



5 PRELIMINARY STRATEGY ASSESSMENT

5.1 Approach To Future Management

Any strategic planning for future coastal defence needs to start from a current position statement which identifies specific details relevant to the frontage and highlights areas where actions that require changes to current practice(s) may need to be considered.

The Shoreline Management Plan(s) (Bullen & Partners, 1998; Shoreline Management Partnership, 1999) covering Walney Island identified a series of individual management units the boundaries of which were based on the following criteria:

- Coastal process behaviour
- Land use
- Coherence in terms of nature conservation interest.
- Hinterland topography
- Compatibility with flooding / erosion risks of adjacent sections of shoreline.

This approach accords with the guidelines for Shoreline Management Plan preparation with regard to the identification of areas in respect of the benefits that may apply and therefore prevents the provision of inappropriate policies for coastal defence along sections of shoreline where there is no justification for artificial defence to be carried out. In the case of Walney Island, however, the data examined to date has shown that due its relatively unique formation (in the UK at least), it would probably be most appropriate to address future coastal management across the island in a reduced number of sections. In order to consider any preliminary management proposals, it is appropriate to consider the key points that have been deduced from the issues identified and the data examined.

5.1.1 *Current Position Statement*

The following specific key points are provided as a current position statement, to form the basis from which options for future management can be adduced:

- Whilst there is historical and current evidence to support our understanding of coastal and geomorphological process behaviour, the exact mechanisms require further examination and investigation if they are to be fully understood.



- Present understanding of coastal and geomorphological processes has identified that the following applies:
 - Erosion of the west coast of the island, south of Sandy Gap, is continuing at various rates that are a function of the incident coastal process conditions, land topography and the geomorphological form of the shoreline.
 - Longshore drift along the west facing coast occurs to the south, along the southern part of the island, and to the north, along the northern part.
 - A drift divide occurs at somewhere between Walk Haw Scar and Sandy Gap, with Mill Scar representing, from historical evidence, a reasonably static feature on the shoreline.
 - Upper beach shingle drift material is a product of the erosion of the glacial deposits that form the shoreline.
 - Lower beach drift is sand that is moved onshore primarily at the extremities of the island due to different tidal current influences associated with Morecambe Bay (south end) and the Duddon Estuary (north end).
 - Material that has eroded from the southern section of the west facing coast has been deposited at the southern end causing a gradual growth in the spit formation at this end of the island.
 - The east facing coast of the island has remained largely unchanged for centuries, with the gradual growth of both the northern and southern ends of the island providing progressively more sheltered conditions. This shelter has provided climates for the growth of saltmarsh habitats.
 - The recent (1994) coastal defence works at Earnse Point appear to have prevented the upper beach longshore drift across the Point and may have caused some localised short-term downdrift erosion across the West Shore Park frontage. However, lower beach movement appears to be maintained and has improved beach conditions immediately on the downdrift side of the 'T' head groyne.
 - Intermittent linear coastal defences on the west facing coast built to protect specific developments/ areas of land are preventing natural geomorphological processes from taking place.

- The general form of existing defences on the west coast is one of a flexible nature that can either be adapted to changing exposure conditions that may apply or, if appropriate, removed

- The standard of protection provided by the different coastal defence elements varies across the frontage. In particular, the defences to the landfill north of Cross Lane appear to be inadequate in relation to the function they are required to perform, i.e. preventing the leaching of landfill from the tip.

- There is a potential conflict that needs addressing between providing coastal defences to protect agricultural land / individual developments and allowing natural geomorphological processes to continue unrestrained, particularly between Bent Haw and Hillock Whins.



- The siting of landfill tips adjacent to the shoreline, historically and continuing to the present day can be seen as having both benefits and dis-benefits, dependent on your particular viewpoint, as described below:
 - Old tips on the west facing, the exact position of which may be unknown, are likely to be vulnerable to erosion in the future with the potential for pollution of the shoreline if they are not protected. This is believed to be happening to the south of Bent Haw.
 - The use of the area of land between Hillock Whins and Hare Hill, where the width of the island is at a minimum, raised the land level and thereby reduced the risk of flooding to this previously low lying area and clearly provided a valuable area for the disposal of waste over a thirty year period. Conversely, the vulnerability of this section of shoreline to on-going erosion, due to the nature of the material, required artificial defences to be constructed and these have interfered with natural process behaviour. If pollution of the shoreline is to be avoided in the future either the tipped material has to be removed, the defences must be maintained or other appropriate management measures instigated.
- The primary criteria for evaluating coastal defence function on the west coast are:
 - Wave and tide climate
 - Shoreline morphology
 - Hinterland topography

The primary function of coastal defences is to prevent or slow erosion of the shoreline and/or prevent or reduce overtopping of defences from causing flooding of the hinterland.

