	Total	**51,356,000**
	Discounted Total	**21,429,000**

Notes: The following intangible benefits are not included in the above table:
- the vital communication link provided by the coast road
- recreational and amenity values of beaches
- small boat mooring facilities
- coastal habitats and archaeological interest of L'Ancresse Common.

Therefore the benefits derived for CU12 are likely to be an underestimate of the actual value.

Costs

Table CU12.2 gives the estimated value of the costs associated with Option 1.

Table CU12.2 Costs

Option	Initial Capital Cost (£)	Future Costs (£)		Total Discounted Cost (£)
		Capital	Maintenance	
1	2,500	2,500/10 years	5,400/year	**92,000**
2	284,000	N/A	2,700/year	**163,000**

Results

Table CU12.3 gives the results of the economic appraisal for Option 1.

Table CU12.3 Results

Option	Benefit–Cost Ratio
1	232
2	132

e) Selection of Preferred Strategic Option

Table CU12.4 summarises the results of the appraisal process for CU12.

Table CU12.4 Summary of Appraisals

Option	Technical Appraisal	Environmental Appraisal	Economic Appraisal
1 • continue existing practice	• ensures integrity of defences	• no significant concerns	• viable
2 • selective removal of rock protection • selective beach nourishment	• ensures integrity of defences protecting assets	• opportunities for enhancement	• viable

Option 1 is technically sound, environmentally acceptable and economically viable. However, Option 2 potentially provides an opportunity for environmental enhancements.

On the basis of the above the following is proposed:

- initially Option 1 is adopted as the preferred option.
- studies are undertaken to confirm the environmental viability of Option 2.
- on completion of the above studies, a decision is taken as to whether to adopt Option 1 or Option 2 as the long-term preferred option.

CU12

KEY

MAN–MADE FLOOD DEFENCES
MAN–MADE EROSION DEFENCES
NATURAL DEFENCES
FLOOD AREA

VALE
GRAND HAVRE
VALE
GRAND HARVE
LADIES BAY
VALE
ROUSSE
VALE
AMARREURS
VALE
LA GARENNE
VALE
LE PICQUEREL
ST. SAMPSON
ISLET COMMON
L'ISLET
VALE
ST. SAMPSON

1270500
1280500
1270495
1280495
1270490
1280490

PROJECT: GUERNSEY STRATEGY FOR COASTAL DEFENCE AND BEACH MANAGEMENT	TITLE: COASTAL UNIT 12 Rousse to Chouet	CONSULTING ENGINEERS: POSFORD DUVIVIER	DRAWN MDWP / SCALE 1:5,000
			DATE FEB' 99 / CHKD JEC
			DRG No. FIGURE 6.12

6.13 Coastal Unit 13 – Chouet to Fort Pembroke

a) Attributes

Introduction

Coastal Unit 13 is located on the north side of the island and extends between Chouet and Fort Pembroke (see Figure 6.13). This unit occupies the northernmost length of coastline in the strategy, and is approximately 2,200m long.

Coastal Processes and Beach Behaviour

The foreshore between Chouet and Crève Coeur is rocky with little mobile sediment. There is a sandy beach with a rocky upper foreshore within the Baie de la Jaonneuse. The rocky foreshore then continues around the headland to Fort Pembroke.

This length of coast is very exposed to wave attack from the north and north west. There is little mobile sediment present on the beaches, with the exception of Baie de la Jaonneuse. The Baie is surrounded by rocky headlands, which prevent sediment transport to the west and east of the unit.

Coastal Defences

The frontage is defended by intermittent lengths of rock protection against the soft eroding coastal edge. The length in front of the quarry at Le Grand Camp has an additional soil bank behind the rock to reduce overtopping of the frontage. There is an embankment along the Mont Cuet frontage, protecting the low-lying land behind it from flooding. Baie de la Jaonneuse is defended by the natural rocky cliffs that form the bay.

There is evidence of erosion of the soft coastal deposits along the frontage and the soil bank is exhibiting signs of deterioration, thus reducing its effectiveness.

These defences, together with the area at risk from flooding, are shown in Figure 6.13 at the end of this sub-section.

Land Use and Human and Built Environment

The Chouet headland is an undeveloped stretch of coastline that has been utilised for quarrying over the past couple of centuries. The large quarry at Mont Cuet ceased production in 1997, and is now being used for the disposal of the island's putrescible waste.

This area of the north coast provides relatively little interest and few facilities for tourists or visitors. There is a large slipway providing access to the small cobble and shingle beach at Jaonneuse, which is locally of recreational importance.

The Chouet headland was heavily fortified in the past in an attempt to guard the navigational channel into Ladies Bay, initially during the Napoleonic Wars and later during World War II. Pre-Martello Tower 10 (built between 1778 and 1779) is located at the western end of the headland and formed part of a defence complex with two cannon platforms and a musketry wall. These were uncovered following the collapse of a German World War II tower into a nearby quarry. At the eastern end of the unit, clear evidence of the importance of this area as a strategic defence point is provided by the presence of pre-Martello Tower 9, Platon Battery, Star Fort and Fort Pembroke on the narrow rocky headland.

The entire common, together with adjacent headlands, is an area of archaeological importance. This is highlighted by the presence of a number of dolmens of Neolithic age and the Megalithic passage grave at La Varde. In addition to these is the ancient monument of Les Fouaillages. Dated at about 6,000 years old, this long mound is probably the oldest known stone structure in Europe. A large number of artefacts have been recovered from the site following its excavation in the late 1970s, indicating that occupation of the site, and possibly the area, occurred over a period of nearly 4,000 years. At Jaonneuse Point, a buried soil horizon beneath a capping of blown sand has yielded flints of Mesolithic and Neolithic types along with teeth of an extinct species of cattle (*Bos*. sp.).

Natural Environment

The western and central sections of the Chouet headland are formed in the Bordeaux Diorite. Baie de la Jaonneuse, at the eastern end of the headland, marks a change to the intrusive L'Ancresse Granodiorite, the contact between the two rock types occurring at Les Landelles.

Rocky shore and mixed substrate littoral habitats occur along the entire length of the unit. However, the development of upper shore communities is very limited given the large amounts of quarried rock debris that cover much of this area. Fucoid seaweeds and associated communities dominate the foreshore below about mid-tide level.

The coastal headlands and immediate hinterland within this unit form part of the large L'Ancresse Common SNCI. Much of this area is a buried landscape and comprises blown sand and alluvium infilling and overlying a large number of small rocky outcrops The vegetation found on the headlands is typical rough coastal grassland with areas of scrub vegetation including gorse, bramble and bracken (*Pteridium aquilinum*). In areas subject to more intensive grazing, or where bare sandy ground is present, species such as dwarf pansy (*Viola kitaibeliana*), sea spurge (*Euphorbia paralias*), quillwort (*Isoetes histrix*) and orange birds-foot (*Ornithopus pinnatus*) can be found. L'Ancresse is the only site in the north of the island where Dartford warbler (*Sylvia undata aremorica*) occur, and at least five pairs of stonechat also breed in the dense sections of gorse. The position of the area on the north coast makes it an important landfall site for migrating birds, particularly species such as redstart, wheatear, whinchat and yellow wagtail.

Planning Policies

The entire coastal frontage within the unit is an Area of Special Environmental Importance (Green Zone 1). The quarry at Mont Cuet is both an existing Mineral Working Site and a Site Reserved for Waste Disposal. The western end of the Chouet headland is a designated Area of Safeguarded Mineral Resources. In addition, the quarry plus the immediate coastline from Les Landelles westwards, including the southern side of the headland, is an identified Enhancement Target Area. These areas are subject to the relevant conservation and enhancement policies set out in the Rural Area Plan (Phase 1).

b) Key Interests within Unit

The following list highlights the main interests within the unit that have the potential to interact with, or be influenced by, coastal defence policies. They are:

- local vehicular access tracks
- landfill site
- recreational value of the beach
- coastal archaeology.

c) Appraisal of Strategic Options

Do Nothing

If nothing is done to maintain or improve the defences between Chouet and Fort Pembroke, the following scenarios over the 50-year period covered by the strategy are envisaged:

i) In the short term, the erosion of the soil embankment in front of the landfill site owing to overtopping would continue, increasing the instances of localised flooding.

ii) In the medium to long term, the deterioration of the rock protection caused by wave action would lead to erosion of the headland and flooding once the soil embankments had completely failed, resulting in loss of sections of the vehicular access tracks.

The Do Nothing option would cause economic damage through the loss of developed and undeveloped land through flooding and erosion. In total approximately 6 hectares of undeveloped and 1 hectare of developed land would be affected. The option of Do Nothing does not satisfy all the Objectives set out in Section 2.3.

For these reasons the option is rejected.

Do Something

From the above discussion it is evident that the Do Something option should be adopted if a viable scheme can be identified. Sustaining the defences at their present standard would address the future problems of erosion and flooding associated with the unit. Therefore options to improve the existing standard of defence are not considered.

d) Do Something Potential Scheme Options

The reasoning described in Section 5.3.3 (Possible Defence Methods) together with the problems and issues referred to above, results in the selection of one option for appraisal.

Technical and Environmental Appraisal

Option 1 – Continue Existing Practice (Sustain)

Option 1 comprises the following elements:

- continue existing practice by limited tipping of rock into the existing rock protection structures and rebuilding earth embankments as necessary
- annual inspection of defences.

Continuing the existing practice of maintaining the lengths of man-made defences will ensure the integrity of the defences for the life of the strategy and thus protect the assets they defend.

The environmental consequences of adopting this option are relatively limited, as in effect the existing situation would be largely maintained. It is therefore considered that, in general, there is unlikely to be any significant adverse impacts on either existing coastal habitats, human activity or development over the lifetime of the strategy. This option would safeguard the landfill site at Mont Cuet.

Economic Appraisal

Benefits

Table CU13.1 gives the estimated value of the assets protected by the defences within CU13.

Table CU13.1 Benefits

Assets	Area/Length	Value (£)
Flooding		
Developed Land	0.7ha	910,000
Undeveloped Land	6.4ha	118,000
Erosion		
Minor Road	700m	210,000
Coast Road	N/A	-
Ribbon Development	100m	325,000
	Total	**1,563,000**
	Discounted Total	**652,000**

Notes: The following intangible benefits are not included in the above table:
- recreational value of the beach
- coastal archaeology.

Therefore the benefits derived for CU13 are likely to be an underestimate of the actual value.

Costs

Table CU13.2 gives the estimated value of the costs associated with Option 1.

Table CU13.2 Costs

Option	Initial Capital Cost (£)	Future Costs (£)		Total Discounted Cost (£)
		Capital	Maintenance	
1	N/A	N/A	900/year	**15,000**

Results

Table CU13.3 gives the results of the economic appraisal for Option 1.

Table CU13.3 Results

Option	Benefit–Cost Ratio
1	43

e) Selection of Preferred Strategic Option

Table CU13.4 summarises the results of the appraisal process for CU13.

Table CU13.4 Summary of Appraisals

Option	Technical Appraisal	Environmental Appraisal	Economic Appraisal
1 • continue existing practice	• ensures integrity of defences	• no significant concerns	• viable

Option 1 is technically sound, environmentally acceptable and economically viable and is, therefore, selected as the appropriate strategy for CU13.

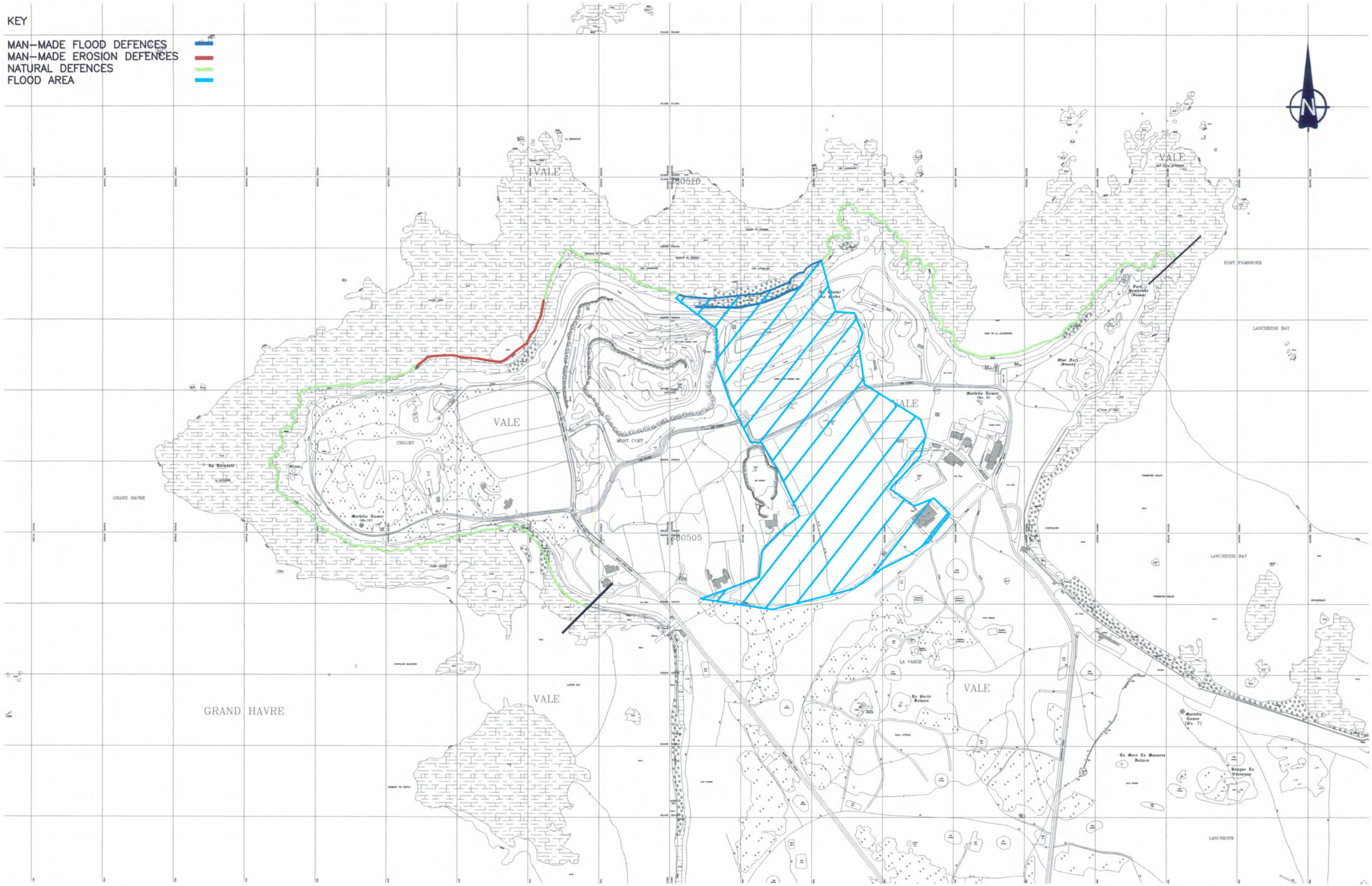
As with many other stretches of the west and north coasts, allowing the action of natural processes to continue could result in the loss of some archaeological interest, as erosion of the largely unconsolidated sediments overlying the rock platform and forming the low cliffs takes place. The archaeological interest of these sediments has already been highlighted by the finds at Jaonneuse. Periodic monitoring of the area for any evidence of archaeological artefacts or structures should be carried out. If significant finds are made, then either excavation should be undertaken or protection from further erosion provided.

This environmental enhancement has not been included within the appraisal of Option 1.

CU13

KEY

MAN-MADE FLOOD DEFENCES
MAN-MADE EROSION DEFENCES
NATURAL DEFENCES
FLOOD AREA



PROJECT
GUERNSEY STRATEGY FOR COASTAL DEFENCE AND BEACH MANAGEMENT

TITLE
COASTAL UNIT 13
Chouet to Fort Pembroke

CONSULTING ENGINEERS
POSFORD DUVIVIER

Job No.	E3309	DATE	FEB'99	SCALE	1:5,000
ACAD Ref.		CHECKED	JEC	PASSED	AJS
DRAWN	MDWP	DRG No.	FIGURE 6.13		REV

6.14 Coastal Unit 14 – Fort Pembroke to L'Ancresse (Pembroke Bay and L'Ancresse Bay)

a) Attributes

Introduction

Coastal Unit 14 is located on the north side of the island and extends between Fort Pembroke and L'Ancresse (see Figure 6.14). The unit forms Pembroke Bay and the western part of L'Ancresse Bay, a total length of approximately 1,400m.

Coastal Processes and Beach Behaviour

Pembroke Bay and L'Ancresse Bay are separated by a rocky outcrop on the beach. Both bays have wide flat sandy foreshores with shingle and boulders forming a storm ridge on the upper foreshore. The beach levels vary throughout the unit but they are generally healthy.

Pembroke Bay and L'Ancresse Bay are surrounded by rocky headlands, which limit the direction of the wave attack to a broadly normal approach. This limits the longshore transport of material within the bays. During storms, the beaches are susceptible to drawdown potentially exposing the defences to increased wave attack. However, the sheltering effect of the headlands suggest that beach material is not permanently lost from the bay by tidal or wave action. The beaches are, therefore, able to rebuild after the storm has passed.

The bays are effectively a sediment cell with limited input or loss of sediment from the unit.

Coastal Defences

The coastal defences that exist within the Pembroke and L'Ancresse Bays were built during the Occupation as anti-tank defences rather than as sea defences.

A 10m length of rock revetment exists against the soft coastal edge at the western end of Pembroke Bay. There does not appear to be any filter layer under the amour stones. There are signs of erosion of the soft material at the crest of the revetment. This defence prevents outflanking of the main concrete wall. The remainder of Pembroke Bay is defended by an anti-tank wall. The first 120m of wall has had additional toe protection added in the form of sheet piling with a concrete apron.

There is a gap in the defences, near the kiosk, for a slipway. The eastern end of the gap is damaged. There is a further gap in the defences near pre-Martello Tower 7, where rock is outcropping on the beach. A toe beam has also been added to the wall along the length between the towers (Nos 6 and 7). A small section of masonry wall exists about 50m from the gap in the wall. A section of the toe protection is damaged and repairs are evident, although they do not appear to be working. To the east of this a section of the concrete wall has moved seaward approximately100mm. A short length of rock protection exists at the eastern end of the wall to prevent outflanking of the eastern end of the seawall.

Two trial pits were dug in autumn 1998. The first, near the kiosk, indicated over 1.7m of mobile sediment overlying the base of the wall, the beach level being at 1.3m above MHWS. The second pit, located near Tower 6, had about 0.9m of material over the base of the wall and was approximately 1.6m below MHWS. These levels support the beach processes described above.

Generally, the residual life of the defences within Pembroke and L'Ancresse Bays is low, with certain lengths having residual lives of between 0 and 10 years (but significantly less than 10 years). Many sections of the wall are in need of repair now. Mathematical modelling has indicated that the standard of defence provided by the wall is low. The overtopping discharges are relatively high as can be seen by the quantity of beach material on the landward side of the defences, particularly within L'Ancresse Bay. Scour is also evident along the backface of the seawall over this length.

These defences are shown in Figure 6.14 at the end of this sub-section.

Land Use and Human and Built Environment

The wide sandy beach and shallow waters of Pembroke Bay make it an ideal and popular location for a wide range of beach activities and swimming. There is a windsurfing centre located adjacent to the Pembroke Bay Hotel on the western side of the bay. Visitors are well served with four car parks, kiosks and public conveniences located at various points around the bay. L'Ancresse Common, which surrounds the bay, is a popular area with walkers and is also occupied by the island's main golf course, several holes of which are located directly behind the bay.

Three loopholed pre-Martello Towers (Nos 5, 6 and 7) overlook the bay. A total of 15 of these Napoleonic coastal defence towers were built around the coast between 1778 and 1779 in response to the threat of attack by the French. The strategic importance of the Channel Islands to the Germans during World War II, and the subsequent fortification of much of the Guernsey coastline, is particularly prominent within Pembroke Bay. In order to prevent amphibious landings, the beach was effectively sealed off by the construction of a high concrete anti-tank wall, which today forms the seawall within the bay. In addition, batteries and bunkers were constructed on higher ground overlooking the bay.

The entire common, together with adjacent headlands, is an area of archaeological importance. This is highlighted by the presence of a number of dolmens of Neolithic age and the Megalithic passage grave at La Varde. In addition to these is the ancient monument of Les Fouaillages. Dated at about 6,000 years old, this long mound is probably the oldest known stone structure in Europe. A large number of artefacts have been recovered from the site following its excavation in the late 1970s, indicating that occupation of the site, and possibly the area, occurred over a period of nearly 4,000 years.

Natural Environment

Pembroke Bay cuts through the main outcrop of the L'Ancresse Granodiorite, which has been intruded into the Bordeaux Diorite. Both rock types are exposed, with the L'Ancresse Granodiorite forming both sides of the bay and the Bordeaux Diorite forming the back of the bay, although exposure of this unit is limited to foreshore reefs.

The sheltered intertidal zone and inshore waters of Pembroke Bay provide refuge and feeding for several marine bird species especially divers, grebes and sea-duck. In addition, the area may provide foraging and feeding habitat for a number of species of waders during the winter months.

The immediate hinterland within this unit forms part of the large L'Ancresse Common SNCI. Much of this area is a buried landscape and comprises blown sand and alluvium infilling and overlying a large number of small rocky outcrops The vegetation comprises typical rough coastal grassland with areas of scrub vegetation including gorse (*Ulex europeaus*), bramble (*Rubus fruitcosus*) and bracken (*Pteridium aquilinum*) and some small areas of heathland vegetation with heather (*Calluna vulgaris*), although much of this habitat has disappeared following development of the golf course. In areas subject to intensive grazing or where bare sandy ground is present, species such as dwarf pansy (*Viola kitaibeliana*), sea spurge (*Euphorbia paralias*), quillwort (*Isoetes histrix*) and orange birds-foot (*Ornithopus pinnatus*) can be found.

L'Ancresse is the only site in the north of the island where Dartford warbler (*Sylvia undata aremorica*) occur, and at least five pairs of stonechat also breed in the dense sections of gorse. The position of the area on the north coast makes it an important landfall site for migrating birds, particularly species such as redstart, wheatear, whinchat and yellow wagtail.

Planning Policies

The entire coastal frontage and L'Ancresse Common to the south of the bay is an Area of Special Environmental Importance (Green Zone 1). This area is subject to the relevant conservation and enhancement policies set out in the Rural Area Plan (Phase 1).

b) Key Interests within Unit

The following list highlights the main interests within the unit that have the potential to interact with, or be influenced by, coastal defence policies. They are:

- commercial properties
- local access roads
- golf course
- recreational value of the beach
- archaeology and ecology of L'Ancresse Common.

c) Appraisal of Strategic Options

Do Nothing

If nothing is done to maintain or improve the defences within Pembroke and L'Ancresse Bays, the following scenarios over the 50-year period covered by the strategy are envisaged:

i) In the short term, the continued overtopping of the defences would cause intermittent localised flooding of the golf course. Failure of localised sections of the wall caused largely by wave action would result in erosion of the land behind.

ii) In the medium term, the structural failure of the defences throughout the bay caused largely by wave action would result in further erosion and some flooding of the hinterland.

iii) In the long term, there is the potential for the natural stabilising of the defence line.

In the short to medium term, the Do Nothing option would cause economic damage through the loss of the developed and undeveloped land through localised flooding and erosion as the defences fail. In the longer term, it is likely that the bay would stabilise and further economic damage would be minimal. However, the gradual failure of defences would cause a serious risk to health and safety for users of the beach. This option of Do Nothing does not satisfy all the Objectives set out in Section 2.3.

For these reasons the option is rejected.

Do Something

From the above discussion it is evident that the Do Something option should be adopted if a viable scheme can be identified. Sustaining the defences at their present standard would not address the problems of erosion and overtopping nor the extensive deterioration of the seawall. Options to sustain the defences are, therefore, not included under Do Something.

In addition to the options to improve the defences, the nature of the bay suggests that retreating from the existing line of defence is potentially practicable and this has, therefore, also been included as an option.

d) Do Something Potential Scheme Options

The reasoning described in Section 5.3.3 (Possible Defence Methods) together with the problems and issues referred to above, results in the selection of four options for appraisal.

Technical and Environmental Appraisal

Option 1 – Major Repairs and Rebuilding (Improve)

Option 1 comprises the following elements:

- undertake major repairs to and rebuilding of sections of the wall
- raise the seawall locally
- monitor toe protection of all defences after storm events and undertake repair works as necessary
- summer and winter beach surveys
- regular monitoring of the remaining lengths of wall should be undertaken so that works can be planned before the condition of the wall becomes critical
- annual inspection of defences.

Works would be required to a number of sections of the wall, in particular lengths of the toe beam, the damaged section of the wall near the kiosk and repairs to the cracks in the wall. In addition, it would be necessary to completely rebuild the section of wall that is suffering from the effects of movement. These works would ensure the integrity of the defences for the life of the strategy.

Locally raising the seawall would reduce the frequency and severity of overtopping. This would reduce flooding and the risk of washout of the rear face. Seawall raising could be undertaken in combination with rear face protection at locations where there is a particular risk of washout.

Perhaps of greatest consideration with regard to this option is the historic value of the seawall itself. Having been built during the Occupation it forms part of Guernsey's World War II heritage. This value needs to be weighed against its value as a modern-day coastal defence. If considered worthy of conservation, the wall should be repaired and rebuilt in an appropriate manner to ensure that its heritage value is not diminished.

In addition, works, when undertaken, would need to take into account the recreational values of both the beach and adjacent golf course. Suitable measures would need to be incorporated into both the design and construction phases so as to minimise disruption to these interests.

Option 2 – Beach Nourishment (Improve)

Option 2 comprises the following elements:

- minor repairs to existing walls
- beach nourishment with sand
- regular surveys of the newly nourished beach
- annual inspection of the defences.

Repairs to lengths of the seawall (to halt further deterioration), along with the nourishment of the beach, would ensure the integrity of the defences for the life of the strategy. Nourishing the beach would reduce the overtopping by forcing the waves to break further away from the wall thus improving the standard of the defence. Beach nourishment would also protect the toe of the wall from further wave attack and so prevent further damage. It is anticipated that only limited beach nourishment material would be lost offshore during storm events because of the protection provided by the adjacent headlands. Nevertheless periodic renourishment of the beaches to make good losses and maintain the standard of defence would be required.

Minor repairs to the existing structures are unlikely to have any adverse impact on existing environmental interests. Any proposed works should be undertaken outside the main tourist season in order to reduce potential disruption to the recreational use of the beach.

Beach nourishment within the unit would need to be compatible with existing substrates within the unit, i.e. sand, given the recreational importance of the beach. In addition to providing toe protection and reducing overtopping, nourishment with sand would enhance the existing beach resulting in consequent benefits for recreational and tourism interests.

The majority of the intertidal area within Pembroke Bay comprises sand with some areas of coarser sediment and rocky platform along the upper foreshore. While the intertidal area supports a variety of communities, both infaunal and attached, many of these will be typical of the changing substrate conditions associated with sandy and mobile sediment shores. Potential additional sediment input and distribution within the bay, while having an impact upon these communities, is unlikely to be detrimental in the longer term, although this is difficult to predict. Ideally, given the importance of the Guernsey coastline for its intertidal flora and fauna, further information on the ecology of the intertidal area would be required to provide a reasonable assessment of the potential impacts of beach nourishment recharge within the bay.

Option 3 – Beach Nourishment with Detached Breakwaters (Improve)

Option 3 comprises the following elements:

- as Option 2
- detached breakwaters.

The detached breakwaters would prevent most of the loss of beach nourishment material offshore during storm events. However, periodic renourishment of the beaches to make good the losses and maintain the standard would still be required but to a lesser extent than in Option 2.

The impact on environmental interests are as for Option 2, with regard to minor repairs and beach nourishment.

The placement of detached breakwaters within the bay could have several significant environmental impacts. These are as follows:

- visual intrusion into an important and aesthetic coastal landscape
- direct loss of intertidal/subtidal area of potential interest for its maritime flora and fauna.

Option 4 – Abandon Defences (Retreat)

Option 4 comprises the following elements:

- abandon the defences, and clear debris from the beach
- allow natural alignment of the bay to develop
- beach nourishment (dune creation).

The existing defences were built at the top of the beach during the Occupation to prevent landings. An inspection of the unit indicates that the natural shape of the bay approximates to the current defence line. It should, therefore, be possible to abandon the existing defences without causing extensive flooding or erosion of the land. The defences would be removed in sections as they deteriorate and fail. The defences in L'Ancresse would be the first to fail. The debris from the failed defences should be removed for health and safety reasons.

Originally, a semi-mobile dune ridge would have occurred around much of the back of the bay but this area of dunes was effectively lost through sand extraction during World War II in order to construct the anti-tank wall. Although allowing failure of the wall and natural re-alignment to take place appears to be the simplest retreat technique, this option could have some adverse environmental impacts. Without a healthy beach and dune ridge at the back of the bay, erosion of the low-lying hinterland of L'Ancresse Common could occur. This could lead to loss of part of the golf course, could threaten the structural integrity of the two pre-Martello Towers and could lead to the loss of potential archaeological interest.

Potentially, these adverse impacts could be significantly reduced by undertaking beach nourishment as part of the option and re-instating the dune ridge at the back of the bay. Sediment would need to be partially stabilised through planting with marram grass and other dune vegetation, possibly in addition to the emplacement of sand traps. Re-instating the dune ridge would reduce the potential rate of erosion of the seaward edge of L'Ancresse Common and, in addition, could reduce the overtopping that currently occurs. While there would be some loss of land currently occupied by the golf course, the likely impact in comparison with allowing natural re-alignment would be lessened.

From a purely environmental point of view, this option should be further investigated. It provides an opportunity to recreate a bay-fringing dune system and enhance the overall level of this important habitat on the island. In addition, this option could also provide enhancements with regard to the recreational value of the bay.

Economic Appraisal

Benefits

Table CU14.1 gives the estimated value of the assets protected by the defences within CU14.

Table CU14.1 Benefits

Assets	Area/Length	Value (£)
Flooding		
Developed Land	N/A	-
Undeveloped Land	N/A	-
Erosion		
Minor Road	500m	150,000
Coast Road	N/A	-
Ribbon Development	N/A	-
	Total	**150,000**
	Discounted Total	**112,000**

Notes: The following intangible benefits are not included in the above table:
- recreational value of the beach
- archaeology and ecology of L'Ancresse Common.

Therefore the benefits derived for CU14 are likely to be an underestimate of the actual value.

Costs

Table CU14.2 gives the estimated value of the costs associated with Options 1 to 4

Table CU14.2 Costs

Option	Initial Capital Cost (£)	Future Costs (£)		Total Discounted Cost (£)
		Capital	Maintenance	
1	132,000	-	4,100/year	**167,000**
2	5,162,000	1,032,000/10 years	4,100/year	**4,806,000**
3	7,394,000	516,000/10 years	13,500/year	**6,191,000**
4	55,000	*55,000	*585/year	**163,000**

*Demolition costs incurred in years 5, 10, 15 and 20.

Results

Table CU14.3 gives the results of the economic appraisal for Options 1 to 4.

Table CU14.3 Results

Option	Benefit–Cost Ratio
1	0.7
2	0.02
3	0.02
4	0.7

e) Summary of Preferred Strategic Option

Table CU14.4 summarises the results of the appraisal process for CU14.

Table CU14.4 Summary of Appraisals

Option	Technical Appraisal	Environmental Appraisal	Economic Appraisal
1 • major repairs and rebuilding	• ensures integrity of defences • long-term commitment to toe strengthening	• historic significance of defences	• not viable
2 • beach nourishment	• ensures integrity of defences • protects toe of wall	• detrimental impacts on environmental interests • enhances beaches	• not viable
3 • beach nourishment • detached breakwaters	• ensures integrity of defences • protects toe of wall	• detrimental impacts on environmental interests • enhances beaches • visual intrusion	• not viable
4 • abandon defences • dune creation	• unlikely to significantly increase erosion	• loss of historic defences • opportunity for habitat creation	• not viable

The appraisal indicates that all four options are not economically viable. However, the appraisal does not take into account the (intangible) benefits associated with the recreational use of the beach and adjacent golf course, and the environmental enhancements associated with Option 4. With the inclusion of these intangible benefits it is likely that Option 1 and Option 4 would be economically viable. In contrast, the high costs associated with Option 2 and Option 3 are such that they would remain non-viable. For this reason Option 2 and Option 3 are rejected.

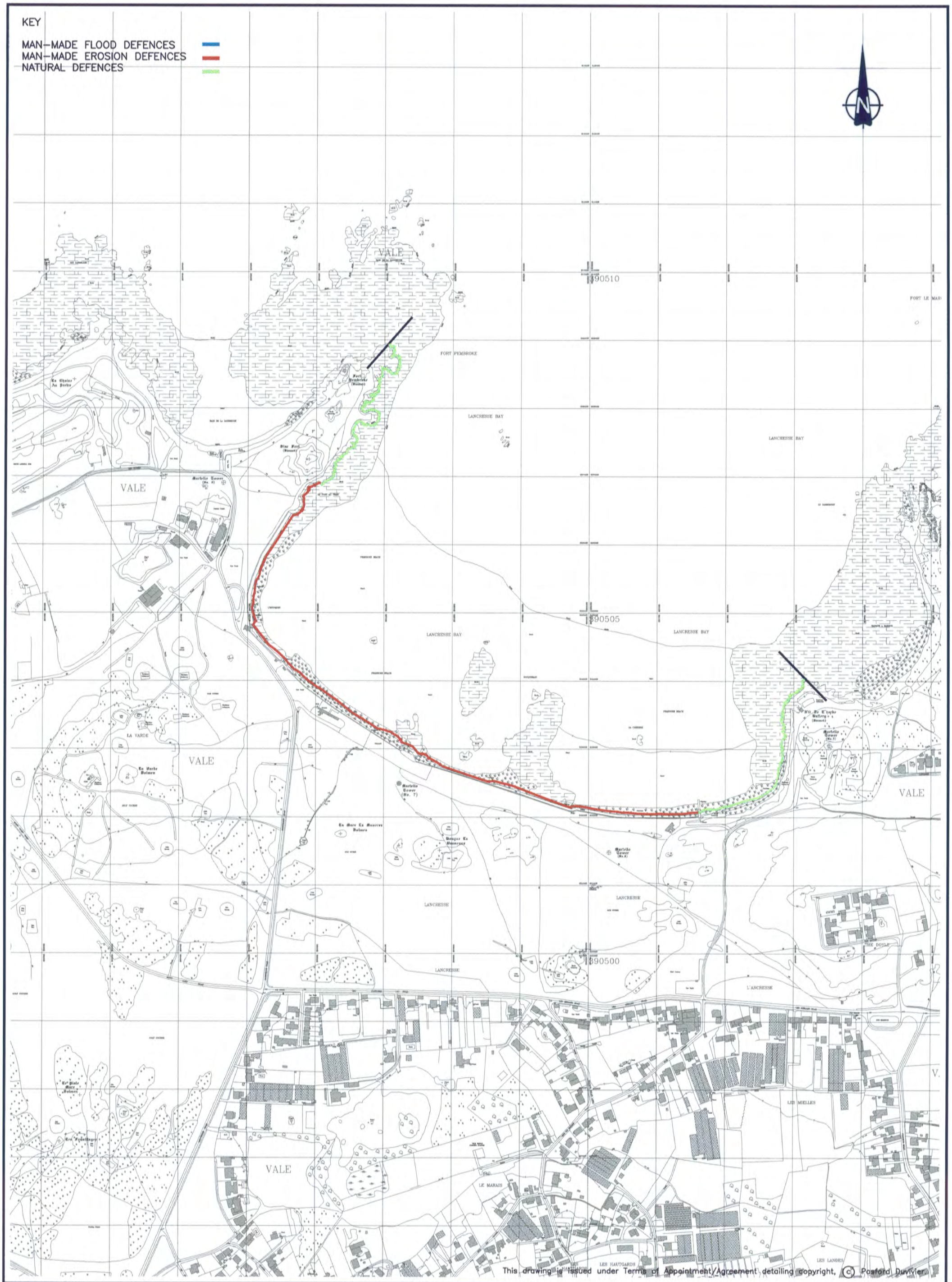
Option 1 is technically sound and environmentally acceptable (subject to the use of appropriate techniques to repair and reconstruct the existing walls) and could be selected as the preferred strategy for the unit. Option 4 is potentially technically acceptable and offers considerable opportunities for environmental enhancement. However, there remain a number of technical and environmental issues that need to be investigated before this option could be adopted.

On the basis of the above, the following is proposed for the unit:

- studies are undertaken to refine and reassess the technical, environmental and economic viability of Option 4.
- pending the results of the studies, regular inspections are undertaken to monitor the deterioration of the defences and emergency works are completed as necessary.
- on completion of the studies, a decision is made between Option 1 and Option 4.

KEY

MAN–MADE FLOOD DEFENCES
MAN–MADE EROSION DEFENCES
NATURAL DEFENCES



PROJECT GUERNSEY STRATEGY FOR COASTAL DEFENCE AND BEACH MANAGEMENT	TITLE COASTAL UNIT 14 Fort Pembroke to L'Ancresse	CONSULTING ENGINEERS POSFORD DUVIVIER	DRAWN MDWP / SCALE 1:5,000 DATE FEB' 99 / CHKD JEC DRG No. FIGURE 6.14

6.15 Coastal Unit 15 – L'Ancresse to Fort Doyle (L'Ancresse Bay and Fontenelle Bay)

a) Attributes

Introduction

Coastal Unit 15 is located on the north side of the island and extends between the eastern end of L'Ancresse Bay to Fort Doyle (see Figure 6.15), a length of approximately 2,800m. The unit covers the eastern part of L'Ancresse Bay and Fontenelle Bay.

Coastal Processes and Beach Behaviour

From the eastern end of L'Ancresse Bay to the western limit of Fontenelle Bay the foreshore is rocky with little mobile sediment. A shingle ridge protects the coastal edge of Fontenelle Bay. The soft coastal edge in Fontenelle Bay is exhibiting signs of erosion.

This length of coast is very exposed to wave attack from the north and north west. The exposed nature of this part of the island results in limited mobile sediment on the foreshore.

Coastal Defences

The coastal unit is defended primarily by natural defences. The soft coastal edge in Fontenelle Bay is exhibiting signs of erosion.

These defences, together with the areas at risk from flooding, are shown in Figure 6.15 at the end of this sub-section.

Land Use and Human and Built Environment

This north-eastern edge of L'Ancresse Common is essentially undeveloped and comprises rough grassland used for extensive grazing. A small area of lower-lying land behind Fontenelle Bay, just to the east of Hougue Patris, is in horticultural and agricultural use. There are no metalled roads or infrastructure adjacent to the immediate coastline. L'Ancresse Common is popular for walking, with a number of tracks and footpaths crossing the area. One of these tracks follows the coastline, immediately behind Fontenelle Bay.

From a military perspective, the strategic importance of the northern part of the island over the last three centuries is reflected in the presence of a number of batteries, forts and other military installations. A loopholed pre-Martello Tower (No. 4) is located on relatively high ground towards the southern end of the Fort le Marchant headland. This position provides clear views over Pembroke Bay to the west and Fontenelle to the east. A total of 15 of these Napoleonic coastal defence towers were built around the coast between 1778 and 1779 in response to the threat of attack by the French. The two headlands on either side of the unit were originally well defended. The headland between L'Ancresse Bay and Fontenelle Bay is occupied by Fort le Marchant. The original installation, constructed to counter the threat of invasion from the French during the Revolutionary and Napoleonic Wars, was further developed during Victorian times, with the construction of new barracks to provide accommodation for troops defending the exposed coastline. Fort Doyle, located on the small headland at the eastern end of the unit was also remodelled at this time to give improved mountings to the guns, and defensible accommodation for the artillerymen.

During World War II, numerous coastal artillery and anti-aircraft batteries were constructed around the coast. The remains of such a battery are located on the eastern side of L'Ancresse Bay.

The entire Common, together with the headlands on either side of Fontenelle Bay, is an area of archaeological importance. This is highlighted by the presence of a number of dolmens of Neolithic age and the Megalithic passage grave at La Varde. In addition to these is the ancient monument of Les Fouaillages. Dated at about 6,000 years old, this long mound is probably the oldest known stone structure in Europe. A large number of artefacts have been recovered from the site following its excavation in the late 1970s, indicating that occupation of the site, and possibly the area, occurred over a period of nearly 4,000 years.

In addition, Banque à Barque, the rocky bay on the eastern side of L'Ancresse (Pembroke) Bay, is a designated site of archaeological importance.

Natural Environment

The north-eastern tip of Guernsey, in and around Fontenelle Bay, provides exposures through two rock formations. The eastern side of L'Ancresse Bay cuts through the lenticular mass of the L'Ancresse Granodiorite, which has been intruded into the Bordeaux Diorite. This latter rock type forms the majority of northern Guernsey and outcrops on the headlands and main part of Fontenelle Bay, including the Fort Doyle headland. The contact between the two formations occurs parallel to the back of Fontenelle Bay and cutting across the southern end of the Fort le Marchant headland. Wind-blown sand covers much of L'Ancresse Common, and this, together with post-glacial loess deposits, forms the softer sediments exposed on top of the low rock platform around the edge of Fontenelle Bay.

The rocky shoreline and intertidal areas within the unit form a diverse range of habitats, which in turn support a variety of different shoreline bird species. The entire west and north coasts of Guernsey are of national importance for wintering ringed plover and, together with the east coast (principally Belle Greve Bay), are internationally important for wintering turnstone. Many other wading birds including dunlin (*Calidris alpina*) and oyster-catchers are present during winter and on migration.

The immediate hinterland within this unit forms part of the large L'Ancresse Common SNCI. Much of this area is a buried landscape and comprises blown sand and alluvium infilling and overlying a large number of small rocky outcrops The vegetation comprises typical rough coastal grassland with areas of scrub vegetation including gorse (*Ulex europeaus*), bramble (*Rubus fruitcosus*) and bracken (*Pteridium aquilinum*) and some small areas of heathland vegetation with heather (*Calluna vulgaris*), although much of this habitat has disappeared following development of the golf course. Heathland vegetation is particularly well developed at the eastern end of the unit in the vicinity of the Fort Doyle headland. In areas subject to intensive grazing, or where bare sandy ground is present, species such as dwarf pansy (*Viola kitaibeliana*), sea spurge (*Euphorbia paralias*), quillwort (*Isoetes histrix*) and orange birds-foot (*Ornithopus pinnatus*) can be found. L'Ancresse is the only site in the north of the island where Dartford warbler (*Sylvia undata aremorica*) occur, and at least five pairs of stonechat also breed in the dense sections of gorse. The position of the area on the north coast makes it an important landfall site for migrating birds, particularly species such as redstart, wheatear, whinchat and yellow wagtail.

CU15

Planning Policies

The entire coastal frontage, and the eastern part of L'Ancresse Common to the south of the bay, is an Area of Special Environmental Importance (Green Zone 1). The small area of low-lying agricultural land at Hougue Patris is classified as an Area of Landscape Value (Green Zone 2). These areas are subject to the relevant conservation and enhancement policies set out in the Rural Area Plan (Phase 1).

b) Key Interests within Unit

The following list highlights the main interests within the unit that have the potential to interact with, or be influenced by, coastal defence policies. They are:

- footpath
- L'Ancresse Common SNCI and archaeological site.

c) Appraisal of Strategic Options

Do Nothing

If nothing is done to maintain or improve the defences between the eastern end of L'Ancresse Bay and Fort Doyle, the following scenarios over the 50-year period covered by the strategy are envisaged:

i) In the short and medium term, continuing erosion of the coastal edge owing to wave action within Fontenelle Bay would lead to loss of heathland.

ii) In the long term, there would be possible flooding of low lying land in the centre of Fontenelle Bay, at La Hougue Patris, owing to overtopping of the shingle ridge.

Existing environmental interests would not be significantly affected by adopting a policy of Do Nothing. Although limited erosion within Fontenelle Bay and on the western side of the Fort Doyle headland would result in the loss of some areas of heathland vegetation, i.e. part of L'Ancresse Common, this is not considered to be significant given the overall resource. Indeed it is, from an ecological perspective, preferable to allow natural successional processes to occur.

No residential property would be at risk from continued erosion during the lifetime of the strategy. The track along the back of the bay may need to be re-routed if affected by erosion or increased overtopping. The periodic inundation of the small area of lower-lying land at Hougue Patris may, in the longer term, affect its viability for agricultural use, other than for extensive grazing.

All the land within this unit is of recognised archaeological importance. While much of this interest is located on the resistant and higher parts of the headlands, there could be some loss of archaeological interest as erosion of the largely unconsolidated sediments forming the low cliffs overlying the rock platform continues. Periodic monitoring of the area for any evidence of archaeological artefacts or structures should be carried out. If significant finds are made then either excavation should be undertaken or protection from further erosion provided.

CU15

Although the Do Nothing option would result in minor economic damage owing to the continued erosion, and therefore would not satisfy all the Objectives set out in Section 2.3, the selection of a Do Something option could not be justified on either environmental or economic grounds.

Therefore Do Nothing is adopted.

KEY

MAN–MADE FLOOD DEFENCES
MAN–MADE EROSION DEFENCES
NATURAL DEFENCES
FLOOD AREA

PROJECT	GUERNSEY STRATEGY FOR COASTAL DEFENCE AND BEACH MANAGEMENT				
TITLE	COASTAL UNIT 15 L'Ancresse to Fort Doyle	CONSULTING ENGINEERS POSFORD DUVIVIER			
		Job No. E3309	DATE FEB'99	SCALE 1:5,000	
		ACAD Ref.	CHECKED JEC	PASSED AJS	
		DRAWN MDWP	DRG No. FIGURE 6.15		REV

6.16 Coastal Unit 16 – Fort Doyle to Bordeaux

a) Attributes

Introduction

Coastal Unit 16 is located on the east side of the island and extends between Fort Doyle and Bordeaux Harbour (see Figure 6.16), a length of approximately 2,100m.

Coastal Processes and Beach Behaviour

The frontage comprises a rocky foreshore with localised pockets of mobile sediment. The coastline between Fort Doyle and Bordeaux is comparatively sheltered to wave attack from the east owing to the relatively short fetch lengths over which waves can be generated. Strong currents exist in Little Russel Channel, which is situated between Guernsey and Herm.

A break in the coastline exists in the north of the unit at Beaucette Marina. The entrance to the marina was formed in the 1960s by blasting through from a disused quarry.

Coastal Defences

Quarry waste has been extensively tipped along this frontage in the past and evidence of this activity can be seen on the foreshore. The majority of the frontage is protected by natural defences backed by the quarry waste. At the southern end of the unit, there is a length of rock protection. To the north of this rock protection a shingle ridge dominates the foreshore.

There is evidence of erosion of the soft cliffs along the frontage. The man-made defences in the south of the unit are in good condition, having a residual life of between 10 and 25 years.

These defences are shown in Figure 6.16 at the end of this sub-section.

Land Use and Human and Built Environment

Land use within this unit is dominated by former quarry workings and horticultural use, with smaller areas in residential or general agricultural use. One flooded quarry is used for fish farming. The hinterland is served by a number of minor access roads, with the main coast road situated approximately 400m inland. The coastline within the southern half of the unit has been built out by tens of metres through the dumping of spoil material arising from quarrying.

This part of the island does not hold much attraction for the tourist or visitor, apart from the old quarry at Beaucette that was converted into a marina in the 1960s with the help of the Royal Engineers, who blasted a gap in the rock wall between the original quarry and the sea. There are disused coastal batteries at Beaucette and the offshore islet of Hommet Benes. The latter site, together with Petils Bay and the islet of Hommet Paradis, are of archaeological importance.