- The primary criteria for evaluating coastal defence function on the east coast are:
 - Tide climate
 - Hinterland topography

The primary function of coastal defences is to prevent or reduce the risk of flooding, apart from those between Water Garth Nook and North Scale which provide a dual function.

- The shoreline scars off the west coast may have a potential role to play in future coastal management.
- The potential for the width of the island to be reduced, by erosion of the west facing coast, such that a permanent low water passage of waters between offshore and the Walney Channel is produced, has largely been removed by increasing the land height by landfill and the erection of coastal defences to prevent erosion taking place.
- All of the inter tidal zone around the island, apart from the section between Hillock Whins and Sandy Gap, is designated of international or national conservation importance. In addition, the hinterland areas of the north and south ends of the island are similarly designated. The north and south ends of the island are a Geological Conservation Review site by virtue of their morphological features and on-going erosion and accretion.



- The historical removal of sand and gravel from, particularly, the south end of the island has changed the morphological condition of this area but has created alternative habitats for development and conservation benefit.
- The viability and sustainability of maintaining present hinterland assets in their current position requires examination in any strategy development. The Car Park at Bent Haw falls into this category.
- Utilisation of natural assets, e.g. shingle resource, could be a key element in the development of a long term strategy

5.1.2 Management Definition

From the data examined and the key points identified in section 5.2.1, it is clear that where behaviour between adjacent management units is inextricably linked by coastal process and morphological behaviour and that there is potential flood plain linkage between the east and west coasts. Therefore, strategy evaluation would best be carried out over longer lengths than those identified and that a reduced number of strategy evaluation units should be defined.

The shoreline lengths as shown in Table 5.1 below, have been identified as providing the most appropriate shoreline division for Strategy evaluation, with the following rationale for unit boundaries proposed:

SU1 - North end of the island, characterised by dune formations. No development but of high conservation importance. Behaviour influenced more by the Duddon than Morecambe Bay.

SU2 - Developed section of west coast to the north of Mill Scar, characterised by recently improved defences across Earnse Point. Northerly drift with southern boundary defined by drift null point.

SU3 – Southern part of the island including west facing coast of the island where erosion is taking place, southern end of island and east coast south of Tummer Hill. Whole area is linked by shoreline erosion / accretion linkage between west coast and south end and by potential flood water linkage across the island in the vicinity of Biggar and Bent Haw /Middle Hill and to the south of South End farm.

SU4 - Developed section of east coast. Risk exposure is water level driven and there is the potential for coastal slope slippage as a result of extreme event impacts and/or coastal defence failure.

It should be noted that there is a degree of interconnectivity between all Strategy Units and a preliminary quantification of this will be completed in Stage 2.

Table 5.1 - Strategy Evaluation Units			
<i>Strategy Unit No.</i>	<i>From</i>	<i>To</i>	<i>SMP Management Unit Refs.</i>
1	Walney Airfield (East)	Walney Airfield (West)	1/1
2	Walney Airfield (West)	Mill Scar	1/2
3	Mill Scar	Tummer Hill	1/3 1/4 1/5 1/6 1/7
4	Tummer Hill	North Scale	1/8

The boundaries of the Strategy Units are shown on Figure 5.1.



5.2 Strategic Aims And Objectives

With a starting point established, it is appropriate to develop a series of strategic aims and objectives to guide future development of the Strategy. As with all such exercises this is likely to require a degree of compromise from the different parties involved who will each have their own agenda and will be looking to meet this agenda as much as possible. In the end, if the strategy is to be moved forward a consensus will have to be reached on which all parties can agree.

The following criteria have been defined as critical to the evaluation of future management actions across the island:

- The affects on the behaviour of coastal and geomorphological processes;
- Maintenance of the 'favourable' status of key environmental habitats across the majority of the shoreline;
- Provision of an appropriate standard of coastal defence in relation to the assets at risk;
- Prevention of pollution from historic/current landfill tips.

It is important in the setting of objectives that the objectives defined directly link to the specific interests associated with the frontages, as well as reflecting the problems and issues associated with the specific frontages.

There are a number of documents and management plans/initiatives that contain objectives that can feed directly into development of specific objectives for the Walney Island strategy, particularly:

- Shoreline Management Plans
- Duddon Estuary and Morecambe Bay Strategies
- English Nature Natural Area Profiles
- English Nature Habitats Regulations Advices

All relevant objectives from these past planning initiatives have been identified such that appropriate local and specific objectives for Walney Island can be defined. Many of these are by their nature generic and it will be important for the objectives that are ultimately defined to reflect the particular local issues and concerns peculiar to Walney Island.

Appendix N contains details of relevant objectives extracted from the above documents and these objectives have been used as the basis to establish specific objectives relevant to development of the Strategy for Walney Island. Consultation and discussion with the steering group identified two categories of objectives:

Primary Objectives: Those that address the fundamental issues and problems associated with the island, based on the critical criteria identified above.

Secondary Objectives: Those that address other interests and concerns that are linked to future coastal defence management, but which either address specific local aims or are peripherally linked to the provision of coastal defence in the future.

It should be noted that these objectives may be revised as a result of ongoing consultation with stakeholders outside the steering group. The objectives defined are provided below:



Primary Objectives

To minimise the effect that artificial coastal defences have on the natural behaviour of coastal and geomorphological processes across the island.

To maintain Walney Island as a strategic defence to the Port of Barrow and the surrounding area.

To ensure that in planning and managing the coast protection and flood defences on Walney Island, all necessary sustainable steps are taken to help the internationally and nationally important nature conservation interests around Walney Island (SPA, cSAC, Ramsar, NNR, SSSI) to achieve favourable condition, subject to natural change.

To provide an appropriate level of coastal defence to the built up areas of Vickerstown and North Scale.

To evaluate whether it is appropriate to provide artificial flood protection to low-lying land that is vulnerable to tidal inundation, and, if so, what the standard of protection should be.

To take appropriate measures to prevent pollution of the shoreline from historic or active landfill sites adjacent to the coast.



Secondary Objectives

To continue to monitor the effects of the Earnse Point Groyne and its potential effect on downdrift frontages and provide appropriate coastal management measures where appropriate.

To avoid adverse interference with navigation into and out of the Port of Barrow as a result of future coastal management actions.

To maintain and where possible improve the provision of appropriate access to the foreshore at Earnse Point and other points around the island, for use by emergency services vehicles and other shoreline users, subject to environmental restraints applying.

To take due account of the historic resource of the island in any future coastal management.

To avoid adverse affects on bathing water quality off the island as a result of future coastal management actions.

To inform the statutory planning process with regard to areas at risk from erosion and/or flooding.



5.3 Preliminary Strategy Evaluation

Examination of the data carried out in section 3 (table 3.10 refers), identified the principle developments and therefore tangible assets adjacent to the coast. The following section provides a preliminary assessment of the economic, technical and environmental criteria applying in respect of justification for future coastal management actions.

5.3.1 Introduction to the Evaluation of the Do-Nothing Scenario

In accordance with the latest MAFF guidance on Flood and Coastal Defence Project Appraisal (FCDPAG3), the basis of evaluation of future shoreline management strategies or individual schemes is the economic viability of incurring expenditure against the option of doing nothing (the 'do-nothing' scenario). The technical robustness and environmental effects of adoption of such a policy also require careful consideration.

The do-nothing scenario varies dependant on the specific existing circumstances applying:

- Where existing defences are in place, walk-away, cease all maintenance, repairs and similar activities. Any expenditure for health and safety reasons to abandoned works should be counted as a scheme cost.
- Where there are no existing defences in place do not intervene in natural process behaviour.

The two Shoreline Management Plans that cover Walney Island both identified significant lengths of shoreline where a do-nothing policy was appropriate (ref. Tables 2.1 & 2.2), either because of the lack of tangible benefits being protected or because of the specific environmental criteria applying. Notwithstanding this, the appraisals carried out for the SMP's provided only 'ballpark' assessments that require further refinement to confirm or modify the actions to be taken.