CU16

Natural Environment

The coastline within this unit is formed entirely within the outcrop of the Bordeaux Diorite, which forms the majority of northern Guernsey. The diorite includes some interesting features, including a series of pip-like structures containing granitic rock, which cut through the diorite. These may have formed from the mixing of two magma bodies of different composition. Wind-blown sand covers much of L'Ancresse Common, and this together with post-glacial loess and head deposits, forms the softer sediments exposed on top of the low rock platform forming the cliff edge where present within the unit.

The far northern end of the unit forms the north-easterly extension of L'Ancresse Common. Here, as with much of the rest of the coastal-influenced section of the common, the vegetation comprises maritime heathland and grassland with species such as gorse (*Ulex europeaus*) and heather (*Calluna vulgaris*). The shoreline is generally of limited interest, particularly as much of the beach and immediate hinterland is made up of spoil material from quarrying.

The extensive and diverse substrates of the intertidal provide good feeding grounds for a number of waders, but in particular turnstone and ringed plover. The east coast, principally Belle Greve Bay together with the entire coastal strip from Pleinmont round to Fort Doyle, is of national importance for wintering ringed plover and internationally important for wintering turnstone. The offshore islets of Omptolle and Hommet Paradis are relatively undisturbed and form important breeding and roosting sites for waders and gulls.

Planning Policies

The immediate, and entire, coastal frontage within this unit is an Area of Special Environmental Importance (Green Zone 1). Beaucette Marina is classified as an Area of Landscape Value (Green Zone 2), while the coastal strip south of the disused quarry at Hougue Noirmont is an identified Enhancement Target Area. These areas are subject to the relevant conservation and enhancement policies set out in the Rural Area Plan (Phase 1).

b) Key Interests within Unit

The following list highlights the main interests within the unit that have the potential to interact with, or be influenced by, coastal defences policies. They are:

- residential properties
- local access roads
- Beaucette Marina.

c) Appraisal of Strategic Options

Do Nothing

If nothing is done to maintain or improve the defences between Fort Doyle and Bordeaux, the following scenarios over the 50-year period covered by the strategy are envisaged:

i) In the short term, the erosion of the soft coastal edge owing largely to wave action would continue resulting in minor losses of undeveloped land.

ii) In the medium to long term, the continuing erosion caused by wave action would result in the loss of sections of the local access track. In additional, structural failure of the rock protection owing largely to wave action would take place, leading to erosion of the land behind.

The Do Nothing option would cause economic damage through the loss of the developed and undeveloped land through erosion owing to the gradual retreat of the shoreline. This option of Do Nothing does not satisfy all the Objectives set out in Section 2.3.

For these reasons the option is rejected.

Do Something

From the above discussion it is evident that the Do Something option should be adopted if a viable scheme can be identified. Sustaining the defences at their present standard would address the problems of structural failure of the man-made defences and hence the problems of erosion in the southern end of the unit. Continued erosion of he undefended cliff line within the rest of the unit is not considered to be a major issue and therefore options to improve the existing standard of defence are not considered.

d) Do Something Potential Scheme Options

The reasoning described in Section 5.3.3 (Possible Defence Methods) together with the problems and issues referred to above, results in the selection of one option for appraisal.

Technical and Environmental Appraisal

Option 1 – Continue Existing Practice (Sustain)

Option 1 comprises the following elements:

- continue existing practice by limited tipping of rock into the existing rock protection
- annual inspection of defences.

The continuing maintenance of the existing rock protection within the unit would ensure its integrity over the duration of the strategy and hence the assets it protects.

The environmental consequences of adopting this option are relatively limited, as in effect the existing situation would be largely maintained. It is therefore considered that in general there is unlikely to be any significant adverse impacts on existing coastal habitats, human activity or residential development over the lifetime of the strategy.

The Petils Bay section of the unit is of recognised archaeological importance. Potentially, there could be some loss of archaeological interest as erosion of the largely unconsolidated sediments forming the low cliffs overlying the rock platform continues. Periodic monitoring of the area for any evidence of archaeological artefacts or structures should be carried out. If significant finds are made, then either excavation should be undertaken or protection from further erosion provided.

CU16

Economic Appraisal

Benefits

Table CU16.1 gives the estimated value of the assets protected by the defences within CU16.

Table CU16.1 Benefits

Assets	Area/Length	Value (£)
Flooding		
Developed Land	N/A	-
Undeveloped Land	N/A	-
Erosion		
Minor Road	750m	225,000
Coast Road	N/A	-
Ribbon Development	N/A	-
	Total	**225,000**
	Discounted Total	**94,000**

Notes: The following intangible benefits are not included in the above table:
- Beaucette Marina.

Therefore the benefits derived for CU16 are likely to be an underestimate of the actual value.

Costs

Table CU16.2 gives the estimated value of the costs associated with Option 1.

Table CU16.2 Costs

Option	Initial Capital Cost (£)	Future Costs (£)		Total Discounted Cost (£)
		Capital	Maintenance	
1	N/A	N/A	1,800/year	**30,000**

Results

Table CU16.3 gives the results of the economic appraisal for Option 1.

Table CU16.3 Results

Option	Benefit–Cost Ratio
1	3.1

e) Summary of Preferred Strategic Option

Table CU16.4 summarises the results of the appraisal process for CU16.

Table CU16.4 Summary of Appraisals

Option	Technical Appraisal	Environmental Appraisal	Economic Appraisal
1 • continue existing practice	• ensures integrity of defences	• no significant concerns	• viable

Option 1 is technically sound, environmentally acceptable and economically viable and is, therefore, selected as the appropriate strategy for CU16.

CU16

KEY

MAN–MADE FLOOD DEFENCES
MAN–MADE EROSION DEFENCES
NATURAL DEFENCES

FORT DOYLE
VALE
BEAUCETTE MARINA
PARADIS
LES MARAIS
HOUGUE NORMONT
COCAGNE
BORDEAUX
MIELLETTE BAY
PETIT BAY
10300
10195
10490

PROJECT
GUERNSEY STRATEGY FOR COASTAL DEFENCE AND BEACH MANAGEMENT

TITLE
COASTAL UNIT 16
Fort Doyle to Bordeaux

CONSULTING ENGINEERS
POSFORD DUVIVIER

DRAWN MDWP	SCALE 1:5,000
DATE FEB' 99	CHKD AJS
DRG No. FIGURE 6.16	

6.17 Coastal Unit 17 – Bordeaux to Vale Castle

a) Attributes

Introduction

Coastal Unit 17 is located on the east side of the island and extends between Bordeaux and Vale Castle (see Figure 6.17), a length of approximately 1,400m. The unit includes the whole of Bordeaux Harbour.

Coastal Processes and Beach Behaviour

The foreshore of Bordeaux Harbour is characterised by a sandy foreshore with lengths of shingle intermittently forming the upper beach. The lower foreshore is rocky. The east-facing shore of Bordeaux Harbour is covered by a thin veneer of sand. The foreshore to the south of the harbour is dominated by a shingle upper beach with a sandy lower foreshore. The Vale Castle frontage comprises a rocky foreshore.

The coastline between Bordeaux and Vale Castle is comparatively sheltered from wave attack from the east owing to the relatively short fetch lengths over which waves can be generated. Strong currents exist in Little Russel channel between Guernsey and Herm.

Coastal Defences

Bordeaux Harbour is defended by a combination of man-made and natural defences. Natural defences and rock protection defend the south-facing shore. Dunes defend a short length of the frontage along the north-western edge. A vertical masonry wall defends the east-facing frontage to La Banque Imbert. The coastline from La Banque Imbert to just south of the kiosk comprises a shingle beach with no built defences. Rock protection defends the cliffs to the north of Vale Castle.

The headland of Vale Castle is protected by a vertical masonry wall, founded on rock. A short length (20m) of rock revetment protects the southern end of the wall and the soft coastal edge in front of a car park. A gap (20m long) in the defences then exists with erosion evident of the soft cliff. The rock revetment (30m long) then continues to the end of the unit.

A trial pit dug on the western shore of Bordeaux Harbour in autumn 1998 indicated that there was about 0.5m of mobile sediment covering the clay layer and that the beach level was at approximately 2.4m below MHWS.

The foundations to the masonry wall within Bordeaux Harbour are potentially at risk owing to the lack of sediment covering the base of the wall and the mobile nature of the beach. However, the cross-shore movement of sediment with Bordeaux Harbour suggests that the foundations of the wall would only be intermittently exposed. The northern end of the masonry wall defending Vale Castle is damaged and further deterioration could lead to outflanking of the defences. Erosion is evident between the lengths of rock protection at the southern end of the unit.

Generally, the defences within the unit have an estimated residual life of between 10 and 25 years, with the exception of the masonry wall within Bordeaux Harbour and the damaged section of wall protecting the Vale Castle headland. Both of these lengths have an estimated residual life of 0 to 10 years.

These defences, together with the area at risk from flooding, are shown in Figure 6.17 at the end of this sub-section.

Land Use and Human and Built Environment

The main coast road runs immediately adjacent to the shore through most of the unit, apart from the northern side of Bordeaux Harbour, although this is backed by a minor road. The immediate hinterland is partially developed, with residential development and glasshouses on the western side of the harbour. To the south, land is primarily in agricultural use, except for the rough grassland and scrub surrounding Vale Castle. A narrow strip of amenity grassland and scrub occurs between the coast road and the shoreline south of the southern side of Bordeaux Harbour (La Banque Imbert). Part of this area is used as a car park.

Bordeaux Harbour provides sheltered moorings for small pleasure craft and fishing boats.

Vale Castle, which is located towards the southern end of the unit, was built to command the eastern approaches to the Braye du Valle. The Castle occupies the site of an Iron Age hill fort. The date of the original masonry enclosure remains in some doubt, though it is believed to date from the early 15th century. The castle was strengthened in the late 18th century to improve the artillery defences and later during World War II by the Germans, who constructed concrete positions inside and around the old walls.

Natural Environment

The Bordeaux Diorite, which forms the majority of northern Guernsey, takes its name from the village of Bordeaux and the surrounding quarries and is exposed around the harbour area. To the south, the coastline is formed in the St Peter Port Gabbro, a banded coarsely crystalline igneous rock.

The shingle shoreline provides suitable habitat for a range of plants characteristic of semi-stabilised shingle including sea spurge (*Euphorbia paralias*), shore dock (*Rumex rupestris*) and balm-leaved figwort (*Scophularia scorodonia*). These last two species are rarities on the UK mainland, and the shore dock is listed in Annex II of the Habitats Directive.

The extensive and sheltered intertidal area provides suitable feeding habitat for a range of waterfowl, typically species such as turnstone, ringed plover and occasionally dark-bellied Brent geese. In addition, a variety of marine flora and fauna have been recorded including various algae (*Carpomitra costata, Champia parvula* and *Codium tomentosum*).

Planning Policies

Apart from Bordeaux Village, which is classified as a Conservation Area, the entire coastal frontage is classified as an Area of Special Environmental Importance (Green Zone 1). These areas are subject to the relevant conservation and enhancement policies set out in the Rural Area Plan (Phase 1).

In the southern half of the unit he coastal frontage in the vicinity of Vale Castle is classified as a Green Area and is subject to the relevant conservation and enhancement policies set out in the Urban Area Plan.

b) Key Interests within Unit

The following list highlights the main interests within the unit that have the potential to interact with, or be influenced by, coastal defence policies. They are:

- residential properties
- coast road
- Vale Castle
- boat moorings and use within Bordeaux Harbour
- shingle beach flora.

c) Appraisal of Strategic Options

Do Nothing

If nothing is done to maintain or improve the defences within Bordeaux Harbour and the frontage to the south to Vale Castle, the following scenarios over the 50-year period covered by the strategy are envisaged:

i) In the short term, there would be little or no risk to the interests within the unit.

ii) In the medium term, the damage to the foundations of the masonry wall on the western shore of Bordeaux Harbour caused by wave action would continue. The deterioration of the northern end of the masonry wall at Vale Castle would carry on as a consequence of wave action placing the coast road at risk from erosion. In addition erosion would occur owing largely to wave action gap in the rock protection fronting the southern end of the unit, leading to loss of sections of the car park.

iii) In the long term, structural failure of the man-made defences within the unit would result largely from wave action. Do Nothing would lead to loss of the coast road and properties.

The Do Nothing option would cause economic damage through the loss of developed and undeveloped land through erosion and flooding. In total approximately 7 hectares of undeveloped and 1 hectare of developed land would be affected. The option of Do Nothing does not satisfy all the Objectives set out in Section 2.3.

For these reasons the option is rejected.

Do Something

From the above discussion it is evident that the Do Something option should be adopted if a viable scheme can be identified. Sustaining the defences at their present standard would address the problems of undermining and deterioration of the defences. Therefore options to improve the standard of defence are not considered.

d) Do Something Potential Scheme Options

The reasoning described in Section 5.3.3 (Possible Defence Methods) together with the problems and issues referred to above, results in the selection of one option for appraisal.

Technical and Environmental Appraisal

Option 1 – Continue Existing Practice and Minor Works (Sustain)

Option 1 comprises the following elements:

- continue existing practice by regular re-pointing of the masonry structures
- minor repairs and works to the walls in Bordeaux Harbour and adjacent to Vale Castle
- monitor toe protection of all defences after storm events and undertake repair works as necessary
- annual inspection of defences.

The continuing maintenance of the existing man-made defences and the minor works to the wall in Bordeaux Harbour and the northern section of wall defending Vale Castle would ensure the integrity of the man-made defences and hence the assets they protect.

The cross-shore movement of sediment within Bordeaux Harbour suggests that the foundation to the wall in this bay would only be intermittently exposed. This, together with the sheltered nature of the bay, indicates that only minor works would be required to the foundations. The regular monitoring of the defences would allow that works to planned before any erosion becomes critical.

The environmental consequences of adopting this option are relatively limited, as in effect the existing situation would be largely maintained. It is therefore considered that in general there is unlikely to be any significant adverse impacts on the identified environmental interests including coastal habitats, human activity, residential development and the archaeological interest of Vale Castle over the lifetime of the strategy.

CU17

Economic Appraisal

Benefits

Table CU17.1 gives the estimated value of the assets protected by the defences within CU17.

Table CU17.1 Benefits

Assets	Area/Length	Value (£)
Flooding		
Developed Land	1ha	1,300,000
Undeveloped Land	7ha	154,000
Erosion		
Minor Road	350m	105,000
Coast Road	1,050m	945,000
Ribbon Development	50m	163,000
	Total	**2,667,000**
	Discounted Total	**1,113,000**

Notes: The following intangible benefits are not included in the above table:
- vital communications link provided by coast road
- Vale Castle
- boat moorings and use within Bordeaux Harbour
- shingle beach flora.

Therefore the benefits derived for CU17 are likely to be an underestimate of the actual value.

Costs

Table CU17.2 gives the estimated value of the costs associated with Option 1.

Table CU17.2 Costs

Option	Initial Capital Cost (£)	Future Costs (£)		Total Discounted Cost (£)
		Capital	Maintenance	
1	10,000	10,000/10 years	5,850/year	**106,000**

Results

Table CU17.3 gives the results of the economic appraisal for Option 1

Table CU17.3 Results

Option	Benefit–Cost Ratio
1	11

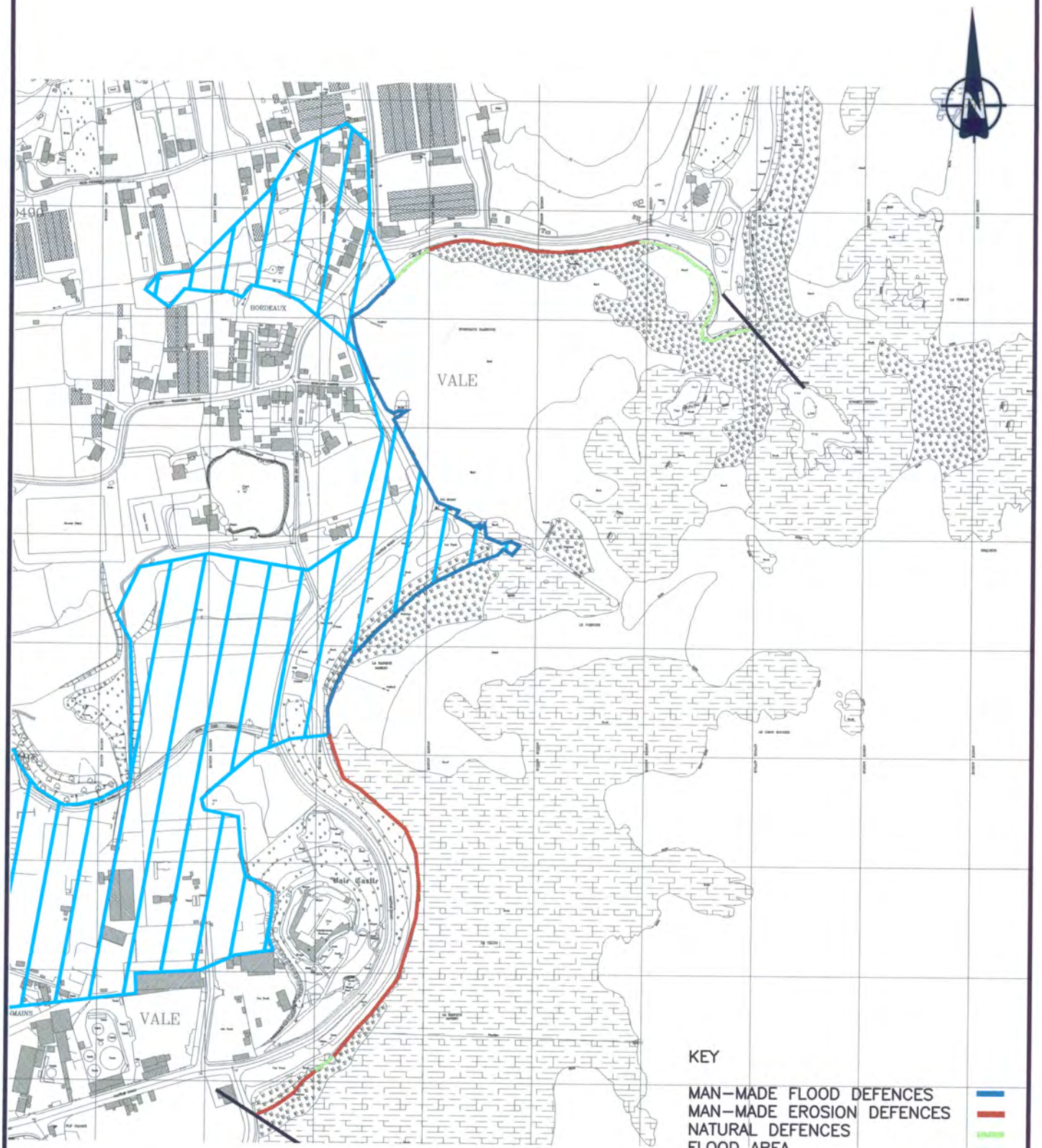
e) Summary of Preferred Strategic Option

Table CU17.4 summarises the results of the appraisal process for CU17.

Table CU17.4 Summary of Appraisals

Option	Technical Appraisal	Environmental Appraisal	Economic Appraisal
1 • continue existing practice • minor repairs	• ensures integrity of defences	• no significant concerns	• viable

Option 1 is technically sound, environmentally acceptable and economically viable and is, therefore, selected as the appropriate strategy for CU17.



PROJECT GUERNSEY STRATEGY FOR COASTAL DEFENCE AND BEACH MANAGEMENT	TITLE COASTAL UNIT 17 Bordeaux to Vale Castle	CONSULTING ENGINEERS POSFORD DUVIVIER	DRAWN MDWP SCALE 1:5,000 DATE FEB'99 CHKD JEC DRG No. FIGURE 6.17

6.18 Coastal Unit 18 – Vale Castle to Spur Point (St Sampson)

a) Attributes

Introduction

Coastal Unit 18 is located on the east side of the island and extends between Vale Castle and Spur Point (see Figure 6.18), a length of approximately 1,800m. The unit includes the whole of St Sampson Harbour.

Coastal Processes and Beach Behaviour

The majority of the frontage is characterised by a rocky foreshore with localised pockets of mobile sediment. Much of the frontage is reclaimed.

This unit is protected to a certain extent from easterly waves owing to the shelter afforded by Herm and Sark. Strong tidal currents occur in the Little Russel Channel, particularly on high spring tides. Little mobile sediment exists within the unit. Any longshore transport that does exist is interrupted by the reclamation at Longue Hougue.

Coastal Defences

A sloping masonry wall defends the boat yard (formerly the old coal yard), which is situated on reclaimed land. Rock pillars at random spacing have been included along the wall, presumably to reduce wave energy and hence overtopping. However, their effectiveness is questionable. There is a secondary wall behind the defences across the road.

St Sampson Harbour is protected by vertical masonry breakwaters. The harbour has not changed shape since 1880 when the final phase of construction, the building of the North Pier, was completed. The Longue Hougue reclamation began in the early 1990s, and at present it consists of rubble mound breakwaters encircling the land yet to be reclaimed. Proposals are currently being considered regarding the expansion of St Sampson Harbour, including possible further reclamation and extension of the breakwaters.

Much of the land to the south of St Sampson Harbour has been reclaimed. It is protected from erosion by a rock revetment.

Generally, the man-made defences are in good condition, having a residual life of between 10 and 25 years. An inspection of the quay walls within the harbour at St Sampson was not undertaken for this strategy.

These defences are shown in Figure 6.18 at the end of this sub-section.

Land Use and Human and Built Environment

This unit is dominated by St. Sampson Harbour and the large reclamation site to the south at Longue Hougue. This area is likely to be utilised for port-related uses and new industrial development, possibly re-located from other areas on the east coast of the island. Land adjacent to the immediate coastline is therefore developed for activities associated with the harbour or in industrial use with a mix of activities including heavy engineering (ship-building), technology industries, and storage and distribution. The harbour developed as quarrying in the north of the island grew in extent and rapidly developed as the island's main industrial harbour.

The harbour layout has changed little since the late 1800s, which is reflected in its classification as an Area of Archaeological Importance (early modern) and an Urban Conservation Area.

The pre-Martello Tower (No. 3), which stands atop the small hillock overlooking the southern end of St Sampson Harbour, is one of 15 such towers that were built around the coast between 1778 and 1779 in response to potential attack from the French and to support the coastal batteries at possible landing sites.

There have been finds of Gallo–Roman pottery and coins near the harbour, which itself is of interest for its early modern buildings. There are the remains of a coastal battery at Spur Point.

Natural Environment

The coastline within this unit is formed in the St Peter Port Gabbro, although natural exposure is limited to the foreshore.

Due to the development of the harbour, and the reclamation works to the south, areas of ecological interest are very limited within this unit. Spur point, forming the south-western boundary to the unit, represents the only area of semi-natural coastal vegetation and comprises rough grassland with some bracken (*Pteridium aquilinum*) and established tamarisk trees. Much of the original intertidal area along this frontage has now been reclaimed. The remaining rocky foreshore in front of Spur Point is likely to provide some suitable feeding habitat for waterfowl.

Planning Policies

St Sampson Harbour and the surrounding land is classified as an Urban Conservation Area with the potential for enhancement. Reclaimed land to the south of the harbour is designated as an Industrial Area and gives way just to the north of Spur Point to land that is classified as a Green Area. These areas are subject to the relevant conservation and enhancement policies set out in the Urban Area Plan.

b) Key Interests within Unit

The following list highlights the main interests within the unit that have the potential to interact with, or be influenced by, coastal defence polices. They are:

- residential properties
- coast road
- industrial properties
- commercial harbour
- Longue Hougue reclamation.

c) Appraisal of Strategic Options

Do Nothing

If nothing is done to maintain or improve the defences between Vale Castle and Spur Point, the following scenarios over the 50-year period covered by the strategy are envisaged:

i) In the short term, there would be little or no risk to the interests within the unit.

ii) In the medium term, Do Nothing would lead to the erosion of the reclaimed land south of the Longue Hougue reclamation. In addition, the breakwaters protecting St Sampson Harbour and the Longue Hougue reclamation would be subject to wave action and would deteriorate.

iii) In the long term, there would be the continuing erosion of the reclaimed land and the progressive deterioration of the breakwaters protecting the harbour and the Longue Hougue reclamation, largely owing to wave action.