Evaluation of the do-nothing scenario for Walney Island requires sufficient information to identify the plan shape of the island and hence the position of the shoreline at the end of the appraisal period which, in this case, is assumed to be 50 years hence. Based on the data examined and knowledge of how the island has evolved in the past, this requires certain criteria to be defined:

- For those sections of frontage that are at present or may in the future be vulnerable to erosion: What are the likely rates of erosion that will apply? Will those rates be uniform or are they likely to cease at some stage? Will defences that are presently preventing erosion last for the next fifty years, or will they fail and open up these sections to erosion at some time in the future?
- For those sections of frontage that are at present or may in the future be vulnerable to flooding: What are the present levels of defence being provided? What is the life expectancy of these structures and if they fail how vulnerable will the hinterland be to flooding? What conditions will cause flooding, what areas of land will be flooded and will this affect infrastructure, property, and the environment or possibly threaten life?



In addition, some sections of the island will be vulnerable to both erosion and flooding and it is important to define whether erosion will lower the level of defence, making the hinterland more vulnerable to flooding as a result. Furthermore, present flood risk mapping (ref. Figure 4.1) indicates that there are flood plains that link across the width of the island and whereas flooding on the east coast is water level driven, the effects of waves on the west coast needs to be considered in this case, i.e. flooding from the west could occur when water levels are below present protection levels on the east coast.

The starting point for evaluation of the do-nothing scenario across Walney Island is defined by the following criteria:

- The current condition of the existing coastal defences.
- The standard of service currently being provided by these defences (more relevant in respect of flood prevention).
- The current and likely future position of the shoreline.
- The effects on the assets being protected of :
 - erosion of the shoreline;
 - overtopping of defences, leading to short term flooding of the hinterland and associated assets.
 - breaching of defences, leading to recurrent flooding of the hinterland and associated assets.
- The effects on the natural environment

5.3.2 *Condition of Existing Defences*

The condition and age of existing artificial defences around the island varies from very good to poor condition and from less than 10 to 70 years old. Notwithstanding the above, the older defences tend to be located either in sheltered positions or where beach levels are reasonably stable, which clearly prolongs their active life. Table 3.8 contains details of defences recorded either in the NRA Sea Defence Survey (1991) and/or the MAFF CPSE (1994). Where appropriate, information in this table has been updated from specific site inspection/ record.

With regard to the behaviour of these defences in the next fifty years, assuming that a do-nothing scenario was to apply across the whole of the island, the following salient points are provided based on the data assessed:

- The Earnse Point rock groyne and rock revetment (210/8036) are anticipated to have a residual life expectancy of the order of 50 years without significant problems. (Photos 4 and 5).
- The effect of the rock groyne has been to stabilise upper beach levels between Walk Haw Scar and Earnse Point. Although the defences here (210/8034,35) are 50 years old, they are apparently not showing signs of distress at the present time, but could conceivably fail if conditions changed in the future. (Photo 4)



- The defences across Bent Haw (210/8033) are a mixture of rock armour and broken concrete that appears to have simply been tipped against the eroding cliff face. If, as appears, there is no filter membrane between the cliff and the protection, then the construction is vulnerable to disruption from water movement that will destabilise the cliff behind and reduce the integrity of the structure. The MAFF CPSE has identified the structure as being class 1 (i.e. new or nearly new), however its residual life probably could not be put at more than 20 years. (Photo 10)
- The defences at Middle Hill (210/8032) and Cow Leys (210/8031) (Photos 12 and 13) were erected in the late 1980's in an attempt to protect the very low lying sections of frontage between Bent Haw and Hillock Whins from flooding. Aerial photographs confirm that the shingle bank was rolled back into the hinterland prior to the defences being erected and that, since that time, shingle has continued to be washed through the loosely packed revetment (see Photo 12). The February 1997 event overtopped the defences and caused extensive flooding that reached Biggar on the east side of the island. The defences were identified as being Class 1 condition in the MAFF CPSE and whilst they do not appear to be structurally deficient to any great extent there are low spots in the crest that reduce their effectiveness.
- The three isolated defences at Bent Haw, Middle Hill and Cow Leys represent isolated lengths of artificial defence on an otherwise unprotected shoreline that is subject to erosive forces. So whilst these defences will in the short term 'hold the line' at these positions, the shorelines in between and to either side will, if erosion continues, carry on recessing with the eventual likelihood that the artificial defences will be outflanked and rendered obsolete. Examination of the most recent aerial photographs suggests that this is already taking place (see Photos 28 and 29).
- The defences to the landfill tip between Hillock Whins and Hare Hill were constructed in two stages. The first section from Hillock Whins to Honeypot Lane (210/8030) appears either to have been set at too low a crest elevation or has not been appropriately detailed in respect of filter layers etc., as there has been disruption to the material being retained behind the defences, with the consequence that tip rubbish is now visible. This structure will continue to be vulnerable, and exposure conditions are likely to increase as the beach lowers in front of it. As a consequence, exposure conditions are expected to increase causing more damage and eventual leaching of tip material onto the foreshore (Photo 16). The second stage of defences, across Low Bank, was not recorded in the MAFF survey but is identified in Table 3.8. The sea defences appear to be generally better constructed and there is a safety margin between the defences and the elevated area of landfill. The beach in front of this section, although apparently stable at the present time, is also likely to decrease in level with time with consequently increased exposure conditions and the potential for damage to the structure and ultimately exposure of the landfill.
- Unlike the isolated defences to the north, the two lengths of tip defence are situated in a natural embayment that has formed between the two drumlin headlands to either side and are therefore unlikely, subject to definition of erosion rates, to be outflanked in the next fifty years.
- The tidal embankments on the east coast of the island (010/368-373) are not well defined from the survey information. All of them are privately maintained and generally are earth bunds that have been erected to stop flood waters penetrating inland. The primary structure is the Biggar Bank/Dyke that runs along the edge of the marsh between Biggar and Tummer Hill. (Photo 20)
- The defence on the north side of Jubilee Bridge (210/8028) represents the oldest remaining contemporary coastal defence structure on the island, dating back to 1930. The structure is a simple sloping masonry or stone pitched revetment that abuts the footpath and highway. In places vegetation has covered the sloping face. The structure is sheltered from wave attack but without routine maintenance it is anticipated that this structure could deteriorate in the next half century. (Photo 23)



5.3.3 Standard of Service

As the condition of defences across the frontage is variable, so the level of service provided by defences varies as well. Crest levels of structures on the west coast are available from the beach profiling work and / or construction details. The crest levels of the artificial structures vary between 7.2 and 9.1 metres AOD. With a predicted 1 in 200 year extreme water level of approximately 6.50 metres AOD, the freeboard between water level and the crest is only small for some of the defences. It must also be borne in mind that waves of up to 4.0 metres in height can, due to the general profile of the foreshore along the west facing coast, approach to within 50 metres or so of the shoreline. Notwithstanding that some of this energy will be dissipated on the beach, it is estimated from the storm climates derived (sections 3.1.1/4.1.1) that typical significant wave heights of between 2.0 and 2.5 metres will occur.

If it is assumed, as a first approximation, that waves run up a rough (rock) surface the equivalent of the height of the wave above the still water level applying for any given condition, the crest of a structure would need to be set at a level equivalent to the level of the water + the height of the wave to provide reasonable protection against overtopping. This also assumes that the highest waves would occur at times of the highest water levels.

Applying the above to the structures on the west coast, assuming an incident wave height of 2.0m (a reasonable estimate of significant wave height from the data presently available), the existing structures are providing a maximum level of service as shown below:

Table 5.2 – Standard of Service Provided By Existing Defences			
STRUCTURE	CREST LEVEL (m AOD)	CREST LEVEL – WAVE HEIGHT (m AOD)	RETURN PERIOD WATER LEVEL PROTECTED AGAINST (YEARS)
Earnse Point	9.0	7.0	1000
Walk Haw Scar (N)	8.7	6.7	250
Walk Haw Scar (S)	7.2	5.2	2
Bent Haw	9.1	7.1	1000
Middle Hill	7.6	5.6	5
Cow Leys	7.6	5.6	5
Landfill Tip North	7.5	5.5	5
Landfill Tip - Low Bank	8.4	6.4	150
East Coast Defences South of Biggar ^{(1) (3)}	6.0	6.0	25
Biggar Dyke ^{(2) (3)}	7.0	7.0	1000
Revetment North of Jubilee Bridge ^{(1) (3)}	5.8	5.8	15
Notes:			
The above can only act as a first approximation of the levels of service being provided and detailed consideration of the probability of waves and water level occurrences, specific structural integrity, together with particular beach profiles in front of the various structures is required to confirm the levels of service being provided.			
1) Crest level assumed to be approximately equivalent to highway level.			
2) Level estimated to be 1.0m above highway level.			
3) On sheltered east coast the level of service is defined by water level only.			