The Do Nothing option would cause economic damage through the loss of developed and undeveloped land through erosion as the defences fail. This option of Do Nothing does not satisfy all the Objectives set out in Section 2.3.

For these reasons the option is rejected.

Do Something

From the above discussion it is evident that the Do Something option should be adopted if a viable scheme can be identified. Sustaining the defences at their present standard would solve the problem of structural failure of the man-made defences caused by lack of maintenance. Therefore options to improve the existing standard of defence are not considered.

d) Do Something Potential Scheme Options

The reasoning described in Section 5.3.3 (Possible Defence Methods) together with the problems and issues referred to above, results in the selection of one option for appraisal.

Technical and Environmental Appraisal

Option 1 – Continue Existing Practice (Sustain)

Option 1 comprises the following elements:

- continue existing practice by regular re-pointing of the masonry structures
- annual inspections of defences.

This option would ensure the integrity of the man-made defences for the life of the strategy and hence the assets they protect.

Adopting this option would safeguard existing environmental interests and is compatible with the relevant planning policies for this area. Any repair works or small improvements within the harbour area should take into account its archaeological importance and utilise materials in keeping with the form and composition of the existing structures.

CU18

Economic Appraisal

Benefits

Table CU18.1 gives the estimated value of the assets protected by the defences within CU18.

Table CU18.1 Benefits

Assets	Area/Length	Value (£)
Flooding		
Developed Land	N/A	-
Undeveloped Land	N/A	-
Erosion		
Minor Road	N/A	-
Coast Road	1,800m	1,620,000
Ribbon Development	500m	1,625,000
	Total	**3,245,000**
	Discounted Total	**1,354,000**

Notes: The following intangible benefits are not included in the above table:
- vital communications link provided by coast road
- commercial harbour
- Longue Hougue reclamation.

Therefore the benefits derived for CU18 are likely to be an underestimate of the actual value.

Costs

Table CU18.2 gives the estimated value of the costs associated with Option 1.

Table CU18.2 Costs

Option	Initial Capital Cost (£)	Future Costs (£)		Total Discounted Cost (£)
		Capital	Maintenance	
1	N/A	N/A	8,100/year	**135,000**

Results

Table CU18.3 gives the results of the economic appraisal for Option 1.

Table CU18.3 Results

Option	Benefit–Cost Ratio
1	10

e) Summary of Preferred Strategic Option

Table CU18.4 summarises the results of the appraisal process for CU18.

Table CU18.4 Summary of Appraisals

Option	Technical Appraisal	Environmental Appraisal	Economic Appraisal
1 • continue existing practice	• ensures integrity of defences	• no significant concerns	• viable

Option 1 is technically sound, environmentally acceptable and economically viable and is, therefore, selected as the appropriate strategy for CU18.

CU18

KEY

MAN–MADE FLOOD DEFENCES
MAN–MADE EROSION DEFENCES
NATURAL DEFENCES

ST. SAMPSON
VALE
MONMAINS
100480
100475
LONGUE HOUGUE
DELANCEY PARK
RICHMOND

PROJECT	GUERNSEY STRATEGY FOR COASTAL DEFENCE AND BEACH MANAGEMENT	TITLE	COASTAL UNIT 18 Vale Castle to Spur Point	CONSULTING ENGINEERS	POSFORD DUVIVIER

Job No.	E3309	DATE	FEB'99	SCALE	1:5,000
ACAD Ref.	E3309_0018a3	CHECKED	JEC	PASSED	AJS
DRAWN	MDWP	DRG No.	FIGURE 6.18	REV	

6.19 Coastal Unit 19 – Spur Point to La Salerie (Belle Greve Bay)

a) Attributes

Introduction

Coastal Unit 19 is located on the eastern side of the island and extends between Spur Point and La Salerie, forming Belle Greve Bay (see Figure 6.19), a length of approximately 2,400m.

Coastal Processes and Beach Behaviour

The coastline from Spur Point to Richmond Corner is predominantly rocky with pockets of shingle and sand on the foreshore. The beach level increases south of Richmond Corner and the rocky outcrops occur further down the beach. The beach from Richmond Corner to Halfway is characterised by a shingle upper beach with a sandy foreshore leading to rocky outcrops. A shingle ridge, which backs onto grass, exists between Halfway and Le Grande Bouet roundabout. The position of the high water mark can be seen on the ridge. It does appear that the ridge is overtopped regularly because of the condition of the grass.

This unit is protected to a certain extent from easterly waves owing to the shelter afforded by Herm and Sark. Strong tidal currents occur in the Little Russel Channel, particularly on high spring tides.

Beach levels gradually lower towards the site of Hougue à la Perre Battery, which was built on a rock outcrop. South of the battery, the foreshore is characterised by sand with boulders scattered on the beach. Beach levels vary along the foreshore towards Longstore. Beach levels are low throughout the remainder of the unit to La Salerie.

Although the beach levels vary throughout the unit, there is little evidence of long shore transport as obstructions on the foreshore such as slipways and outfalls, generally have similar levels of material on both sides. However, the beaches are liable to cross-shore losses. During storms, material is drawn down the beach and deposited on the lower foreshore where it can be removed by the strong tidal currents. Material lost in this way is effectively removed from the beach system and is not available for beach rebuilding once the storm has passed. The extent to which material drawn down the beach is permanently lost is not known.

Trial pits dug in autumn 1998 indicated that at the northern end of the unit, near Spur Point, there is about 0.9m of mobile sediment overlying the clay layer and the beach level is approximately 1m below MHWS. At Longstore there is about 0.3m of mobile sediment overlying the decomposed granite and the beach level is approximately 2.6m below MHWS. At the southern end of the unit, near La Salerie, there is about 0.3m of mobile sediment and the beach level is approximately 2.3m below MHWS. These levels support the beach processes described above.

Coastal Defences

The promontory of Spur Point is defended by a combination of natural defences and rock dumped on the foreshore, and the soft coastal edge is exhibiting signs of erosion. Belle Greve Bay is protected by a vertical masonry wall to Halfway. Approximately 30m to the north of Richmond Corner, the toe of the wall is exposed. Several repairs have been carried out on this problem area in the past but there remains evidence of continuing deterioration of the toe.

A slipway exists to the south of Richmond Corner. Between Halfway and just north of Le Grande Bouet roundabout there are no man-made defences, a shingle ridge fronts the foreshore. Erosion of the soft coastal edge is evident at the gun battery. The remainder of Belle Greve Bay, to La Salerie, is defended by vertical masonry walls. The length of wall south of Hougue à la Perre battery, along Les Banques, has had additional toe protection provided in the form of concrete-capped sheet piles.

To the north of the Prism the masonry toe protection appears to have undergone several repairs in the past. South of the Prism, the concrete-capped sheet-piled toe protection resumes to Longstore. Washout of the backfill within the sheet-piled toe protection at Longstore is occurring. A vertical masonry wall protects the frontage from Longstore to La Salerie. Although beach levels along this length are particularly low, the foundations to the wall do not appear to be at risk from undermining. A small harbour exists at La Salerie.

Generally, the man-made defences have an estimated residual life of between 10 and 25 years with the following exceptions: the masonry wall north of Richmond Corner where the toe of the masonry wall is exposed, and the sheet-piled toe protection at Longstore.

Generally, the defences throughout this unit are 0.5–1.0m lower in height than those on the west coast. Overtopping is a serious problem in the southern end of the unit where the beaches are significantly lower than at the northern end. Mathematical modelling has indicated that the present standard of defence with regard to overtopping is low. The toe sheet piling at Longshore has badly corroded piles and there is the potential for leakage of the backfill.

The defences, together with the areas at risk from overtopping, are shown in Figure 6.19 at the end of this sub-section.

Land Use and Human and Built Environment

Belle Greve Bay is largely backed by land in residential and commercial use, developed along the coast road, which runs immediately adjacent to the shoreline along the entire length of the bay.

The lack of a large sandy beach within the bay and the developed hinterland effectively limit traditional recreational use, the main activities being dog walking and some angling. Areas of amenity grassland in the northern half of the bay provide a location for people sit and watch boat activity into and out of St Peter Port. Car parking is available at Richmond Corner and Halfway. There are four slipways located around the bay.

The remains of coastal batteries can be found at Halfway (Hougue à la Perre) and La Salerie, and the sites of two former batteries (Kempt and Bellegreve) are situated in the northern half of the bay. La Salerie Harbour, at the southern end of the bay (and the unit), is a post-medieval development of archaeological interest.

Natural Environment

The foreshore provides exposure of the St Peter Port Gabbro, which forms the main outcrop along the central part of the east coast. Banding within the gabbro is often prominent and comprises layers of aligned crystals of hornblende and feldspar, including good examples of "Bird's Eye" gabbro.

The large tidal range within Belle Greve Bay creates a wide variety of habitats for many species. In addition, the long sea sewage outfall creates a nutrient-rich environment, which increases the abundance of many invertebrate prey species. The numerous low-lying rocks and reefs are used by roosting gulls and waders. Over 100 turnstones are present in early winter, which is over 10% of the total population wintering on the island. The areas of mud and sand are used as feeding grounds for ringed plover (50), oyster-catchers (75) and grey plover (35). The sheltered bay has been the prime site in Guernsey for great-crested grebes with flocks of up to 15 birds being seen. Divers and sea-duck are also regular winter visitors to this area.

The undefended section of frontage in the vicinity of the former Bellgreve battery supports a transitional strandline flora backed by amenity grassland. Species occurring here include sea beet (*Beta vulgaris* spp. *maritima*) and halberd-leafed orache (*Atriplex hastata*).

Planning Policies

The coastal frontage within this unit is covered by several policy areas and includes a mixture of land classified as Urban Conservation Area with the potential for enhancement, Green Area, Built-Up Areas and Mixed Use Redevelopment Area. The frontage from just south of Hougue à la Perre Battery to the slipway at Longstore is classified as a Central Activity Area. These areas are subject to the relevant policies set out in the Urban Area Plan.

b) Key Interests within Unit

The following list highlights the main interests within the unit that have the potential to interact with, or be influenced by, coastal defence policies. They are:

- residential properties
- coast road
- commercial properties
- overwintering waterfowl
- La Salerie Harbour.

c) Appraisal of Strategic Options

Do Nothing

If nothing is done to maintain or improve the defences within Belle Greve Bay, the following scenarios over the 50-year period covered by the strategy are envisaged:

i) In the short term, overtopping that occurs in the southern end of the unit would continue to cause disruption and localised flooding. The undermining of the masonry wall at the northern end of the bay would continue, owing to wave scour, increasing the risk of structural failure of the wall. Further deterioration of the sheet-piled toe protection near Longstore would occur caused largely by wave action, resulting in more loss of backfill material. Erosion of the soft coastal edge along the undefended frontage at Halfway would continue.

ii) In the medium term, the masonry wall at the northern end of the unit would fail owing to undermining resulting in localised erosion of the land behind. The continuing washout of the backfill within the sheet-piled toe protection at Longstore would lead to the potential failure of the toe protection, weakening the masonry wall that it protects.

iii) In the long term, structural failure of all the man-made defences within the unit would result from wave action. Do Nothing would lead to erosion of the shoreline and as a consequence the loss of the coast road and properties.

The Do Nothing option would cause economic damage through the loss of developed and undeveloped land through erosion and flooding. In total approximately 18 hectares of undeveloped and 8 hectares of developed land would be affected. This option of Do Nothing does not satisfy all the Objectives set out in Section 2.3.

For these reasons the option is rejected.

Do Something

From the above discussion it is evident that the Do Something option should be adopted if a viable scheme can be identified. Sustaining the defences at their present standard would solve the problem of the toe scour and deterioration of the sheet piles, however, it would not address the problems of overtopping causing localised flooding and erosion of the undefended lengths. However, the continued erosion of the undefended lengths is not considered to be a major issue and therefore options to prevent the erosion are not considered. Therefore, options to improve the standard are also included under Do Something option to alleviate the overtopping problems.

d) Do Something Potential Scheme Options

The reasoning described in Section 5.3.3 (Possible Defence Methods) together with the problems and issues referred to above, results in the selection of three options for appraisal.

Technical and Environmental Appraisal

Option 1 – Continue Existing Practice and Minor Works (Sustain)

Option 1 comprises the following elements:

- continue existing practice by regular re-pointing of the masonry structures
- minor toe protection to short length of wall that is being undermined
- monitor toe protection of all man-made defences after storm events and undertake repair works as necessary
- repair sheet piles
- summer and winter beach surveys
- annual inspection of the defences.

The continuing maintenance of the man-made defences, along with the minor toe protection measures and the repairing of damaged sheet piles, should ensure the integrity of the man-made defences for the life of the strategy and hence the assets they defend.

Continued maintenance of the existing defences, including undertaking minor repairs, is unlikely to have any significant impacts on environmental interests within this unit. Identified Urban Conservation Areas and Green Areas along the frontage are unlikely to be affected by maintenance work and the continued functioning of the seawall. However, it should be ensured that suitable measures are taken during any proposed works to prevent damage to these areas and, if possible, opportunities for enhancement should be sought.

Option 2 – Raise Local Sections of Seawall (Improve)

Option 2 comprises the following elements:

- as Option 1
- raise local sections of seawall to reduce the effects of overtopping.

Local raising of the seawall in areas of overtopping would reduce the instances of coast road disruption owing to dangerous overtopping levels and hence improve the standard of defence.

Other technical issues are as discussed in Option 1.

As Option 1 with regard to the environmental impacts of maintaining the existing defences.

Locally raising the seawall could reduce the frequency and severity of disruption for users of the coast road and potential damage to the adjacent commercial and residential property. This option could have a visual impact for properties located landward of the coast road. The opinions of local residents on their preference between potentially obscured seaward views or continued overtopping and potential damage and disruption should be sought, as this could prove to be a significant determinant in the course of action taken.

Option 3 – Beach Nourishment (Improve)

Option 3 comprises the following elements:

- as Option 1 without repairs to sheet piles
- beach nourishment with shingle
- regular surveys of the newly nourished beach.

Nourishing the beaches south of Le Grand Bouet would reduce overtopping of the defences by forcing the waves to break further away from the wall, thus improving the standard of defence. Beach nourishment would also protect the toe of the defences from further attack, therefore no repairs to the sheet piling would be required. The use of shingle (rather than sand) would limit the losses during storm events as it would be less susceptible to drawdown and transport by tidal currents. Therefore, offshore control structures such as breakwaters are not considered necessary within this unit.

Environmental considerations are as for Option 1 with regard to continued maintenance of the defences.

Beach nourishment within the unit would need to be compatible with the existing mixed substrates within the bay. Unlike the majority of the west-coast bays, nourishment with coarser sediments is more likely to be acceptable at Belle Greve from a recreational perspective given the limited amount beach activity that occurs there.

Placement of sediment towards the base of the seawall would result in change to an area of upper intertidal foreshore and the consequent loss of, or change to, the existing intertidal community in this area. In addition, there could be some re-distribution of sediment from the recharge area into other parts of the bay, potentially leading to community changes and impacts upon food resources available to wintering waterfowl.

Economic Appraisal

Benefits

Table CU19.1 gives the estimated value of the assets protected by the defences within CU19.

Table CU19.1 Benefits

Assets	Area/Length	Value (£)
Flooding		
Developed Land	8ha	10,400,000
Undeveloped Land	18ha	396,000
Erosion		
Minor Road	N/A	-
Coast Road	2,400m	2,160,000
Ribbon Development	400m	1,300,000
	Total	**14,256,000**
	Discounted Total	**5,949,000**

Notes: The following intangible benefits are not included in the above table:
- vital communications link provided by coast road
- overwintering waterfowl
- La Salerie harbour.

Therefore the benefits derived for CU19 are likely to be an underestimate of the actual value.

Costs

Table CU19.2 gives the estimated value of the costs associated with Options 1 to 3.

Table CU19.2 Costs

Option	Initial Capital Cost (£)	Future Costs (£)		Total Discounted Cost (£)
		Capital	Maintenance	
1	200,000	£1,000/10 years	£9,000/year	**235,000**
2	307,000	£9,000/10 years	£9,000/year	**286,000**
3	1,638,000	288,000/10 years	£9,000/year	**1,079,000**

Results

Table CU19.3 gives the results of the economic appraisal for Options 1 to 3.

Table CU19.3 Results

Option	Benefit–Cost Ratio
1	25
2	21
3	6

e) Summary of Preferred Strategic Option

Table CU19.4 summarises the results of the appraisal process for CU19.

Table CU19.4 Summary of Appraisals

Option	Technical Appraisal	Environmental Appraisal	Economic Appraisal
1 • continue existing practice	• ensures integrity of defences • does not address overtopping problem • long-term commitment to sheet piles and toe protection	• no significant concerns	• viable
2 • raise seawall	• ensures integrity of defences • reduces overtopping problem • long-term commitment to sheet piles and toe protection	• affects view from coast road properties	• viable
3 • beach nourishment	• ensures integrity of defences • reduces overtopping problem • protects sheet piles	• detrimental impact on environmental interests	• viable

Option 1 does not address the problems of overtopping within the unit. For this reason the option is rejected as a long-term course of action but could be considered as an interim measure.

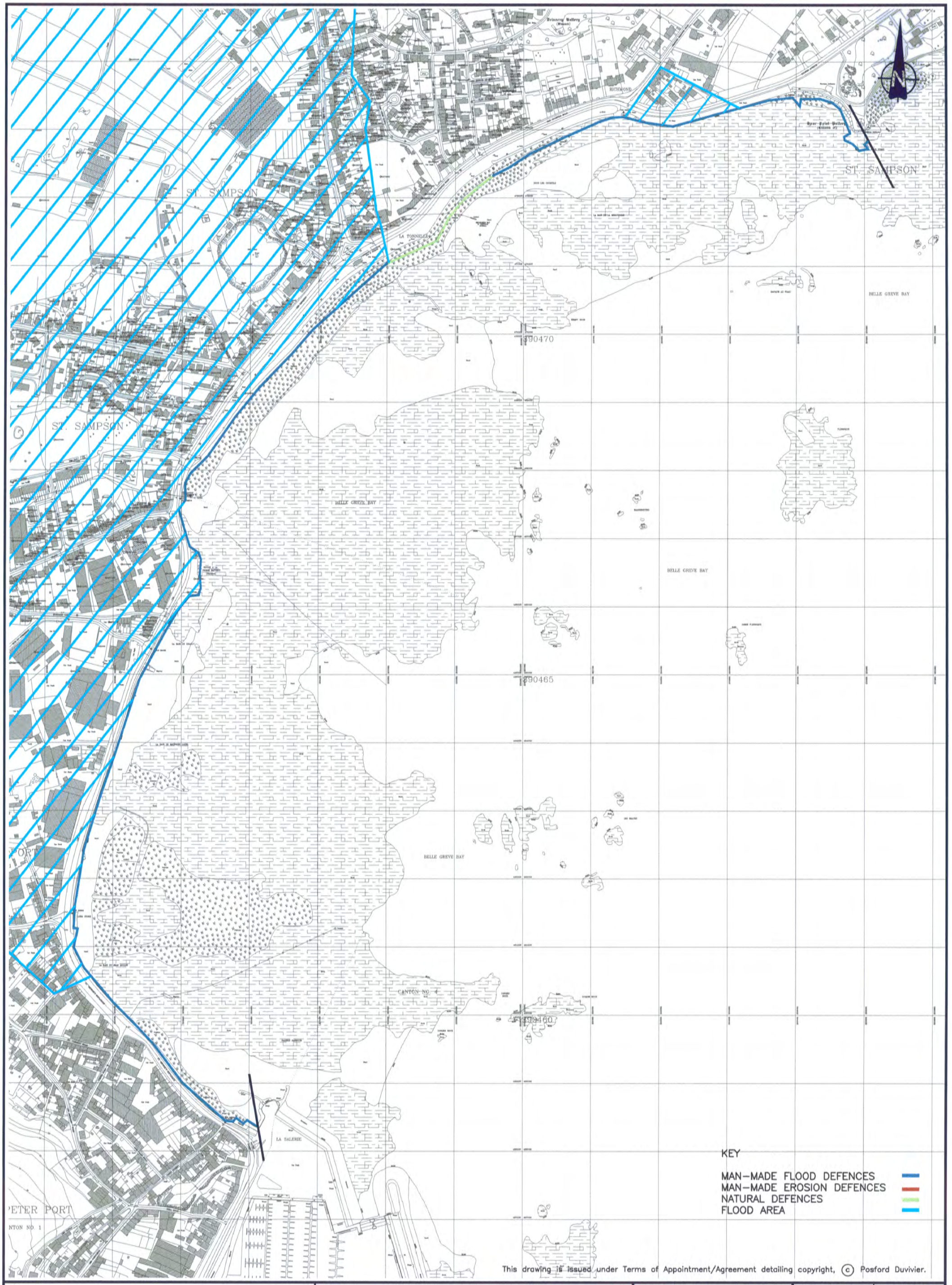
Option 2 and Option 3 are technically sound as they should ensure the integrity of the defences and address the problem of overtopping within the unit. In economic terms, Option 2 is more attractive than Option 3.

Although Option 2 addresses the current problems within the unit, it means the adoption of a long-term commitment to toe strengthening. This is seen as an appropriate strategy if beach levels do not fall significantly in the future. If, however, levels fall, it may become increasingly costly to continue with a long term programme of toe strengthening and the strategy may prove to be unsustainable.

Overall, both Option 2 and Option 3 are environmentally acceptable, however, there remain concerns over the effect seawall raising would have on views from the coast road (Option 2) and the effect of shingle nourishment on the intertidal habitat (Option 3).

On this basis, the following is proposed:

- initially, Option 1 is adopted as the preferred option and works are to be undertaken to the vulnerable lengths of the toe of the masonry wall to the north of Richmond Corner and the sheet piling at Longstore, this assumes that temporary closures of the coast road from overtopping are acceptable in the short term.
- monitor the beaches so that a view can betaken on their behaviour in five years' time.
- in five years' time, a long-term strategy is selected for the unit. Option 2 would be preferred if beach levels are tolerably stable and Option 3 if beach levels are continuing to fall.



PROJECT
GUERNSEY STRATEGY FOR COASTAL DEFENCE AND BEACH MANAGEMENT

TITLE
COASTAL UNIT 19
Spur Point to La Salerie

CONSULTING ENGINEERS
POSFORD DUVIVIER

DRAWN MDWP	SCALE 1:5,000
DATE FEB' 99	CHKD AJS
DRG No. FIGURE 6.19	

6.20 Coastal Unit 20 – La Salerie to La Vallette (St Peter Port)

a) Attributes

Introduction

Coastal Unit 20 is located on the east side of the island and extends from La Salerie to La Vallette, which includes St Peter Port (see Figure 6.20), a length of approximately 1,900m.

Coastal Processes and Beach Behaviour

There is little mobile sediment along the frontage of this unit. The foreshore from Havelet Bay to La Vallette is rocky, with the exception of South Beach, which has a sandy foreshore with intermittent rocky outcrops. The beach is fully covered at high tide. The sand that does exists in Havelet Bay is effectively trapped by the Castle Pier Breakwater and the rocky headland of La Vallette.

A trial pit dug in autumn 1998 within Havelet Bay, indicated approximately 1.5m of material above the decomposed granite and the beach level at about 3.8m below MHWS.

This unit is protected to a certain extent from easterly waves owing to the shelter afforded by Herm and Sark. Strong tidal currents occur in the Little Russel Channel, particularly on high spring tides.

Coastal Defences

The old harbour at St Peter Port was effectively completed in 1868, with the construction of two large masonry breakwaters. Since this time developments, have taken place within the harbour and immediately to the north, where the Queen Elizabeth II (or North Beach) Marina has been created. Rock armoured breakwaters surround the North Beach Marina. The White Rock Pier, which extends from the East Breakwater of the North Beach Marina is of masonry construction. Vertical masonry walls form Castle Pier, which extends to Castle Cornet and beyond. All these structures appear in good condition. St Peter Port Harbour is protected internally by vertical masonry walls. An inspection of the quay walls within the harbour was not undertaken for the strategy.

Havelet Bay is fronted by a masonry wall, which extends to La Vallette.

Much of the frontage of St Peter Port is reclaimed. Water is known to overtop Victoria Marina (in the south of the harbour) during high spring tides. Water is also known to overtop at Havelet Bay, particularly at the northern end adjacent to the harbour wall. The defences within this unit generally have a residual life of between 10 and 25 years.

These defences are shown in Figure 6.20 at the end of this sub-section.

Land Use and Human and Built Environment

CU20

This unit is dominated by the piers, jetties and marinas of St Peter Port Harbour. Originally the main commercial harbour for the island and a centre for shipbuilding, the old docks and harbour areas were converted into marinas in the 1970s and 1980s. The marinas now represent one of the island's more important tourism features, both from the point of view of being an attraction in themselves and as a means of bringing visitors to the island, with approximately 40,000 visiting yachtsmen in a year (1997). In addition, visiting cruise ships that dock at White Rock Pier bring in another 10,000 visitors annually. The development of the marina at North Beach has provided a large number of car-parking spaces. The piers and jetty in the vicinity of White Rock are also used for container and Ro-Ro ferry traffic.

Apart from general sight seeing, the harbour area also provides visitors and locals with facilities such as restaurants and access, via ferries, to the other Channel Islands. The outer harbour walls are well used for sea angling at certain times of the year. Havelet Bay (South Beach) provides sheltered conditions for swimming during the summer months and, in addition, a salt-water bathing pool has been excavated into the rock platform on the southern side of the bay.

The coastline in the vicinity of St Peter Port has provided sheltered anchorage since at least Roman times, as shown by the discovery of a Roman shipwreck and evidence for settlement in and around the harbour. The southern side of the harbour is dominated by the islet of Cornet, upon which stands the imposing Castle Cornet. Founded in 1204 by King John, the Castle was built for the defence of the anchorage of St Peter Port, which was an important staging post on the route between England and southern France. It has had continuous military use up to World War II. The Castle is now a popular tourist attraction and houses the Royal Guernsey Militia Museum and a number of other small museums.

Another tourist attraction is the Underground Military Museum at La Vallette, situated within a former German concrete-lined tunnel complex.

Natural Environment

Apart from intertidal areas of mixed substrate (rock, shingle and sand), areas of ecological interest within this section are confined to the far southern end of the unit at La Vallette. Here there is a short section of steep vegetated cliff, forming the northern end of the south-eastern cliffs. Vegetation here comprises rough maritime grassland with bracken (*Pteridium aquilinum*), blackthorn (*Prunus spinosa*) and bramble (*Rubus fruiticosus*) on the sheltered cliff faces, grading into woodland on the upper cliff slope.

Planning Policies

The main marina at St Peter Port is classified as a Central Activity Area, while the harbour is an Urban Conservation Area with the potential for enhancement. Castle Cornet is an Urban Conservation Area. Havelet Bay is split between two area plans. The main part of it comprises a Central Activity Area and Urban Conservation Area. All of these areas are subject to the relevant policies set out in the Urban Area Plan.

The southern part of the bay is classified as an Area of Special Environmental Importance (Green Zone 1), under the Rural Area Plan. This area is subject to the relevant conservation and enhancement policies set out in the Rural Area Plan (Phase 1).

b) Key Interests within Unit

The following list highlights the main interests within the unit that have the potential to interact with, or be influenced by, coastal defence policies. They are:

- residential properties
- coast road
- commercial properties
- St Peter Port Harbour and North Beach Marina
- Castle Cornet.

c) Appraisal of Strategic Options

Do Nothing

If nothing is done to maintain or improve the defences between La Salerie and La Vallette, the following scenarios over the 50-year period covered by the strategy are envisaged:

i) In the short to medium term, the overtopping at Havelet Bay and Victoria Marina would continue to result in occasional closure of the coast road and localised flooding of adjacent properties.

ii) In the long term, structural failure of the man-made defences would occur largely caused by wave action. Do Nothing would lead to erosion of the reclaimed land within St Peter Port resulting in the loss of the coast road, damage to and loss of properties.

The Do Nothing option would cause economic damage through the loss of developed and undeveloped land through erosion owing to the gradual retreat of the shoreline. This option of Do Nothing does not satisfy all the Objectives set out in Section 2.3.

For these reasons the option is rejected.

Do Something

From the above discussion it is evident that the Do Something option should be adopted if a viable scheme can be identified. Sustaining the man-made defences at their present standard would address the problems of deterioration of the defences but would not address the problems of overtopping associated with the unit. Therefore options to both sustain and improve the present standard of defence are considered.

d) Do Something Potential Scheme Options

The reasoning described in Section 5.3.3 (Possible Defence Methods) together with the problems and issues referred to above, results in the selection of two options for appraisal.

CU20

Technical and Environmental Appraisal

Option 1 – Continue Existing Practice (Sustain)

Option 1 comprises the following elements:

- continue existing practice by regular re-pointing of the masonry structures
- annual inspection of defences.

The continuing maintenance of the man-made defences would ensure the integrity of the defences for the life of the strategy and hence the assets they defend.

This option is unlikely to have any significant impact on environmental interests within this unit. Much of the harbour area is an identified Urban Conservation Area. It should, therefore, be ensured that suitable measures are taken during maintenance works to prevent damage to structures within this area and to use materials that maintain its general character. If possible, opportunities for enhancement should be sought.

This option does not address the overtopping problems associated with the unit.

Option 2 – Raise Local Sections of Seawall (Improve)

Option 2 comprises the following elements:

- as Option 1
- raise local sections of seawall to reduce the effects of overtopping.

Local raising of the seawall in areas of problem overtopping, such as Victoria Marina (due to water levels) and Havelet Bay (due to a combination of waves and water levels), would reduce the instances of coast road closure and localised flooding.

Other technical issues are as discussed in Option 1.

Environmental considerations are as for Option 1 with regard to maintenance.

Materials used in raising the wall should be in keeping with those originally used in the construction of the structures. Consideration would need to given to the effect that this option may have on obscuring views of the harbour and marina areas. If this is considered to be an important issue additional works, such as raising the level of pavements adjacent to the walls, may have to be undertaken.

CU20

Economic Appraisal

Benefits

Table CU20.1 gives the estimated value of the assets protected by the defences within CU20.

Table CU20.1 Benefits

Assets	Area/Length	Value (£)
Flooding		
Developed Land	N/A	-
Undeveloped Land	N/A	-
Erosion		
Minor Road	N/A	-
Coast Road	1,900m	1,710,000
Ribbon Development	1,900	6,175,000
	Total	**7,885,000**
	Discounted Total	**1,373,000**

Notes: The following intangible benefits are not included in the above table:
- vital communications link provided by coast road
- St Peter Port Harbour and North Beach Marina
- Castle Cornet.

Therefore the benefits derived for CU20 are likely to be an underestimate of the actual value.

Costs

Table CU20.2 gives the estimated value of the costs associated with Options 1 and 2.

Table CU20.2 Costs

Option	Initial Capital Cost (£)	Future Costs (£)		Total Discounted Cost (£)
		Capital	Maintenance	
1	N/A	N/A	8,550/year	**143,000**
2	67,000	N/A	8,550/year	**155,000**

Results

Table CU20.3 gives the results of the economic appraisal for Options 1 and 2.

Table CU20.3 Results

Option	Benefit–Cost Ratio
1	10
2	9

e) Summary of Preferred Strategic Option

Table CU20.4 summarises the results of the appraisal process for CU20.

Table CU20.4 Summary of Appraisals

Option	Technical Appraisal	Environmental Appraisal	Economic Appraisal
1 • continue existing practice	• ensures integrity of defences • does not address overtopping problem	• no significant concerns	• viable
2 • raise seawall	• ensures integrity of defences • reduces overtopping problem	• no significant concerns	• viable

Option 1 does not address the problems of overtopping within the unit. For this reason the option is rejected.

Option 2 is technically sound, environmentally acceptable and economically viable and is, therefore, selected as the appropriate strategy for CU20.

KEY

MAN–MADE FLOOD DEFENCES
MAN–MADE EROSION DEFENCES
NATURAL DEFENCES

PROJECT GUERNSEY STRATEGY FOR COASTAL DEFENCE AND BEACH MANAGEMENT	TITLE COASTAL UNIT 20 La Salerie to La Vallette	CONSULTING ENGINEERS POSFORD DUVIVIER	DRAWN MDWP / SCALE 1:5,000 DATE FEB' 99 / CHKD AJS DRG No. FIGURE 6.20

6.21 Coastal Unit 21 – La Vallette to St Martin's Point

a) Attributes

Introduction

Coastal Unit 21 is located on the east side of the island and extends between La Vallette and St Martin's Point (see Figure 6.21), a length of approximately 5,200m. The unit includes Soldiers Bay and Fermain Bay.

Coastal Processes and Beach Behaviour

The coastline from La Vallette to St Martin's Point is characterised by high cliffs broken by several small bays, the largest being Fermain Bay. Fermain Bay is a shingle beach with sand being exposed at low tide. The bay is surrounded by rocky headlands that limit the transport of material along the unit. Soldiers Bay consists of a shingle beach, and like Fermain Bay, is enclosed by rocky headlands. The foreshore of Le Pied du Mur (Marble Bay) is covered in pebbles and shingle.

The foreshore along this frontage contains little mobile sediment, apart from that present within the bays described above. There is little longshore transport as any material available is effectively trapped between rocky headlands. During storms, the beaches within the bays are susceptible to drawdown potentially exposing the cliffs and defences to increased wave attack. However, the sheltering effect of the surrounding headlands suggests that the drawn down beach material is not permanently lost from the bay by tidal or wave action. The beaches are, therefore, able to rebuild after the storm has passed.

Coastal Defences

There are little in the way of coastal defences within this unit. There is a masonry faced wall at the back of Fermain Bay. The wall prevents washout of the back of the beach and provides stability to the cliffs within the bay. The wall was strengthened a few years ago after suffering damage due in part to cliff instability. The residual life of the seawall is estimated to be 10 to 25 years.

These defences are shown in Figure 6.21 at the end of this sub-section.

Land Use and Human and Built Environment

The northern half of this frontage from La Vallette to Fermain Bay comprises steep wooded cliffs rising to a height of about 75m, with residential development along the cliff top. Southwards to St Martin's Point, the coastline takes on a more rugged character. The cliff footpath along this section of coast is well used. During the summer a boat service runs between St Peter Port Harbour and Fermain Bay. The shingle beaches and sheltered waters of Fermain Bay, and Soldiers Bay to the north, are popular locations for swimming and general beach activity. There is s a café and a picnic site located at Fermain Bay, to which there is very limited vehicular access.

CU21

As with a large part of the Guernsey coastline, former defence points and fortification against attack are much in evidence. This includes Fort George, opposite Soldiers Bay. Constructed between 1782 and 1812, the fort is the largest defensive work on the island and incorporates eight batteries, including Clarence Battery at Les Terres Point. The area occupied by the main fort was developed for housing in the 1960s. The sites of former coastal batteries are dotted all along the coast, with two located in Fermain Bay. In addition, there is a pre-Martello Tower (No. 15) located in Fermain Bay. This is one of 15 such towers that were built around the coast between 1778 and 1779 in response to potential attack from the French and to support the coastal batteries at possible landing sites.

Other features of historic interest along the coast include a late medieval jetty at Divette, which was used during the 14th century to supply stores, etc. to the garrison stationed at Jerbourg.

Natural Environment

From La Valette southwards as far as Marble Bay, the coast is formed in the Icart Gneiss Group. A fault zone runs through Marble Bay, so-named for a large quartzite (white marble) vein 2–3m thick, which outcrops on the southern side of the bay, and marks the contact between the Icart Gneiss and the Perelle Gneiss. From Divette southwards to St Martin's Point, the cliffs are formed in the Jerbourg Metasediment. The 8m wave-cut platform is prominent along this section of the coast and in many places is overlain and obscured by head deposits that mask the cliff face.

The scrub and wooded cliffs of the east coast represent a continuation of the rugged cliffs of the south coast. The less exposed nature of the east coast has enabled woodland vegetation to establish particularly in some of the smaller more sheltered valleys, e.g. Fermain Bay. Deciduous woodland dominates with sycamore (*Acer pseudoplatanus*) and ash (*Fraxinus excelsior*). Towards the southern end of the unit, where there is more exposure, scrub and maritime grassland tend to dominate. Along this stretch of coast, but particularly in the vicinity of Soldiers Bay, both of Guernsey's indigenous species of reptile, the green lizard and the slow worm, can be found. The green lizard, a Mediterranean species, does not occur on the UK mainland or on Alderney or Sark.

Planning Policies

This unit is split between the two Rural Area Plans, the divide occurring at the northern end of Fermain Bay. The entire frontage is classified as an Area of Special Environmental Importance (Green Zone 1) and is subject to the relevant conservation and enhancement policies set out in the Rural Area Plans (Phase 1 and Phase 2).

b) Key Interests within Unit

The following list highlights the main interests within the unit that have the potential to interact with, or be influenced by, coastal defence policies. They are:

- recreational use of the small bays
- coastal landscape
- cliff-top footpath.

c) Appraisal of Strategic Options

Do Nothing

If nothing is done to maintain or improve the defences between La Vallette and St Martin's Point, the following scenarios over the 50-year period covered by the strategy are envisaged:

i) In the short term there would be little or no risk.

ii) In the medium term, there would be the potential for further instability of the cliffs within Fermain Bay, leading to structural damage to the masonry wall.

iii) In the long term, the masonry wall within Fermain Bay would be lost owing to structural failure caused by a combination of cliff instability and wave action, leading to the loss of the recreational facilities in Fermain Bay.

The Do Nothing option would cause economic damage through the loss of the developed land owing to erosion and cliff instability. This option of Do Nothing does not satisfy all the Objectives set out in Section 2.3.

Therefore the option is rejected.

Do Something

From the above discussion it is evident that the Do Something option should be adopted if a viable scheme can be identified. Sustaining the man-made defences at their present standard would address the problems of deterioration caused by cliff instability and wave action. Therefore options to improve the existing standard of defence are not considered.

d) Do Something Potential Scheme Options

The reasoning described in Section 5.3.3 (Possible Defence Methods) together with the problems and issues referred to above, results in the selection of one option for appraisal.

Technical and Environmental Appraisal

Option 1 – Continue Existing Practice (Sustain)

Option 1 comprises the following elements:

- continue existing practice by regular re-pointing of the masonry structure
- annual inspection of the defences.

Continuing the existing practice of maintaining the man-made defences within Fermain Bay would ensure the integrity of the defences for the life of the strategy and hence the assets they protect.

This option is unlikely to have any significant impact on environmental interests within this unit. If possible, any works in Fermain Bay should be undertaken outside the main tourist season.

CU21

Economic Appraisal

Benefits

Table CU211 gives the estimated value of the assets protected by the defences within CU21.

Table CU21.1 Benefits

Assets	Area/Length	Value (£)
Flooding		
Developed Land	N/A	-
Undeveloped Land	N/A	-
Erosion		
Minor Road	N/A	-
Coast Road	N/A	-
Ribbon Development	30m	98,000
	Total	**98,000**
	Discounted Total	**41,000**

Notes: The following intangible benefits are not included in the above table:
- recreational use of the small bays
- coastal landscape
- cliff-top footpath.

Therefore the benefits derived for CU21 are likely to be an underestimate of the actual value.

Costs

Table CU21.2 gives the estimated value of the costs associated with Option 1.

Table CU21.2 Costs

Option	Initial Capital Cost (£)	Future Costs (£)		Total Discounted Cost (£)
		Capital	Maintenance	
1	N/A	N/A	1,350/year	**23,000**

Results

Table CU21.3 gives the results of the economic appraisal for Option 1.

Table CU21.3 Results

Option	Benefit–Cost Ratio
1	1.8

e) Summary of Preferred Strategic Option

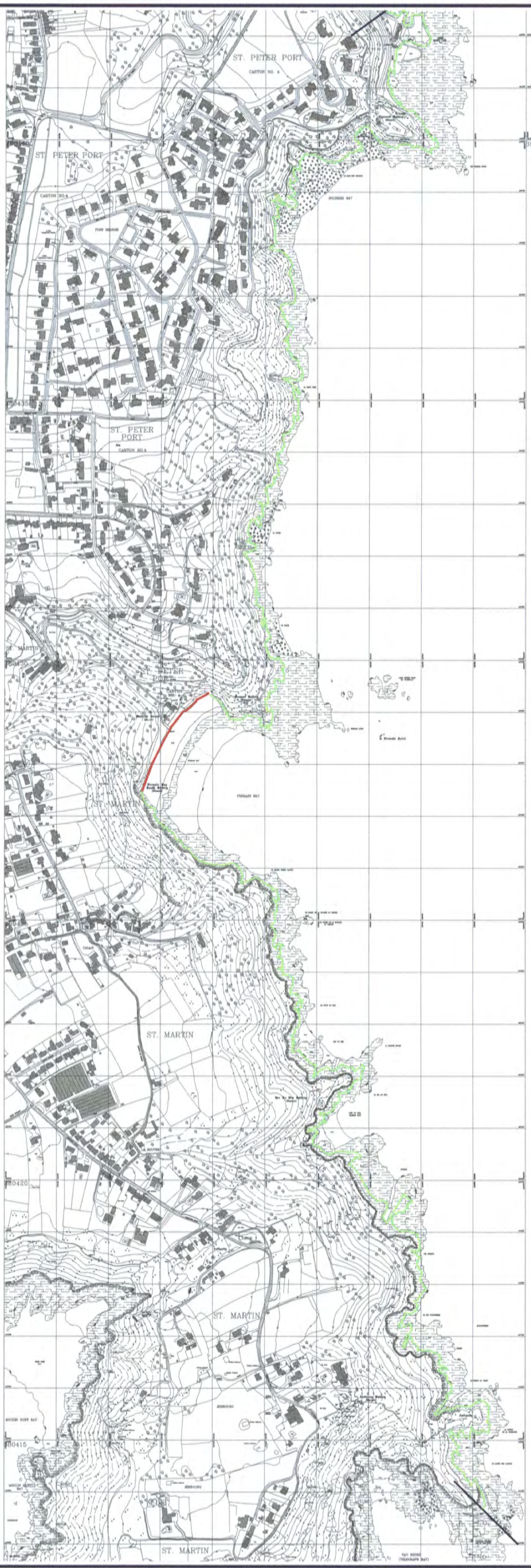
Table CU21.4 summarises the results of the appraisal process for CU21.

Table CU21.4 Summary of Appraisals

Option	Technical Appraisal	Environmental Appraisal	Economic Appraisal
1 • continue existing practice	• ensures integrity of defences	• no significant concerns	• viable

Option 1 is technically sound, environmentally acceptable and economically viable and is, therefore, selected as the appropriate strategy for CU21.

CU21



KEY

MAN–MADE FLOOD DEFENCES
MAN–MADE EROSION DEFENCES
NATURAL DEFENCES

PROJECT: GUERNSEY STRATEGY FOR COASTAL DEFENCE AND BEACH MANAGEMENT	TITLE: COASTAL UNIT 21 — La Vallette to St Martin's Point	CONSULTING ENGINEERS: POSFORD DUVIVIER	DRAWN MDWP · SCALE 1:8,000 · DATE FEB' 99 · CHKD AJS · DRG No. FIGURE 6.21

6.22 Coastal Unit 22 – St Martin's Point to Le Gouffre

a) Attributes

Introduction

Coastal Unit 22 is located on the south side of the island and extends between St Martin's Point and Le Gouffre (see Figure 6.22), a length of approximately 10,000m. The unit includes Moulin Huet Bay, Saint's Bay and Petit Bôt Bay.

Coastal Processes and Beach Behaviour

Several small bays have formed at the base of the cliffs owing to weaknesses within the cliffs. These beaches are situated between rocky headlands that provide shelter thus making the beaches relatively stable. The small bays are characterised by an upper beach of shingle and a foreshore of sand. The upper sections of the cliffs are prone to slippage.

There is potential for the longshore movement of sediment within the small bays. However, the headlands protect the bays from oblique wave attack and sediment is not moved along the bays. Cross-shore movements of sediment are likely to take place during storms, with sand being drawn down the beach. Once drawn down the beach the sand is vulnerable to transport by tidal current. However, the headlands of Jerbourg Point and Icart Point deflect the strong tidal currents away from the coastline and the drawn down sand remains available for beach rebuilding once the storm has passed. Any sediment that is supplied to the beaches is likely to be from erosion and weathering of the cliffs.

Coastal Defences

The cliffs are subject to significant wave action and are slowly eroding. The short lengths of masonry wall present in the bays protect the base of the cliffs from erosion thus preventing undercutting and rock falls. Masonry walls are to be found in Le Petit Port (in the east of Moulin Huet Bay), Saint's Bay and Petit Bôt Bay. Generally, these walls have an estimated residual life of between 10 and 25 years.

These defences are shown in Figure 6.22 at the end of this sub-section.

Land Use and Human and Built Environment

This unit forms the eastern half of the dramatic cliffed south coast of the island. The immediate cliff-top land is entirely undeveloped. Only in a few places is the land cultivated right up to the top of the main cliff face and, in general, agricultural land use occurs landward of the main break in slope. This distance inland varies along the section probably depending upon past practice, slope angle and soil type (productivity). Between the cliff face and the cultivated land the main slope is covered by rough vegetation (grassland and scrub), which may have been grazed in the past.

CU22

This section of the south coast contains a number of small bays with sandy beaches. These sites are important recreationally, particularly for beach activities, swimming and shore angling from the rocky headlands. With road access to the shore, Moulin Huet Bay, Saint's Bay and Petit Bôt Bay are the most popular destinations. Le Petit Port is one of the island's finest bays, and can be accessed either from Moulin Huet Bay or via a series of steep steps down the cliff face. Limited car parking is available at Petit Bôt Bay. Saint's Bay is one of the few areas on the south coast that is sufficiently sheltered for boats to be left at their moorings. This has led to the development of a small fisherman's harbour. A coastal footpath runs along the entire length of the southern cliffs and is extremely well used by walkers; walking is one of the most popular recreational activities on the island. The footpath provides access to the shoreline and stunning views, including features such as the offshore rocks known as The Pea Stacks (Les Tas de Pois d'Amont), an important landscape element off the southern tip of Jerbourg Point.

During the Iron Age, the Jerbourg peninsula was converted into a promontory fort by the construction of a series of ramparts and ditches across the isthmus from Le Petit Port to Le Pied du Mur (Marble Bay). Archaeological excavations at Jerbourg have recovered pottery and flint tools from this period. The ramparts were enlarged during the 13th century to provide refuge for the people living in the southern part of Guernsey against the raids that followed separation of the Channel Islands from Normandy in 1204. A castle was built here in the 14th century but only a stone-faced bank remains today.

The pre-Martello Tower 14 above Saints Bay and Tower 13 in Petit Bôt Bay, are two of 15 such towers that were built around the coast between 1778 and 1779 in response to potential attack from the French and to support the coastal batteries at possible landing sites.

Natural Environment

Apart form the Jerbourg peninsula, the entire section of the south coast within this unit is formed in the Icart Gneiss Group. The peninsula is made up of two main rock groups. On its eastern side, the Jerbourg Metasediment outcrops, with a small outcrop of the Perelle Gneiss Group forming the central spine and eastern flank. The steep cliffs along this section are in places formed, or covered, by head material, which is prone to slippage. Both the 18m and 8m raised beach platforms can be seen around the coast, particularly in Moulin Huet Bay.