To provide an indication of the likelihood of extreme events occurring, the following significant return period events have occurred in the past thirty or so years:

<u>Date</u>	<u>Still Water Level (m AOD)</u>	<u>Return Period (years)</u>
November 1977	6.15	50
January 1983	No record	No record
February 1990	5.95	20
February 1997	6.33	100

5.3.4 *Shoreline Position*

The position of the shoreline on the east coast of the island has been largely fixed in the recent past with, if anything, there being a growth of natural protection, i.e. saltmarsh spreading seaward.

On the west coast the position is clearly different with shoreline recession, particularly over the southern part of the island, taking place at various rates over the past millennium. The rates of recession are linked to two specific criteria:

- Exposure conditions
- Shoreline morphology

It is reasonable to assume that, as the island represents the most westerly feature of the eastern Irish Sea shoreline, exposure conditions are likely to have been reasonably constant in the recent past (increased storminess notwithstanding).

However, the morphology of the island is known to vary longshore, dependant on the material deposited. The present offshore scars give an indication that when the shoreline was in advance of its current position the longshore morphology may have been different from the present day. The scars have been formed from erosion of the drumlins, however, at some places along the frontage there is evidence of scars along sections of shoreline between present drumlin positions e.g. between Hare Hill and Hillock Whins, the exposed shoreline is now formed in alluvium deposits and up to the mid 19th century the shoreline was much straighter, compared to its present indented shape. This could indicate that once the inshore extent of the drumlin had been reached, the softer more readily erodable alluvium became exposed and shoreline recession then ensued at a quicker rate.

The behaviour of the shoreline along the eroding west coast has been affected, particularly over the past twenty years, by the erection of intermittent defences and this needs to be taken into account when determining the likely rates of shoreline movement that will occur in future.

It is clearly important not to only rely on historical data to evaluate what position the shoreline might reach in the future. Other criteria such as:

- specific data on ground conditions along the shoreline,
- local hinterland topography,
- analysis of effects of recent hardening of the shoreline, and
- specific cliff recession data and beach profile changes

are required to better define likely future behaviour in this respect.



The database of information available at the present time is only sufficient to provide a first order approximation of the likely rates of recession that would occur and it would be proposed that these predictions would be confirmed or modified by obtaining further data and carrying out more detailed analysis, during the second stage of Strategy development.

At the present time, approximate scaling of offsets from fixed points on the aerial photographs dated 1963, 1970, 1983 and 1997, have been used together with analysis of distances to the cliff edge from the beach profile data (in the absence of specific cliff edge recession measurements) to provide a first approximation of shoreline movement.

The locations chosen for analysis were identified as being areas where no intervention had taken place. Whilst distances taken from aerial photographs were reasonably easy to extract, the figures obtained identified not only potential inaccuracies in the take-offs but also in the scales of the photographs themselves with some variations between successive surveys indicating accretion of a cliff edge, which is clearly not possible. Hence, only a possible range of erosion rates that have applied historically from this data have been determined. On the other hand the beach profile data did not provide precise offsets from the origin markers with distances fluctuating indicating perhaps that the cliff edge position was probably not always recorded.

The data examined provides a range of potential rates of recession as shown in Table 5.3 below:

TABLE 5.3 – Summary of Historical Recession Rates				
<i>XS Position</i>	<i>Short Term</i>		<i>Long Term</i>	
	Movement '96-'99(m)	Rate (m /year)	Range of Movement '63-'97(m)	Rate (m /year)
8	0.0	0.0	0- 8	0.0 – 0.3
10	0.4	0.13	6 – 14	0.2 – 1.0
11	1.5	0.5	15 – 53	0.5 – 3.8
Hillock Whins	ND	ND	15 - 55	0.5 – 3.8
17	0.4	0.13	10 -26	0.4 – 1.8
19	3.0	1.0	10 - 36	0.4 – 2.5
20	0.2	< 0.1	12 - 25	0.4 - 1.5
<i>Notes</i> ND = No data				

It appears from the above that the shoreline along the main west facing coast is recessing at different rates with the section north of Bent Haw significantly slower than that to the south. Due to the inaccuracies identified above, it is not possible from the present analysis to identify the effects intermittent hardening of the shoreline has had on recession rates, although for sections without such an influence the range of rates is not as wide.