The south-western cliffs probably represent, from an ecological perspective, the most natural and unspoilt part of the island. In places they support an interesting flora and provide ideal habitat conditions for a number of bird species found nowhere else of the island. The dominant vegetation is maritime grassland with gorse (*Ulex europaeus*) and bracken (*Pteridium aquilinum*), and areas of hawthorn (*Crataegus monogyna*) and blackthorn (*Prunus spinosa*) scrub. Small pockets of mature deciduous and coniferous woodland occupy some of the small cliff-top valleys. The flora of the southern cliffs is diverse and includes a number of notable species, including wild asparagus (*Asparagus officinalis* ssp. *prostratus*), sea milkwort (*Glaux maritima*), green-winged orchid (*Orchis morio*) and dwarf rush (*Juncus capitatus*). In the UK, this last species is known only from west Cornwall, where it is very rare. The sheltered and wooded valleys that extend down to the coast, e.g. at Moulin Huet and Saint's Bay, provide shelter and important feeding areas for migrating birds. The Pea Stacks of Jerbourg Point are an important sea-bird breeding site. The southern cliffs are an identified SNCI.

Planning Policies

The entire coastal frontage within the unit is an Area of Special Environmental Importance (Green Zone 1). This area is subject to the relevant conservation and enhancement policies set out in the Rural Area Plan (Phase 1).

b) Key Interests within Unit

The following list highlights the main interests within the unit that have the potential to interact with, or be influenced by, coastal defence policies. They are:

- recreational use of the small bays
- coastal landscape
- cliff-top footpath
- cliff flora and fauna.

c) Appraisal of Strategic Options

Do Nothing

If nothing is done to maintain or improve the defences between St Martin's Point and Le Gouffre, the following scenarios over the 50-year period covered by the strategy are envisaged:

i) In the short term there would be little risk to the assets.

ii) In the medium term, there would be the potential for further instability of the cliffs within Le Petit Port, Saint's Bay and Petit Bôt Bay leading to structural damage to the masonry walls.

iii) In the long term, the masonry walls within the bays would be lost owing to structural failure caused by a combination of cliff instability and wave action, leading to the loss of the recreational facilities.

The Do Nothing option would cause economic damage through the loss of the developed land owing to erosion and cliff instability. This option of Do Nothing does not satisfy all the Objectives set out in Section 2.3.

Therefore the option is rejected.

Do Something

From the above discussion it is evident that the Do Something option should be adopted if a viable scheme can be identified. Sustaining the man-made defences at their present standard would address the problems of deterioration caused by cliff instability and wave action. Therefore options to improve the existing standard of defence are not considered.

d) Do Something Potential Scheme Options

The reasoning described in Section 5.3.3 (Possible Defence Methods) together with the problems and issues referred to above, results in the selection of one option for appraisal.

Technical and Environmental Appraisal

Option 1 – Continue Existing Practice (Sustain)

Option 1 comprises the following elements:

- continue existing practice by regular re-pointing of the masonry structures
- annual inspection of defences.

Continuing the existing practice of maintaining the defences within Le Petit Port, Saint's Bay and Petit Bôt Bay would ensure the integrity of the defences for the life of the strategy and hence the assets they protect.

This option is unlikely to have any significant impact on environmental interests within this unit. If possible, any works in the bays should be undertaken outside the main tourist season.

Economic Appraisal

Benefits

Table CU221 gives the estimated value of the assets protected by the defences within CU22.

Table CU22.1 Benefits

Assets	Area/Length	Value (£)
Flooding		
Developed Land	N/A	-
Undeveloped Land	N/A	-
Erosion		
Minor Road	N/A	-
Coast Road	N/A	-
Ribbon Development	70m	228,000
	Total	**228,000**
	Discounted Total	**95,000**

Notes: The following intangible benefits are not included in the above table:
- recreational use of the small bays
- coastal landscape
- cliff-top footpath
- cliff flora and forna.

Therefore the benefits derived for CU21 are likely to be an underestimate of the actual value

Costs

Table CU22.2 gives the estimated value of the costs associated with Option 1.

Table CU22.2 Costs

Option	Initial Capital Cost (£)	Future Costs (£)		Total Discounted Cost (£)
		Capital	Maintenance	
1	N/A	N/A	350/year	**6,000**

Results

Table CU22.3 gives the results of the economic appraisal for Option 1.

Table CU22.3 Results

Option	Benefit–Cost Ratio
1	16

e) Summary of Preferred Strategic Option

Table CU22.4 summarises the results of the appraisal process for CU22.

Table CU22.4 Summary of Appraisals

Option	Technical Appraisal	Environmental Appraisal	Economic Appraisal
1 • continue existing practice	• ensures integrity of defences	• no significant concerns	• viable

Option 1 is technically sound, environmentally acceptable and economically viable and is, therefore, selected as the appropriate strategy for CU22.

CU22

KEY

MAN–MADE FLOOD DEFENCES
MAN–MADE EROSION DEFENCES
NATURAL DEFENCES

PROJECT: GUERNSEY STRATEGY FOR COASTAL DEFENCE AND BEACH MANAGEMENT	TITLE: COASTAL UNIT 22 — St Martin's Point to Le Gouffre	CONSULTING ENGINEERS: POSFORD DUVIVIER	Job No. E3309	DATE FEB'99	SCALE 1:17,500
			ACAD Ref.	CHECKED JEC	PASSED AJS
			DRAWN MDWP	DRG No. FIGURE 6.22	REV

6.23 Coastal Unit 23 – Le Gouffre to Pezeries Point

a) Attributes

Introduction

Coastal Unit 23 is located on the south side of the island and extends between Le Gouffre to Pezeries Point (see Figure 6.23), a length of approximately 8,500m.

Coastal Processes and Beach Behaviour

The coastline from Le Gouffre to Pezeries Point is characterised by an unbroken line of high cliffs.

The frontage is very exposed to wave attack, however, the cliffs are resistant to erosion. There is little mobile sediment present along the frontage.

Coastal Defences

There are no built defences in this unit, the coastal edge comprises natural cliffs.

These defences are shown in Figure 6.23 at the end of this sub-section.

Land Use and Human and Built Environment

The immediate cliff-top land is entirely undeveloped. Only in a few places is the land cultivated right up to the top of the main cliff face and, in general, agricultural land use occurs landward of the main break in slope. This distance inland varies along the section probably depending upon past practice, slope angle and soil type (productivity). Between the cliff face and cultivated land the main slope is covered by rough vegetation (grassland and scrub), which may have been grazed in the past.

The dramatic cliffed coastline from Le Gouffre to Pezeries lacks the small sheltered embayments, with their popular sandy beaches that are found to the south east. However, the area with its superb coastal scenery, wildlife and historic fortifications is still well visited, particularly by walkers who make use of the well-marked cliff-top footpath. Minor roads and tracks from the main coastal road provide access to small cliff-top car parks at several locations.

The cliffs at Havre de Bon Repos represent one of the only locations along a stretch of the south coast where the cliffs are considered to be scalable. Consequently the area has been fortified for a long period of time. The medieval Château de Corbière was established here, although earlier fortifications may have existed, as archaeological excavations have revealed the existence of a Roman bank and ditch system. Later, a granite building known as La Prevôté Watch House was constructed during the Napoleonic era, which was in turn replaced by the Germans during World War II with the formidable concrete and steel observation tower now present on the site. The tower is unique in Guernsey in that it was built by the German Army, all the other towers being built by the Navy. Two other Napoleonic watch towers are situated along this section, at Mont Hérault (the best preserved on the island) and at Pleinmont. Further German fortifications can be seen at L'Angle, where the impressive direction-finding tower dominates the coastline, and just to the west where the almost intact remains of Batterie Dollman, a field gun emplacement site, is sited on overgrown land by the cliff path. Several other sites of former batteries are located along the cliff tops.

Natural Environment

The main part of the south coast is formed within the outcrop of the Icart Gneiss Group. In places the cliffs are covered by head material, which is prone to slippage. The Pleinmont peninsula provides exposure through three different rock types. An outcrop of the intrusive L'Erée Granite forms the western end of the section, while this succeeded to the east, in the vicinity of Mont Hérault, by a small outcrop of the Perelle Gneiss Group. The far northern end of the Pleinmont peninsula provides exposures of the Pleinmont Metasediment. Both the 18m and 8m raised beach platforms can be seen at Pleinmont, in addition to extensive head and loess deposits.

The southern cliffs probably represent, from an ecological perspective, the most natural and unspoilt part of the island. In places they support an interesting flora and provide ideal habitat conditions for a number of bird species found nowhere else on the island. The dominant vegetation is maritime grassland with gorse (*Ulex europaeus*) and bracken (*Pteridium aquilinum*), and areas of hawthorn (*Crataegus monogyna*) and blackthorn (*Prunus spinosa*). Small pockets of mature deciduous and coniferous woodland occupy some of the small cliff-top valleys. The flora of the southern cliffs is diverse and includes a number of notable species, including wild asparagus (*Asparagus officinalis* ssp. *prostratus*), sea milkwort (*Glaux maritima*), green-winged orchid (*Orchis morio*) and dwarf rush (*Juncus capitatus*). In the UK, this last species is known only from west Cornwall, where it is very rare.

The pines and heathland at Plaine des Camprôts provide breeding habitat for the rare Dartford warbler (*Sylvia undata aremorica*), more than three pairs of which normally breed along the south coast. Le Tas de Pois d'Aval (Gull Rock) off the coast at Torteval, provides secluded habitat for breeding sea birds, but in particular herring gulls (*Larus argentatus*) and lesser black-backed gulls (*Larus fuscus*).

Planning Policies

The entire coastal frontage within the unit is an Area of Special Environmental Importance (Green Zone 1). This area is subject to the relevant conservation and enhancement policies set out in the Rural Area Plan (Phase 1).

b) Key Interests within Unit

The following list highlights the main interests within the unit that have the potential to interact with, or be influenced by, coastal defence policies. They are:

- historic fortifications
- cliff flora and fauna
- coastal scenery
- cliff-top footpath.

c) Appraisal of Strategic Options

Do Nothing

If nothing is done to the coastline between Le Gouffre and Pezeries Point, the following scenarios over the 50-year period of the strategy are envisaged:

i) In the short and medium term, there would be little or no risk.

ii) In the long term, there would be some erosion of the cliffs, however, this would be unlikely to effect any assets within the unit as the rate would be slow.

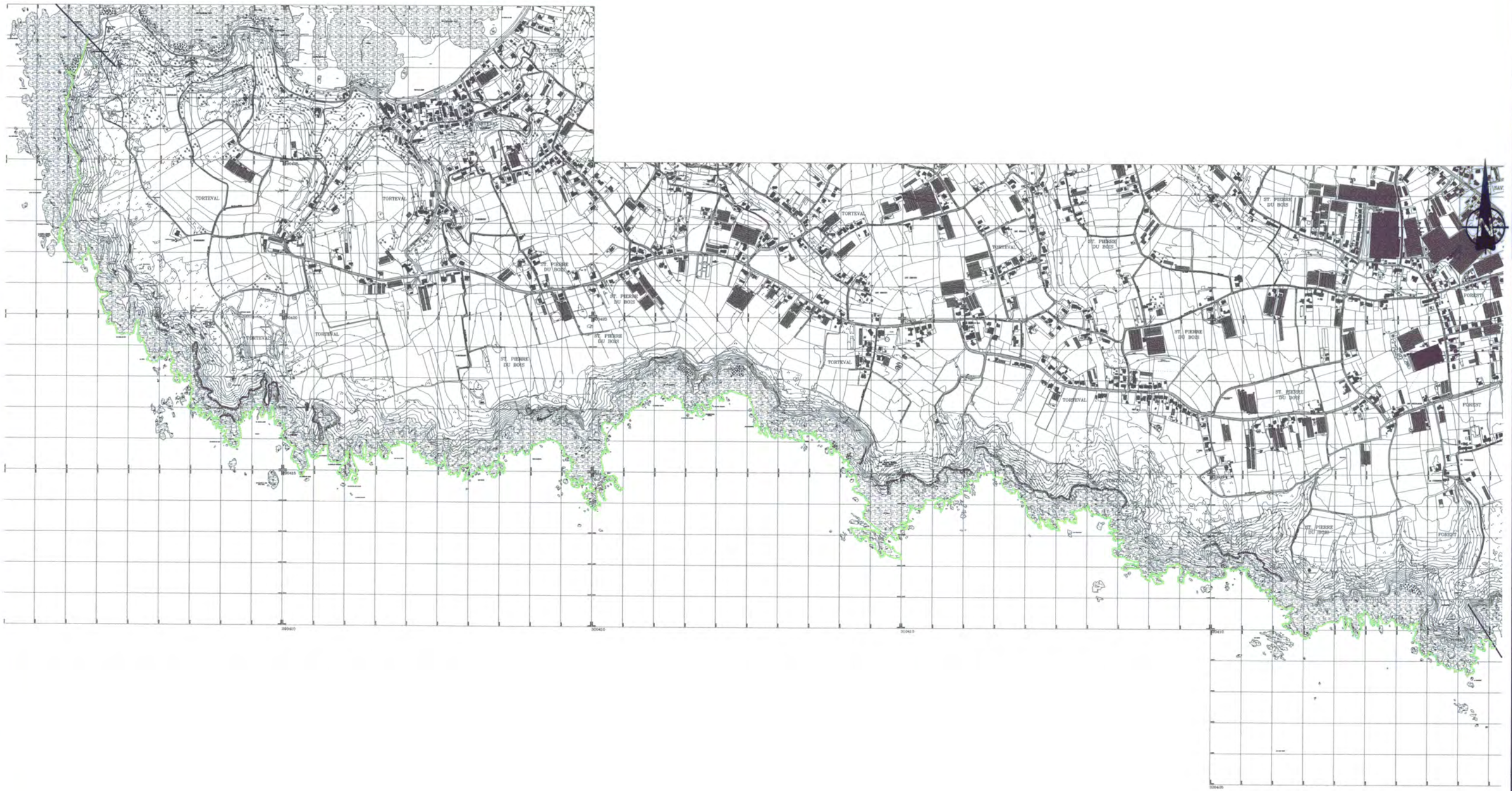
The Do Nothing option is unlikely to have any detrimental effects on the identified interests of this unit and would retain the unspoilt character of this section of coast during the life of the strategy.

Therefore the option is selected.

CU23

KEY

MAN–MADE FLOOD DEFENCES
MAN–MADE EROSION DEFENCES
NATURAL DEFENCES



PROJECT: GUERNSEY STRATEGY FOR COASTAL DEFENCE AND BEACH MANAGEMENT	TITLE: COASTAL UNIT 23 — Le Gouffre to Pezeries Point	CONSULTING ENGINEERS: POSFORD DUVIVIER	Job No. E3309	DATE FEB'99	SCALE 1:12,500
			ACAD Ref.	CHECKED JEC	PASSED AJS
			DRAWN MDWP	DRG No. FIGURE 6.23	REV

6.24 Coastal Unit 24 – Herm (South)

a) Attributes

Introduction

Coastal Unit 24 is located on Herm and extends from Herm Harbour (on the west coast) round the southern half of the island to Shell Bay (on the east coast, see Figure 6.24). The Rosière Steps (half-tide landing point) are located on the west coast 400m south of Herm Harbour and Belvoir Bay is on the east coast. The unit is approximately 3,300m in length.

Coastal Processes and Beach Behaviour

The southern half of Herm is dominated by a cliffed shoreline fronted by a rocky foreshore. A small and steep sandy bay (Belvoir Bay) exists on the east coast and a sandy beach is held against the Herm Harbour wall on the west coast. Offshore, a number of rock outcrops form small islets, the largest are located off the west coast and are known as Mouette and Percée.

The coastline of the unit is relatively sheltered because of the proximity of the islands of Guernsey and Sark and, to a lesser extent, the Normandy coast of France.

The rocky nature of the shoreline means that there is very limited movement of sediment around the unit. The headlands at either side of Belvoir Bay effectively trap the sandy beach within the bay. The beach is, however, susceptible to cross-shore changes during easterly storms. A small beach has developed immediately to the south of Herm Harbour as the harbour wall prevents the longshore movement of sand onto Fisherman's Beach.

Erosion of the soft upper cliffs is evident at a number of locations around the unit. In particular, the length between Herm Harbour and Rosière Steps is subject to continuing loss of the upper cliff. It is likely that this erosion is, in part, caused by the weathering action of rain, wind, sea spray and run-off from the hillside.

Coastal Defences

The unit is largely undefended. A short length of rock protection has been constructed within Belvoir Bay to protect the café and access to the beach. On the west coast between Herm Harbour and Rosière Steps, rock protection has been placed to protect the soft upper cliffs from erosion. Further erosion would threaten an access track along the cliff top between the steps and Herm Harbour. Rock has also been placed adjacent to Rosière Steps to stabilise the cliffs and protect pedestrian and vehicular access to the steps.

The defences in Belvoir Bay are in good condition and have a residual life of between 10 and 25 years. There is minor erosion of the soft headland either side of the rock protection, which could, in time, begin to outflank the defences.

The rock protection between Herm Harbour and Rosière Steps is in poor condition with a residual life of between 0 and 10 years. The protection has not stopped erosion of the soft upper cliffs, which may, in part, be a result of weathering by rain, wind, sea spray and run-off from the hillside. Elsewhere, erosion of the soft upper cliff is unlikely to threaten the coastal path in the short to medium term.

The defences are shown in Figure 6.24 at the end of this sub-section.

Land Use and Human and Built Environment

The southern half of Herm comprises rugged cliffs rising to a height of 60m. Apart from the café and holiday chalets in Belvoir Bay, there is no development. The coastal slope above the cliff face is dominated by scrub and bracken, giving way to agricultural land (pasture) towards the interior. Walking the cliff-top footpath is perhaps the most popular recreational activity within this part of the island. Belvoir Bay provides sheltered mooring for visiting yachtsmen during the summer months.

Natural Environment

The island of Herm is entirely composed of granodiorite, a coarse-grained grey igneous rock similar to the paler varieties of Guernsey's Bordeaux Diorite. Head and loess deposits, laid down during the last glacial cycle, occur at the top of some cliff sections and are prominent in Belvoir Bay. The path around the south-eastern part of the island provides spectacular views of the rugged cliffs and across the Great Russel Channel to Sark. The cliffs of this part of the island are cut by several faults that have been exploited by the sea to form deep gullies and sea caves, such as Barbara's Leap and Le Creux Pigeon.

Much of the coastal slope above the bare cliff faces is carpeted by bracken (*Pteridium aquilinum*), with some areas, mainly right at the cliff edge, supporting a typical maritime flora including thrift (*Armeria maritima*) and prostrate gorse (*Ulex europeaus*). The slightly acidic soils enable plants such as foxglove (*Digitalis purpurea*) to flourish in certain areas. The rare Dwarf rush (*Juncus capitatus*) has been recorded in the past. The crumbling rock and sandy soils towards the cliff tops provide a nesting site for the small puffin colony (about 30 individuals) that regularly breeds on the south-east coast. In addition, there are small populations of fulmar on the south-east coast, and shag, lesser black-backed gulls (*Larus fuscus*), and 10 pairs of great black-backed gulls on the offshore islets. A pair of ravens regularly breed on the south coast cliffs.

Planning Policies

Herm is owned by the States of Guernsey, but has been leased to the Wood family since 1949. It is the present owner's responsibility to manage the various interests of the island.

b) Key Interests within Unit

The following list highlights the main interests within the unit that have the potential to interact with, or be influenced by, coastal defence policies. They are:

- Rosière Steps
- café at Belvoir Bay
- coastal access track/path.

c) Appraisal of Strategic Options

Do Nothing

If nothing is done to maintain or improve the defences within the unit the following scenarios over the 50-year period covered by the strategy are envisaged:

i) In the short term, the soft cliffs between Herm Harbour and Rosière Steps would continue to erode caused by a combination of wave action and land drainage. It is likely that this would require the closure of the access track (between the harbour and the steps) for safety reasons.

ii) In the medium to long term, the access track would be lost through the continuing erosion of the soft cliffs. It is also likely that isolated lengths of the coastal path would be lost through cliff erosion. Do Nothing would lead to loss of the café and access steps to the beach at Belvoir Bay.

The Do Nothing Option would cause economic damage through the loss of the café and access steps at Belvoir Bay and lengths of coastal track/path. The option does not satisfy the objectives set out in Section 2.3.

For these reasons the option is rejected.

Do Something

From the above discussion it is evident that the Do Something option should be adopted if a viable scheme can be identified. Sustaining the defences would protect the assets in Belvoir Bay but would not prevent the erosion of the soft upper cliff. Therefore, options to both sustain and improve the defences are considered.

d) Do Something Potential Scheme Options

The reasoning described in Section 5.3.3 (Possible Defence Methods) together with the problems and issues referred to above, results in the selection of two options for appraisal.

Technical and Environmental Appraisal

Option 1 – Continue Existing Practice (Sustain)

Option 1 comprises the following elements:

- continue existing practice by limited tipping of rock into the existing rock protection
- annual inspection of the defences.

Continuing maintenance of the rock structure within Belvoir Bay would ensure the defences protect the assets over the life of the strategy. Maintenance of the rock protection on the west coast would not eliminate the erosion of the cliff and, in the short to medium term, it would be necessary to close the lower access track and rely on the upper track for access between Rosière Steps and the harbour. While this might be inconvenient with regard to access to the hotel, it is unlikely to have any detrimental impact on other environmental interests. Similarly, cliff erosion will require minor realignments of the coastal path, which could have some impact on its recreational use. Any repair works required would therefore be best undertaken during the winter months.

Option 2 – Re-profiling of Rock Protection (Improve)

Option 2 comprises the following elements:

- as Option 1
- re-profiling of the rock protection between Herm Harbour and Rosière Steps
- improve drainage to the lower access track between Herm Harbour and Rosière Steps.

There is a significant quantity of rock on the upper foreshore between Herm Harbour and Rosière Steps that could be used, in conjunction with rock obtained from elsewhere on the island, to re-profile the existing rock protection. Re-profiling would provide additional protection to the lower section of the exposed cliff face. In combination with re-profiling, drainage would be introduced into the access track to reduce the run-off over the cliff edge.

Other than the impacts identified for Option 1, this option is unlikely to have any additional detrimental impacts on the existing environmental interests.

Economic Appraisal

Benefits

Table CU241 gives the estimated value of the assets protected by the defences within CU24.

Table CU24.1 Benefits

Assets	Area/Length	Value (£)
Flooding		
Developed Land	N/A	-
Undeveloped Land	N/A	-
Erosion		
Minor Road	400m	40,000
Coast Road	N/A	-
Ribbon Development	N/A	-
	Total	**40,000**
	Discounted Total	**30,000**

Note: The following intangible benefits are not included in the above table:
- amenity value of coastal access track/path

Therefore the benefits derived for CU24 are likely to be an underestimate of the actual value.

Costs

Table CU24.2 gives the estimated value of the costs associated with Options 1and 2.

Table CU24.2 Costs

Option	Initial Capital Cost (£)	Future Costs (£)		Total Discounted Cost (£)
		Capital	Maintenance	
1	N/A	N/A	1,100/year	**19,000**
2	42,000	N/A	1,100/year	**50,000**

Results

Table CU24.3 gives the results of the economic appraisal for Options 1 and 2.

Table CU24.3 Results

Option	Benefit–Cost Ratio
1	1.6
2	0.6

e) Summary of Preferred Strategic Option

Table CU24.4 summarises the results of the appraisal process for CU24.

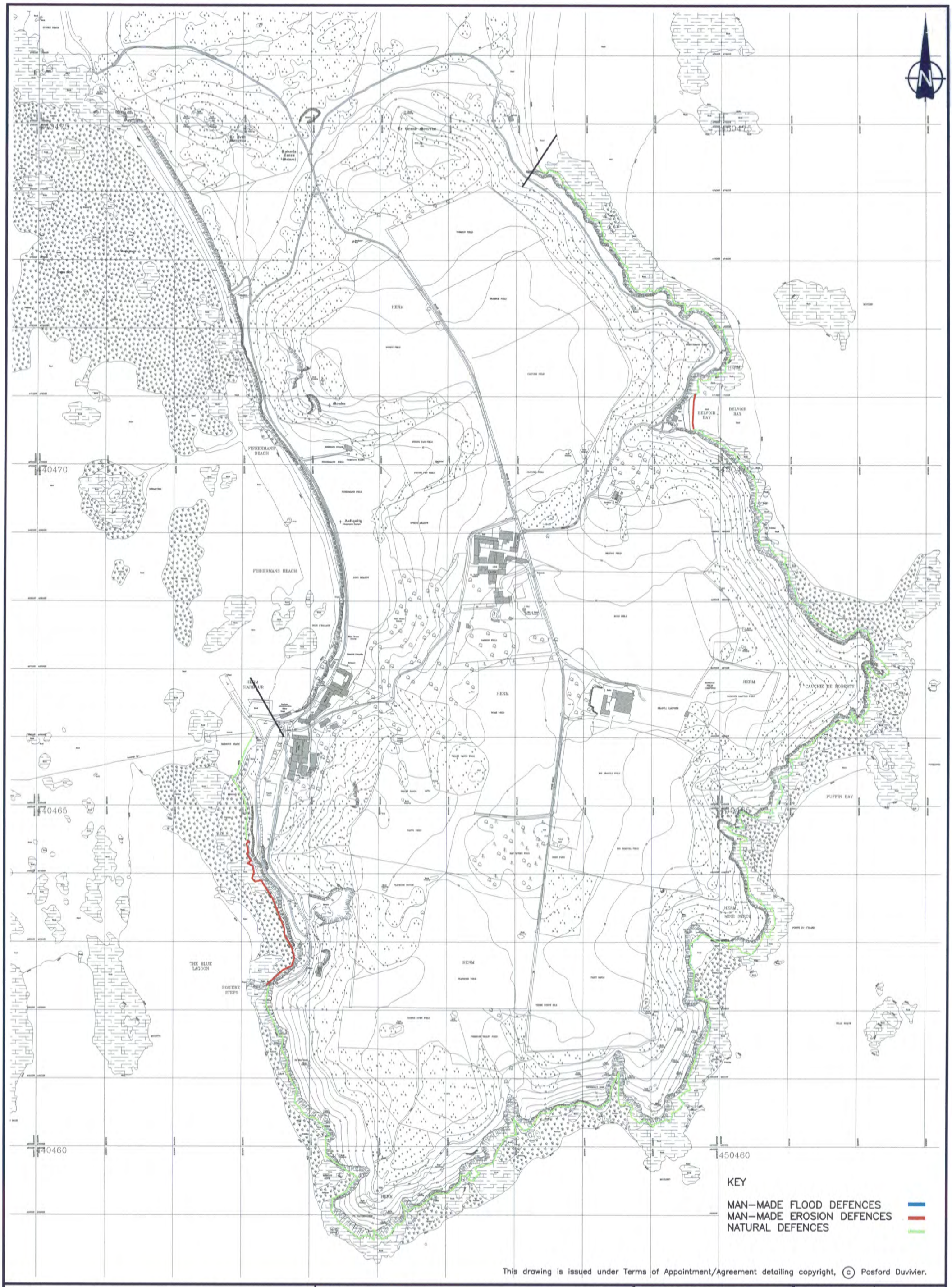
Table CU24.4 Summary of Appraisals

Option	Technical Appraisal	Environmental Appraisal	Economic Appraisal
1 • continue existing practice	• does not address problem of cliff erosion	• no significant concerns	• viable
2 • re-profiling of rock protection	• reduces erosion of cliff	• no significant concerns	• not viable

Option 1 does not address the problem of cliff erosion between Herm Harbour and Rosiere Steps. For this reason the option is rejected.

Although Option 2 is technically sound and environmentally acceptable, it is not economically viable. However, if the intangible benefit associated with the use of the access track by tourists is taken into account, it is likely that the option would be viable. On this basis, Option 2 is selected as the appropriate strategy for CU 24.

CU24



PROJECT: GUERNSEY STRATEGY FOR COASTAL DEFENCE AND BEACH MANAGEMENT	TITLE: COASTAL UNIT 24 Herm Island (South)	CONSULTING ENGINEERS: POSFORD DUVIVIER	DRAWN MDWP · SCALE 1:5,000 · DATE FEB' 99 · CHKD AJS · DRG No. FIGURE 6.24

6.25 Coastal Unit 25 – Herm (North)

a) Attributes

Introduction

Coastal Unit 25 is located on Herm and extends from Herm Harbour (on the west coast) round the northern half of the island to Shell Bay (on the east coast, see Figure 6.25). The unit is approximately 2,700m in length.

Coastal Defences and Beach Behaviour

The northern half of Herm comprises a series of sandy bays with rocky lower foreshores. On the west coast, Fisherman's Beach and The Bear's Beach are separated by a rock outcrop and a half-tide causeway leading to the small island of Hermetier. Along the north coast a small sandy beach, known as Port es Vallais, exists between rock outcrops at the north-west corner of the island and to the east is the long expanse of Mouisonniere Beach. The east coast comprises the long, straight beach known as Shell Beach, so called because of the abundance of shells found along the foreshore (washed onto the beach by the Gulf Stream current).

The north coast of the unit is exposed to large storm waves generated in the English Channel. In contrast, the west and east coasts are more sheltered by both Guernsey 5km to the west and the Normandy coast of France 40km to the east.

The relatively sheltered nature of the west coast, together with the rocky headlands, means that there is limited movement of sediment, either cross-shore or along the shore. The crest of the beaches appear to be stable with only minor erosion of the low cliffs behind the bays.

The narrow sand beach (Mouisonniere Beach) along the exposed north coast is subject to erosion resulting in the gradual retreat of the dune system. Erosion is most evident along the eastern half of the beach and a "blow out" has occurred in the dunes adjacent to the Pierre Aux Rats obelisk. The blow out coincides with a gap in the rocky foreshore, which locally allows larger waves to reach the shoreline. Attempts have been made to stabilise the dunes by the use of sand fences and marram grass planting. It is likely that sand carried down the beaches during storms is subsequently removed from the lower foreshore by the strong tidal currents. There may, however, be some longshore transport to the east onto Shell Beach.

The wide sandy beach (Shell Beach) along the east coat is stable with no evidence of erosion of the dunes. It is likely that the beach and dunes are gaining sediment from the north coast through a combination of wind and wave-driven processes.

Coastal Defences

The unit is largely undefended. A short length of masonry wall exits immediately to the north of Herm Harbour, which provides erosion protection to both the administration buildings adjacent to the harbour and an access road.

The wall is in good condition with a residual life of between 10 and 25 years. No erosion of the cliff is evident above the crest of the wall, and the beach provides adequate protection to the toe of the wall.

The masonry wall of Herm Harbour is located within the unit. This wall provides shelter to the length of defence described above.

The defences, together with the area at risk from flooding, are shown in Figure 6.25 at the end of this sub-section.

Land Use and Human and Built Environment

The northern half of Herm is largely undeveloped, apart from the area in the immediate vicinity of the harbour, comprising the White House Hotel and associated buildings. From the hotel, a track runs adjacent to the shoreline, via Fisherman's Beach, providing access to the café at Shell Beach. This is backed by improved pasture at Fisherman's Beach but, in general, semi-natural vegetation dominates around the northern coastline, particularly on Herm Common and the steeper rocky slopes. The sandy beaches of Herm Common, particularly Shell Beach on the eastern side of the island, play a significant role in the local economy, as they represent one of the key reasons for people to visit and or stay on the island.

The flat area of Herm Common has a number of Neolithic remains, including menhirs and cists. The Pierre Aux Rats obelisk, on the northern edge of Herm Common, replaces a menhir destroyed by quarrymen in the 19th century.

Natural Environment

The island of Herm is entirely composed of granodiorite, a coarse-grained grey igneous rock similar to the paler varieties of Guernsey's Bordeaux Diorite. Head deposits, laid down during the last glacial cycle, are prominent overlying the cliffs from the Rosière Steps to Fisherman's Beach. The dunes at the northern end of Herm are made up largely of blown shell sand deposited on top of the remains of the extensive "fossil" wave-cut platform, which extends to the north of the island as a series of reefs.

Shell Beach, on the north-eastern side of the island, is backed by low mobile sand dunes, strengthened in recent years by the planting of marram grass (*Ammophila arenaria*) and other stabilising plants. Further dune stabilisation measures, including the emplacement of mesh fencing have been undertaken along the northern section (Mouisonniere Beach). The blown sand forming the northern one-third of the island supports a diverse dune flora and fauna, including many of the species found on the west coast of Guernsey such as early sand grass (*Mibora minima*), dwarf pansy (*Viola kitaibeliana*) and small hare's-ear (*Buplerum baldense*). The large amounts of shell material enable plants of calcareous soils to flourish, and the flat-growing spiny white-flowered burnet rose (*Rosa pimpinellifolia*) occurs commonly at Shell Beach. The shoreline supports a number of characteristic species such as sea sandwort (*Honkenya peploides*), sea spurge (*Euphorbia paralias*), sea holly (*Eryngium maritimum*) and the rare sea dock (*Rumex rupestris*).

The intertidal areas of the north and north-west coasts, together with the agricultural pasture land, support a wintering population of about 100 dark-bellied Brent geese.

Planning Policies

Herm is owned by the States of Guernsey, but has been leased to the Wood family since 1949. It is the present owner's responsibility to manage the various interests of the island.

b) Key Interests within Unit

The following list highlights the main interests within the unit that have the potential to interact with, or be influenced by, coastal defence policies. They are:

- Herm Harbour
- administration buildings
- access road
- Shell Beach and other beaches
- archaeological and ecological interest of Herm Common.

c) Appraisal of Strategic Options

Do Nothing

If nothing is done to maintain or improve the defences within the unit the following scenarios over the 50-year period covered by the strategy are envisaged:

i) In the short term, Mouisonniere Beach would continue to erode, as a result of wave action, with the potential loss of the archaeological interest.

ii) In the medium to long term, Do Nothing would result in the structural failure of the harbour wall and the adjacent length of wall caused largely by wave action. Erosion of the cliff south of Fisherman's Beach would lead to the loss of the administration buildings and the access road.

The Do Nothing option would cause economic damage through the loss of the administration buildings and the access road. The option does not satisfy the objectives set out in Section 2.3.

For these reasons the option is rejected.

Do Something

From the above discussion it is evident that the Do Something option should be adopted if a viable scheme can be identified. Sustaining the defences at their present standard would prevent the deterioration of the harbour wall and adjacent seawall. The rate of erosion of the dunes along Mouisonniere Beach could be reduced through undertaking further dune management measures such as those already adopted. The construction of hard defences to stabilise the dune frontage, from a coastal defence perspective, is not required and should be avoided to enable the processes of natural ecological succession to take place.

d) Do Something Potential Scheme Options

The reasoning described in Section 5.3.3 (Possible Defence Methods) together with the problems and issues referred to above, results in the selection of one option for appraisal.

Technical and Environmental Appraisal

Option 1 – Continue Existing Practice (Sustain)

Option 1 comprises the following elements:

- continue existing practice by regular re-pointing of the masonry structures
- management of the dunes along Mouisonniere Beach
- annual inspection of the defences.

Continuing maintenance of the harbour wall and adjacent length of wall would ensure the integrity of these structures over the life of the strategy. The option would, therefore, provide protection to the buildings and the access road.

It should be accepted that further erosion of the dune frontage along the northern edge of Herm Common will occur. This has benefits associated with maintaining a sediment supply to Shell Beach and providing additional habitat diversity. The rate of erosion could be reduced by continuing the existing dune management measures already in place. However, there could be some loss of archaeological interest as the erosion of largely unconsolidated sediments continues. This is particularly the case in the Pierre Aux Rats area, where there are the remains of a Neolithic menhir. Periodic monitoring of the area for any evidence of archaeological artefacts or structures should be carried out. If significant finds are made, then excavation should be undertaken. Temporary protection may need to be provided to prevent the erosion of any significant finds while any excavation takes place.

Economic Appraisal

Benefits

Table CU25.1 gives the estimated value of the assets protected by the defences within CU25.

Table CU25.1 Benefits

Assets	Area/Length	Value (£)
Flooding		
Developed Land	N/A	-
Undeveloped Land	17.5ha	324,000
Erosion		
Minor Road	N/A	-
Coast Road	N/A	-
Ribbon Development	55m	179,000
	Total	**503,000**
	Discounted Total	**210,000**

Notes: The following intangible benefits are not included in the above table:
- Herm Harbour
- access road
- Shell Beach and other beaches
- archaeological and ecological interest of Herm Common.

Therefore the benefits derived for CU24 are likely to be an underestimate of the actual value

Costs

Table CU25.2 gives the estimated value of the costs associated with Option 1.

Table CU25.2 Costs

Option	Initial Capital Cost (£)	Future Costs (£)		Total Discounted Cost (£)
		Capital	Maintenance	
1	3,600	N/A	250/year	**6,000**

Results

Table CU25.3 gives the results of the economic appraisal for Option 1.

Table CU25.3 Results

Option	Benefit–Cost Ratio
1	35

e) Summary of Preferred Strategic Option

Table CU25.4 summarises the results of the appraisal process for CU25.

Table CU25.4 Summary of Appraisals

Option	Technical Appraisal	Environmental Appraisal	Economic Appraisal
1 • continue existing practice	• ensures integrity of defences	• no significant concerns	• viable

Option 1 is technically sound, environmentally acceptable and economically viable and is, therefore, selected as the appropriate strategy for CU25.

CU25

KEY

MAN–MADE FLOOD DEFENCES
MAN–MADE EROSION DEFENCES
NATURAL DEFENCES
FLOOD AREA

LA POINTE DU GENTILHOMME
HERM
MOULIN NIERE BEACH
HERM
Antiquity
Roberts Grave
HERM
HERM
Menhir
FISHERMANS BEACH
Antiquity
FISHERMANS BEACH
HERM HARBOUR
HERM
HERM
BELVOIR BAY
BELVOIR BAY
HERM
CAUCHIE DE ROBERTS
140470
140475
140480
140425
140420

PROJECT: GUERNSEY STRATEGY FOR COASTAL DEFENCE AND BEACH MANAGEMENT	TITLE: COASTAL UNIT 25 Herm Island (North)	CONSULTING ENGINEERS: POSFORD DUVIVIER	DRAWN MDWP · SCALE 1:5,000 · DATE FEB' 99 · CHKD AJS · DRG No. FIGURE 6.25

SECTION 7

SUMMARY OF APPRAISAL

7.1 Summary

The appraisal process described in Section 6 has identified (where possible) long-term strategies for coastal defence and beach management within the 25 coastal units around the islands of Guernsey and Herm.

The outcome of the appraisal is the selection of a preferred strategy option for each unit and the identification of an appropriate scheme option (including monitoring and studies) to enable the strategy to be implemented. Within a number of units, either an interim strategy or a review of the strategy after five years is proposed. This applies to the units where there is insufficient data upon which to determine the appropriate long-term strategy. Such "holding" strategies are intended to allow time for monitoring and further studies to take place before the adoption of a long-term strategy is implemented.

A summary of the results from the appraisal is provided in Table 7.1 under the following headings:

- coastal unit
- strategy option
- scheme option
- scope of works
- proposed monitoring
- proposed studies.

Table 7.1 Summary of Appraisal

No.	Coastal Unit Name	Strategy Option	Scheme Option	Scope of Works	Proposed Monitoring	Proposed Studies
1	Pezeries Point to Imperial Hotel	Do Something (Sustain)	Continue existing practice	• Ongoing maintenance	• Annual inspection of defences • Five-yearly inspection of cliffs	—
2	Imperial Hotel to Fort Grey (Rocquaine Bay)	Do Something (Sustain)	Continue existing practice	• Ongoing maintenance	• Summer and winter surveys of beaches • Annual inspection of defences	• Study into beach behaviour • Decide on long-term strategy after five years' monitoring
3	Fort Grey to L'Erée Headland (Rocquaine Bay)	Do Something (Interim : Sustain Long term : Improve)	Continue existing practice and minor works pending selection of long-term option	• Minor toe protection • Ongoing maintenance pending selection of long-term option	• Summer and winter surveys of beaches • Annual inspection of defences	• Study into beach behaviour • Decide on long-term strategy after five years' monitoring
4	L'Erée Headland and Lihou Island (Lihou Island)	Do Something (Improve)	Excavation and/or protection of archaeological resource	• Excavation/protection of archaeological resource • Ongoing maintenance	• Annual inspection of defences	• Decide on approach for dealing with archaeological resource
5	Fort Saumarez to Le Catioroc	Do Something (Improve)	Continue existing practice pending selection of long-term option	• Ongoing maintenance pending selection of long-term option	• Annual inspection of defences	• Detailed study to confirm environmental viability of inland flood bank • Select scheme option on completion of study • Review strategy after five years
6	Le Catioroc to Fort Richmond (Perelle Bay)	Do Something (Improve)	Beach nourishment	• Beach nourishment • Ongoing maintenance	• Annual inspection of defences • Regular surveys of newly nourished beach	• Detailed study of beach nourishment option (including environmental issues)

No.	Coastal Unit Name	Strategy Option	Scheme Option	Scope of Works	Proposed Monitoring	Proposed Studies
7	Fort Richmond to Fort Le Crocq	Do Nothing	—	—	—	—
8	Fort Le Crocq to Fort Hommet (Vazon Bay)	Do Something (Interim : Sustain Long term : Improve)	Continue existing practice and minor works pending selection of long-term option	• Minor toe protection • Ongoing maintenance pending selection of long-term option	• Summer and winter surveys of beaches • Annual inspection of defences	• Study into beach behaviour • Decide on long-term strategy after five years' monitoring
9	Fort Hommet to Le Guet (Albecq)	Do Something (Sustain)	Continue existing practice	• Ongoing maintenance	• Annual inspection of defences • Periodic inspection of archaeological interest	—
10	Le Guet to Grandes Rocques (Cobo and Saline Bays)	Do Something (Interim : Sustain long term : Improve)	Continue existing practice and minor works pending selection of long-term option	• Minor toe protection • Repair work as necessary after storms • Ongoing maintenance pending selection of long-term option	• Summer and winter surveys of beaches • Annual inspection of defences	• Study into beach behaviour • Decide on long-term strategy after five years' monitoring
11	Grande Rocques to Rousse (Port Soif and Portinfer)	Do Something (Sustain)	Continue existing practice	• Ongoing maintenance	• Annual inspection of defences • Periodic inspection of archaeological interest	—
12	Rousse to Chouet (Le Grande Havre and Ladies Bay)	Do Something (Interim : Sustain) (Long term : Improve)	Continue existing practice pending selection of long-term option	• Ongoing maintenance pending selection of long-term option	• Annual inspection of defences • Periodic inspection of archaeological interest	• Detailed study to confirm environmental viability of selective removal of rock protection • Review scheme option on completion of study

No.	Coastal Unit Name	Strategy Option	Scheme Option	Scope of Works	Proposed Monitoring	Proposed Studies
13	Chouet to Fort Pembroke	Do Something (Sustain)	Continue existing practice	• Ongoing maintenance	• Annual inspection of defences • Periodic inspection of archaeological interest	—
14	Fort Pembroke to L'Ancresse (Pembroke and L'Ancresse Bays)	Emergency works pending selection of strategy	See strategy option	• See strategy option	• Regular inspections of defences pending selection of strategy	• Detailed study to refine and reassess the viability of abandoning the defences • Decide on long-term strategy on completion of study
15	L'Ancresse to Fort Doyle (L'Ancresse and Fontenelle Bays)	Do Nothing	—	—	• Periodic inspection of archaeological interest	—
16	Fort Doyle to Bordeaux	Do Something (Sustain)	Continue existing practice	• Ongoing maintenance	• Annual inspection of defences • Periodic inspection of archaeological interest	—
17	Bordeaux to Vale Castle (Bordeaux Harbour)	Do Something (Sustain)	Continue existing practice and minor works	• Minor repairs and works • Ongoing maintenance	• Annual inspection of defences	—
18	Vale Castle to Spur Point (St Sampson)	Do Something (Sustain)	Continue existing practice	• Ongoing maintenance	• Annual inspection of defences	—
19	Spur Point to La Salerie (Belle Greve Bay)	Do Something (Interim : Sustain Long term : Improve)	Continue existing practice and minor works pending selection of long-term option	• Minor toe protection • Repairs to sheet piles • Ongoing maintenance	• Summer and winter surveys of beaches • Annual inspection of defences	• Study of beach behaviour • Decide on long-term strategy after five years' monitoring
20	La Salerie to La Vallette (St Peter Port)	Do Something (Improve)	Raise seawall	• Raise seawall • Ongoing maintenance	• Annual inspection of defences	• Consultation with local interests over seawall raising

No.	Coastal Unit Name	Strategy Option	Scheme Option	Scope of Works	Proposed Monitoring	Proposed Studies
21	La Vallette to St Martin's Point (Soldiers and Fermain Bays)	Do Something (Sustain)	Continue existing practice	• Ongoing maintenance	• Annual inspection of defences	—
22	St Martin's Point to Le Gouffre (Moulin Huet, Saint's and Petit Bôt Bays)	Do Something (Sustain)	Continue existing practice	• Ongoing maintenance	• Annual inspection of defences	—
23	Le Gouffre to Pezeries Point	Do Nothing	—	—	—	—
24	Herm – South (Belvoir Bay)	Do Something (Improve)	Re-profiling of rock protection	• Re-profiling of rock protection • Improve drainage to track • Ongoing maintenance	• Annual inspection of defences	—
25	Herm – North (Herm Harbour)	Do Something (Sustain)	Continue existing practice	• Management of dunes along Mouisonniere Beach • Ongoing maintenance	• Annual inspection of defences	—

SECTION 8

RECOMMENDATIONS

8.1 Introduction

The study has determined a strategy for the future management of the coastal defences and beaches around the islands of Guernsey and Herm.

The strategies proposed for the 25 coastal units around the islands are explained in detail within Section 6, and are summarised in Section 7.

The purpose of this section is to set out a tentative programme for undertaking the monitoring, studies and coastal defence work required to implement these strategies. The programme concentrates on tasks that should be undertaken over the next five years.

8.2 Recommended Programme for Implementation of Strategy

A tentative programme for the implementation of the strategy over the next five years is set out below. The programme takes into consideration the urgency of the work, the time required to plan the works and the (likely) need to spread expenditure over the next five to 10 years.

a) Immediate Actions

Monitoring

- Commence and continue regular (recommended monthly) inspections of defences in Unit 14 (Fort Pembroke to L'Ancresse) until a long-term strategy is determined.

- Commence and continue a programme of summer and winter beach surveys within the following units:
  - Unit 2 (Imperial Hotel to Fort Grey)
  - Unit 3 (Fort Grey to L'Erée Headland)
  - Unit 8 (Fort Le Crocq to Fort Hommet)
  - Unit 10 (Le Guet to Grandes Rocques)
  - Unit 19 (Spur Point to La Salerie).

- Commence and continue a programme of annual inspections of the defences within all units. A good basis for this ongoing programme is the inspection undertaken as part of this study. (Although annual inspections are not specifically proposed for the units where Do Nothing is the preferred option, i.e. Units 7, 15 and 23, they are recommended.)

- Commence and continue a programme of five-yearly inspections of the cliffs in Unit 1 (Pezeries Point to Imperial Hotel).

Studies

- Undertake a short study to decide on approach for protecting the archaeological resource within Unit 4 (L'Erée Headland and Lihou Island).

- Undertake a detailed study investigate the environmental viability of the inland flood bank scheme within Unit 5 (Fort Saumarez to Le Catioroc), and select the preferred scheme option for the unit.

- Undertake a study of the proposed beach nourishment scheme (to include consideration of the environmental issues) within Unit 6 (Le Catioroc to Fort Richmond).

- Undertake a detailed study to refine and reassess the viability of abandoning the defences in Unit 14 (Fort Pembroke to L'Ancresse).

Works

- Undertake ongoing maintenance within each unit. (With the exception of those units where Do Nothing is the preferred option, i.e. Units 7, 15 and 23.)

- Undertake emergency works as required to maintain the defences in Unit 14 (Fort Pembroke to L'Ancresse), pending the selection of a long-term strategy.

b) Within Three Years

Monitoring

- Undertake an inspection of the archaeological interest within the following units:
  - Unit 9 (Fort Hommet to Le Guet)
  - Unit 11 (Grandes Rocques to Rousse)
  - Unit 12 (Rousse to Chouet)
  - Unit 13 (Chouet to Fort Pembroke)
  - Unit 15 (L'Ancresse to Fort Doyle)
  - Unit 16 (Fort Doyle to Bordeaux).

- Commence and continue a regular programme (initially six-monthly) of summer and winter beach surveys of newly nourished beaches within the following units:
  - Unit 5 (Fort Saumarez to Le Catioroc)
  - Unit 6 (Le Catioroc to Fort Richmond).

Studies

- Undertake a detailed study to confirm the environmental viability of the selective removal of rock protection in Unit 12 (Rousse to Chouet), and select the preferred strategy at the completion of the study.

- Undertake consultation with local interests over seawall raising in Unit 20 (La Salerie to La Vallette).

Works

- Undertake minor toe protection within the following units:
  - Unit 3 (Fort Grey to L'Erée Headland)
  - Unit 8 (Fort Le Crocq to Fort Hommet)
  - Unit 10 (Le Guet to Grandes Rocques).

- Undertake works to protect archaeological resource (and/or undertake excavation) in Unit 4 (L'Erée Headland and Lihou Island).

- Undertake construction of an inland flood bank (subject to the findings of the immediate studies recommended above) within Unit 5 (Fort Saumarez to Le Catioroc).

- Undertake beach nourishment (subject to the findings of the immediate studies recommended above) within Unit 6 (Le Catioroc to Fort Richmond).

- Undertake minor toe protection and repairs to sheet piling in Unit 19 (Spur Point to La Salerie).

- Commence management of the dunes along Mouisonniere Beach in Unit 25 (Herm – North).

c) After Five Years

Studies

- Undertake studies into beach behaviour, including estimating the future trends of beach movement, and review the strategy within the following units:
  - Unit 2 (Imperial Hotel to Fort Grey)
  - Unit 3 (Fort Grey to L'Erée Headland)
  - Unit 5 (Fort Saumarez to Le Catioroc)
  - Unit 8 (Fort Le Crocq to Fort Hommet)
  - Unit 10 (Le Guet to Grandes Rocques)
  - Unit 19 (Spur Point to La Salerie).

Works (within Five Years)

- Undertake seawall raising with Unit 20 (La Salerie to La Vallette).

- Undertake re-profiling of rock protection and improve drainage to access track in Unit 24 (Herm – South).

d) Beyond Five Years

The review of the strategies undertaken after five years within Units 2, 3, 5, 8, 10 and 19 will identify any further studies and works required within these units. A programme for the undertaking of these tasks should be established as part of the (next) five-year review.

LIST OF ABBREVIATIONS AND GLOSSARY

1.0 LIST OF ABBREVIATIONS

CD	Chart Datum (in Guernsey, 5.06m below local OD)
CU	Coastal Unit
DU	Defence Unit
EC	European Community
EU	European Union
HAT	Highest Astronomical Tide
LAT	Lowest Astronomical Tide
MHWN	Mean High Water Neaps
MHWS	Mean High Water Springs
MLWN	Mean Low Water Neaps
MLWS	Mean Low Water Springs
MHW	Mean High Water
NT	National Trust
OD	Ordnance Datum
PD	Posford Duvivier
PV	Present Value
SNCI	Site of Nature Conservation Importance
UK	United Knigdom

2.0 GLOSSARY

Accretion The accumulation of (beach) sediment by natural processes.

Aggregates Sand and gravel, crushed rock and other bulk materials used in the construction industry for purposes such as the making of concrete, mortar and asphalt.

Apron A layer of stone, concrete or other material to protect the toe of a seawall.

Astronomical Tide The tidal levels and flows that would result from gravitational effects, e.g. of the Earth, Sun and Moon, without any meteorological influences.

Backshore The area above normal maximum high water level, that is nevertheless affected by coastal processes.

Bathymetry The spatial variability (topography) of seabed levels, often described in terms of depth below Chart Datum.

Beach Crest The point representing the limit of high tide storm wave run-up.

Beach Management Management of a beach as a coastal defence with a pre-determined standard of protection, using combinations of beach recharge, recycling, re-profiling, beach control structures and a programme of monitoring.

Beach Nourishment The importation of material to supplement the existing natural sediment volume on a beach, also known as beach recharge. Material may be from either quarries or, more commonly, licensed offshore dredging sites.

Beach Plan Shape	The shape of the beach in plan; usually shown as a contour line, or a combination of contour lines or recognisable features such as beach crest and/or still water line.
Beach Profile	A cross-section taken perpendicular to a given beach contour; the profile may include the face of a dune or seawall, extend over the backshore, across the foreshore, and seaward underwater into the nearshore zone.
Breaching	Failure of the defences allowing flooding by tidal action.
Chart Datum	The level to which both tide levels and water depths are reduced on marine charts. On UK charts, this level approximates to the predicted LAT level.
Coastal Defence	General term used to encompass both coast protection against erosion and sea defence against flooding.
Coastal Processes	Collective term covering the action of natural forces on the shoreline and nearshore seabed.
Coastal Squeeze	The process under which coastal habitats and natural features progressively are lost or drowned, by being caught between coastal defences and rising sea levels.
Coastal Unit	Defined as a length of coastline with coherent properties in terms of both coastal processes and land use.
Cross-Shore	Perpendicular to the shoreline.
Cross-Shore Transport	The movement of (beach) sediments approximately normal (at right angles) to the shoreline.
Defence Line	The crest of a seawall/revetment (man-made defences) or the crest of dunes or the cliff edge (natural defences).
Depth-Limited	Situation in which wave generation (or wave height) is limited by water depth.
Detached Breakwaters	Coastal structures lying parallel but not connected to the shore. They are generally constructed from imported rock or concrete units placed on the seabed.
Diffraction	Process affecting wave propagation, by which wave energy is radiated normal to the direction of wave propagation in to the lee of an island or breakwater.
Diurnal	Literally "of the day" but here meaning having a period of a "tidal day", i.e. about 24.8 hours.
Do Nothing	This option would involve no coastal defence activity apart from monitoring/inspection, and any works needed for safety reasons, within a particular coastal unit.
Do Something	This option would involve, by intervention, the provision of coastal defences within a coastal unit. The term "intervention" implies a commitment to provide a level of protection to the assets behind the coastal unit from flooding and coastal erosion, it does not imply the wholesale construction of new defences.

Downdrift	The direction of the predominant longshore movement of beach material.
Dunes	Wind-blown sand deposits, often vegetated.
Ebb	A period when the tidal level is falling. Often taken to mean the ebb current that occurs during this period.
Embankment	An earth bank raised above a low-lying hinterland area to prevent flooding.
Erosion	The process of wearing away, and the subsequent transport of, a material by the action of natural forces.
Erosion Defence	A strucure or scheme designed to prevent erosion of the coastline.
Fauna	Animals.
Fetch-limited	Situation in which wave energy (or wave height) is limited by the size of the wave generation area.
Fetch	Distance over which a wind acts to produce waves, also termed fetch length.
Flood Defence	A structure or scheme designed to limit the risk of flooding in coastal regions, by the sea under extreme wind and tidal conditions.
Flora	Plants.
Freeboard	The height of the crest of a structure above the still water level.
Geomorphology	The study of landforms and landforming processes.
Groynes	Cross-shore coastal structures connected to the shore, designed to reduce longshore transport by causing beach reorientation. They may be constructed from timber, concrete, steel sheet piles or rock.
Hard Defences	Defences that tend to confront and resist the natural coastal processes, e.g. seawalls.
Highest Astronomical Tide	The highest level that can be predicted to occur under average meteorological conditions and under any combination of astronomical conditions.
Hougue	A rocky hillock.
Intertidal Zone or Foreshore	The area between LAT and HAT.
Isthmus	A narrow piece of land connecting two larger pieces of land.
Longshore	Parallel and close to the coastline.
Longshore Transport/Drift	The movement of (beach) sediments approximately parallel to the foreshore as a result of waves and/or currents approaching at an oblique angle to the shoreline. Also known as longshore drift.

Lowest Astronomical Tide	The lowest level that can be predicted to occur under average meteorological conditions and under any combination of astronomical conditions.
Mare	Originally, a lagoon situated in low-lying flat land between bays/escarpments, which often become marshy with the passage of time.
Neap Tides	Tides of small range that occur twice a month (when the moon is in quadrature).
Nearshore	Area over which seabed transport can be caused by storm waves, including the intertidal zone.
Offshore	Area seaward of nearshore zone where seabed transport is not normally driven by waves.
Ordnance Datum	Standard reference level used by the Ordnance Survey for land surveys in the UK. Usually based on mean sea level at Newlyn, Cornwall, although Guernsey and Herm have a local datum.
Overtopping	Water carried over the top of a coastal defence owing to wave run-up exceeding the crest height.
Refraction	The process by which the direction of a wave moving in shallow water at an angle to the contours is changed so that the wave crests tend to become more aligned with those contours.
Residual Life	The number of years the defence is estimated to last before its integrity is compromised as a result of progressive deterioration, if no maintenance or repairs are undertaken.
Return Period	Average time period between occurrences of a given event.
Revetment	General term for sloping, often permeable structures, providing flood or erosion protection to the backshore. May be constructed from rock, concrete or other material. Often a layer (or layers) used to protect the sloping face of an embankment, natural coast or shoreline.
Rock Protection	A simple revetment comprising one layer of rock (i.e. no filter or secondary layers), freguently used around Guernsey to reduce erosion at headlands.
Sea Level Rise	The long-term upward trend in mean sea level resulting from a combination of local or regional geological movements and global climate change.
Seawalls	General term for vertical or near-vertical impermeable structures built parallel to the shoreline and providing flood or erosion protection to the backshore.
Sediment Cell	A length of coastline that is relatively self contained as far as the movement of sand or shingle is concerned.
Sediment Processes	The phrase "sediment processes" is taken to include the following characteristics: coastal geomorphology, longshore transport of sediment, and sediment sources and sinks. This results in two broad types of sediment

	process unit within the current strategy, i.e. bays and cliffs.
Sediment Sink	Point or area at which beach material is irretrievably lost from a coastal cell, such as an estuary or a deep channel in the seabed.
Sediment Source	Point or area on a coast from which beach material arises, such as an eroding cliff, or river mouth.
Semi-Diurnal	In this report, meaning having a period of half a "tidal day", i.e. about 12.4 hours.
Shingle Ridge/Bank	An upper beach feature with a low-lying backshore subject to flooding.
Shoreline	The interface between the land and the sea.
Significant Wave Height	The average of the highest one third of the waves during a given event or time period.
Site of Nature Conservation Importance	A non-statutory designation covering sites that have a significant wildlife value.
Soft Defences	Defences designed to work with rather than against the natural coastal processes. They tend to absorb rather than reflect wave energy and to be dynamic rather than static, e.g. beach nourishment.
Spring Tides	Tides of large range that occur twice a month (when the moon is new or full).
Standard of Defence	The adequacy of defence measured in terms of high, medium or low standard. May also be measured in terms of the return period (years) of the event that causes a critical condition to be reached.
Surges	Changes in water levels as a result of meteorological forcing, e.g. wind, high or low bathymetric pressure, causing a difference between the recorded water level and that predicted using harmonic analysis; may be positive or negative.
Tidal Current	The movement of water associated with the rise and fall of the tides.
Tidal Range	The vertical difference between high and low water levels.
Tide	The periodic rise and fall in the level of the water in oceans and seas, the result of gravitational attraction of the sun and the moon.
Updrift	The direction opposite to that of the predominant longshore movement of beach material.
Wave Climate	The seasonal or annual distribution of wave height, period and direction.

Ref.	Document Title	Report Number	Author	Report Date	Source	Document Type	Subject	Comments
1	A Brief Guide to Lihou Island		Robin Borwick	1986	GTB	Booklet	Visitor Guide	Historic information on Lihou Island
2	An Introduction to the Bailiwick of Guernsey		GTB		GTB	Booklet	Visitor Guide	Historic information on Guernsey
3	Baseline Study for use in the Development of a Biodiversity Strategy for Guernsey		UCL	1996	SOG	Report	Biodiversity Data	Report identifying the principal factors that affect biodiversity within Guernsey
4	Billet D'Etat. 1998 Policy & Resource Planning Report		SOG	Jul-98	SOG	Report	Economics	
5	Channel Islands			1994	Microsoft (R) Encarta	Text	Channel Islands	
6	Coast Defence - Repairs to Sea Walls 1946-		SOG	Jan-97	SOG	Report	Coastal Defences	Provides a history of seawall repairs carried out since 1946 and gives some background as to how they failed
7	Cobo Defences	6050/38	SOG	Apr-62	SOG	Drawing	Coastal Defences	Rebuilding of sea wall, detailing elevations of seawall
8	Cobo Defences	6050/42	SOG	Jun-63	SOG	Drawing	Coastal Defences	Cobo Coast Road seawall elevations and beach levels
9	Cobo Defences	6050/72	SOG	Dec-76	SOG	Drawing	Coastal Defences	Reinforcement details for Cobo seawall
10	Contract for the construction of a sea wall at Fermain Bay		SOG	Jun-95	SOG	Report	Contract	Contract document including Notice for Tenderers, Form of Tender, Specification, Bill of Quantities and Schedules
11	Contract for the Construction of Rubble Mound Breakwaters		SOG	Sep-90	SOG	Report	Contract	Contract document including Notice for Tenderers, Form of Tender, Specification, Bill of Quantities, along with Appendices giving wind data and water levels
12	Euro-Holiday Map 1:50,000 - Channel Islands		Geocenter	1997	PD Library	Map	Visitor Map	Holiday map detailing places of interest
13	Fermain Defences	6507/40	SOG	Jun-95	SOG	Drawing	Coastal Defences	General arrangement of proposed seawall with contoured plan, longitudinal section and typical cross-sections
14	Fermain Defences	6507/41	SOG	Jun-95	SOG	Drawing	Coastal Defences	Proposed seawall slipway details
15	Guernsey Airport Meteorological Office Climatological Report 1997		Met. Office	1997	SOG	Report	Climatological Report	Extensive report on weather conditions for 1997
16	Guernsey Coastal Walks & Nature Trails		Perry's	1998	GTB	Booklet	Visitor Guide	Visitor guide providing description of coastline
17	Guernsey, Alderney, Herm & Sark		GTB	1988	GTB	Booklet	Visitor Guide	
18	Guernsey's Coastal Defence Towers		Fortress Guernsey	1998	GTB	Leaflet	Visitor Guide	
19	Guernsey's German Fortifications		Fortress Guernsey	1998	GTB	Leaflet	Visitor Guide	Visitor guide providing some historic information
20	Guernsey's Historic Fortifications		Fortress Guernsey	1998	GTB	Leaflet	Visitor Guide	
21	Harbours and Coast Defences - Effect of Global Warming		SOG	Jul-91	SOG	Report	Global Warming	Comments on the effects of global warming
22	Heritage Guernsey		SOG	1998	GTB	Leaflet	Visitor Guide	
23	Herm Island - Paradise is close		Travel Trident	1998	GTB	Leaflet	Travel Details	
24	Herm Island Channel Islands		Tenant of Herm		GTB	Map	Island Map	12in to 1mile scale contoured map of Herm with a brief history and details of its legal dispositions

Ref.	Document Title	Report Number	Author	Report Date	Source	Document Type	Subject	Comments
25	Information on the Pleistocene & its archaeology in the Channel Islands		John Renouf	1983	IGS	Report	Geological Data	Notes on the general geology of the Channel Islands during the Upper Pleistocene
26	La Banque Imbert Defences	6676	SOG	Jun-48	SOG	Drawing	Coastal Defences	Extension of sea wall general arrangement with plan, longitudinal section, cross-sections and elevations
27	Le Vivier Seawall, Rocquaine Bay, Guernsey Model Studies for Proposed Rock Armouring	EX 1670	HR Wallingford	Jan-88	SOG	Report	Seawall	Report on previous modelling work carried out by HR giving details of modelled wave climate and overtopping results
28	Les Banques Defences	6009/40	SOG	Dec-53	SOG	Drawing	Coastal Defences	Red Lion Outfall – Site plan and details of new seawall
29	Les Banques Defences	6009/86	SOG	Sep-67	SOG	Drawing	Coastal Defences	Capping to steel sheet piling details
30	Les Banques Defences	6009/84a	SOG	Oct-66	SOG	Drawing	Coastal Defences	Concrete underpinning and toe to seawall with section showing beach levels
31	Map of Guernsey Bus Routes		SOG	Summer 1998	GTB	Map	Bus Routes	
32	More of Peter Girard's Guernsey		Peter Girard		GTB	Booklet	Visitor Guide	Brief history of the sand along the coastline of Guernsey
33	OS Map of Guernsey		OS	1986	GTB	Map	OS Map	1:25,000 scale OS map of Guernsey detailing glasshouses and roofed buildings
34	Outline and Guide to the Geology of Guernsey		R A Roach		SOG	Report	Geology	
35	Pathfinder Route Map & Town Plan of Guernsey		Perry's	1998	GTB	Map	Route Map	
36	Pathfinder Visitor Guide		Perry's	1998	GTB	Booklet	Visitor Guide	
37	Pembroke Defences	6638/20	SOG	Feb-84	SOG	Drawing	Coastal Defences	Protection to sea wall giving details of proposed apron and capping beam
38	Pembroke Defences	6638/21	SOG	Mar-84	SOG	Drawing	Coastal Defences	Protection of sea wall giving reinforcement details of proposed apron and capping beam
39	Perelle Defences	6443/6	SOG	June 1886	SOG	Drawing	Coastal Defences	Cross-section of seawall at Perelle Bay
40	Pocket Guide to Guernsey, Alderney, Herm, Sark		Apache	1996	GTB	Booklet	Visitor Guide	
41	Rocquaine Defences	6459/75	SOG	Mar-65	SOG	Drawing	Coastal Defences	Reconstruction of collapsed wall details with typical section through the seawall
42	Rocquaine Defences	6459/68	SOG	Feb-65	SOG	Drawing	Coastal Defences	Section of seawall with spot heights of beach levels and seawall elevations
43	Rocquaine Defences	6815/4	SOG	Jan-73	SOG	Drawing	Coastal Defences	Plan and details of trial holes, seawall elevations with edge beam and wing wall reinforcement details
44	Rocquaine Defences	6459/135	SOG	Jun-80	SOG	Drawing	Coastal Defences	General arrangement of proposed masonry apron and concrete capping
45	Rocquaine Defences	6459/123	SOG	Jun-76	SOG	Drawing	Coastal Defences	General arrangement with plan, elevation and typical sections for masonry apron at Brock Battery
46	Rocquaine Defences	6459/103	SOG	Sep-67	SOG	Drawing	Coastal Defences	Details of toe Reinforcement
47	Rocquaine Defences	6459/110	SOG	Aug-68	SOG	Drawing	Coastal Defences	Borehole details for L'Erée seawall
48	Rocquaine Defences	6459/111	SOG	Aug-68	SOG	Drawing	Coastal Defences	Reinforcement details for L'Erée seawall
49	Rue de la Rocque Defences	6654/50	SOG	Aug-98	SOG	Drawing	Coastal Defences	Survey of shingle bank and surrounding coastline
50	Rue de la Rocque Defences	6616/8	SOG	Sep-62	SOG	Drawing	Coastal Defences	Reinforcement details of proposed seawall
51	Rue de la Rocque Defences	6616/9	SOG	Sep-62	SOG	Drawing	Coastal Defences	Cross-section and elevation of proposed seawall
52	Rue de la Rocque Defences	6616/14	SOG	Jun-68	SOG	Drawing	Coastal Defences	Plan and cross-sections for repairs to seawall
53	Rue de la Rocque Defences	6616/18	SOG	Aug-80	SOG	Drawing	Coastal Defences	Layout and typical cross-sections of proposed protective apron
54	Rue de la Rocque Defences	6616/19a	SOG	Aug-80	SOG	Drawing	Coastal Defences	Elevations of proposed and existing aprons
55	Rural Area Plan (Phase 1)		SOG	Oct-94	SOG	Report	Strategic Plan	
56	Rural Area Plan (Phase 2)		SOG	Jul-97	SOG	Report	Strategic Plan	

Ref.	Document Title	Report Number	Author	Report Date	Source	Document Type	Subject	Comments
57	St Sampson Harbour, Guernsey. Wave Recording	EX 2149	HR Wallingford	May-90	SOG	Report	Wave Records	An analysis of wave data to predict extreme events within St. Sampson Harbour
58	The Channel Islands during the Neolithic sea level changes and patterns of exploitation		J. Renouf and J. Urry	1983	IGS	Report	Geological Data	Geological paper describing a proposed model for the initial settlement and subsequent development of the Channel Islands
59	The Holocene Deposits of the Channel Islands	Report 81/10	D.H. Keen	1981	IGS	Report	Geological Data	Report on the general geology of the Channel Islands
60	The Pleistocene Deposits of the Channel Islands	Report 78/26	D.H. Keen	1978	IGS	Report	Geological Data	Report on the general geology of the Channel Islands
61	The Rocks & Scenery of Guernsey		de Pomerai & Robinson	1994	GTB	Booklet	Geology	
62	The Story of the Guernsey Flag		GTB	1998	GTB	Leaflet	Visitor Guide	
63	The Sustainable Management of the Guernsey Coastline		Heritage Coast Forum	Sep-94	SOG	Report	Coastline	Report by Heritage Coast Forum providing recommendations for the sustainable management with regard to issues such as landscape, wildlife habitats, tourism and fisheries
64	Urban Area Plan		SOG	Feb-95	SOG	Report	Strategic Plan	
65	Vazon Defences	6618/108a	SOG	Jan-85	SOG	Drawing	Coastal Defences	General arrangement with plan, elevation and typical cross-section of seawall
66	Vazon Defences	6618/92	SOG	Oct-78	SOG	Drawing	Coastal Defences	Plan and elevation of proposed repair work to sea wall
67	Vazon Defences	6618/76	SOG	Oct-69	SOG	Drawing	Coastal Defences	Seawall and promenade reinforcement details
68	Vazon Defences	6618/91	SOG	Apr-78	SOG	Drawing	Coastal Defences	Details of groynes & wave break
69	Vazon Defences	6618/88	SOG	Nov-75	SOG	Drawing	Coastal Defences	Reinforcement details with plan, elevation and typical cross-section for Vazon seawall - south
70	Vazon Defences	6618/105a	SOG	Dec-84	SOG	Drawing	Coastal Defences	General arrangement with plan, elevation and typical cross-section of seawall
71	Vazon Defences	6618/65	SOG	Sep-68	SOG	Drawing	Coastal Defences	Elevations behind sea wall with section of proposed seawall details of promenade
72	Vazon Defences	6618/62	SOG	Jun-68	SOG	Drawing	Coastal Defences	Proposed sea wall plan, elevation and typical sections
73	Vazon Defences	6618/77	SOG		SOG	Drawing	Coastal Defences	Cross-sections with existing and proposed seawall elevations
74	Vazon Defences	6618/93	SOG		SOG	Drawing	Coastal Defences	Reinforcement details of Vazon Bay seawall
75	Vazon Defences	6618/87	SOG		SOG	Drawing	Coastal Defences	Plan, elevation and typical cross-section for Vazon seawall - south
76	Welcome to Guernsey		Hamilton Brooke	1998	GTB	Booklet	Visitor Guide	
77	Welcome to Guernsey Document Wallet		Harlequin Hire Cars	1998	GTB	Leaflets	Visitor Guide	