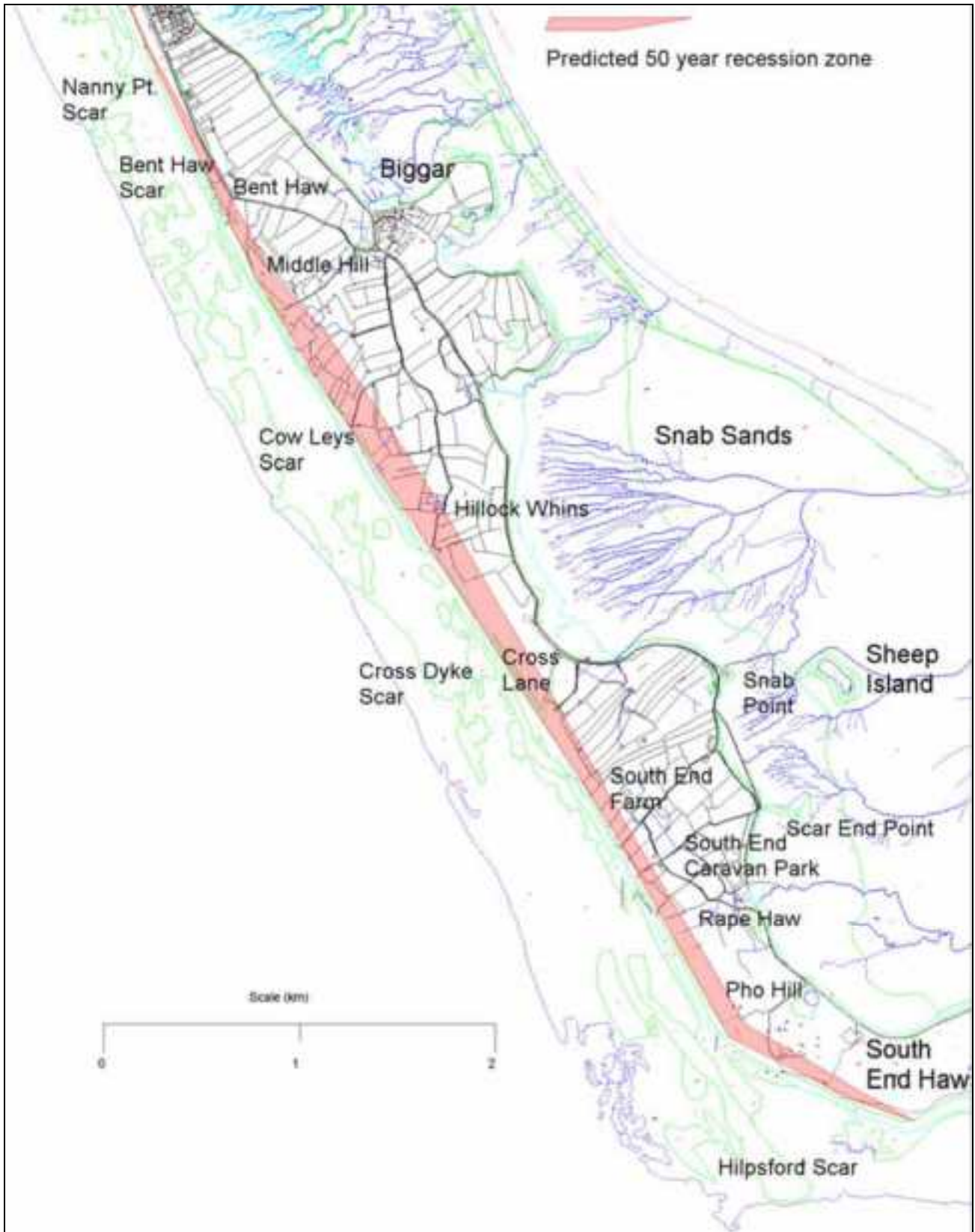
However, at the south end of the island the shoreline turns from NW/SE orientation to East/West orientation and this section of shoreline is more likely to be influenced by oblique wave exposure with consequent differences in longshore drift behaviour (ref. Section 4.3.1).

Notwithstanding discrepancies, the above reconciliation provides the basis for establishment of a range of potential shoreline positions in the future and these are shown on Figure 5.2.



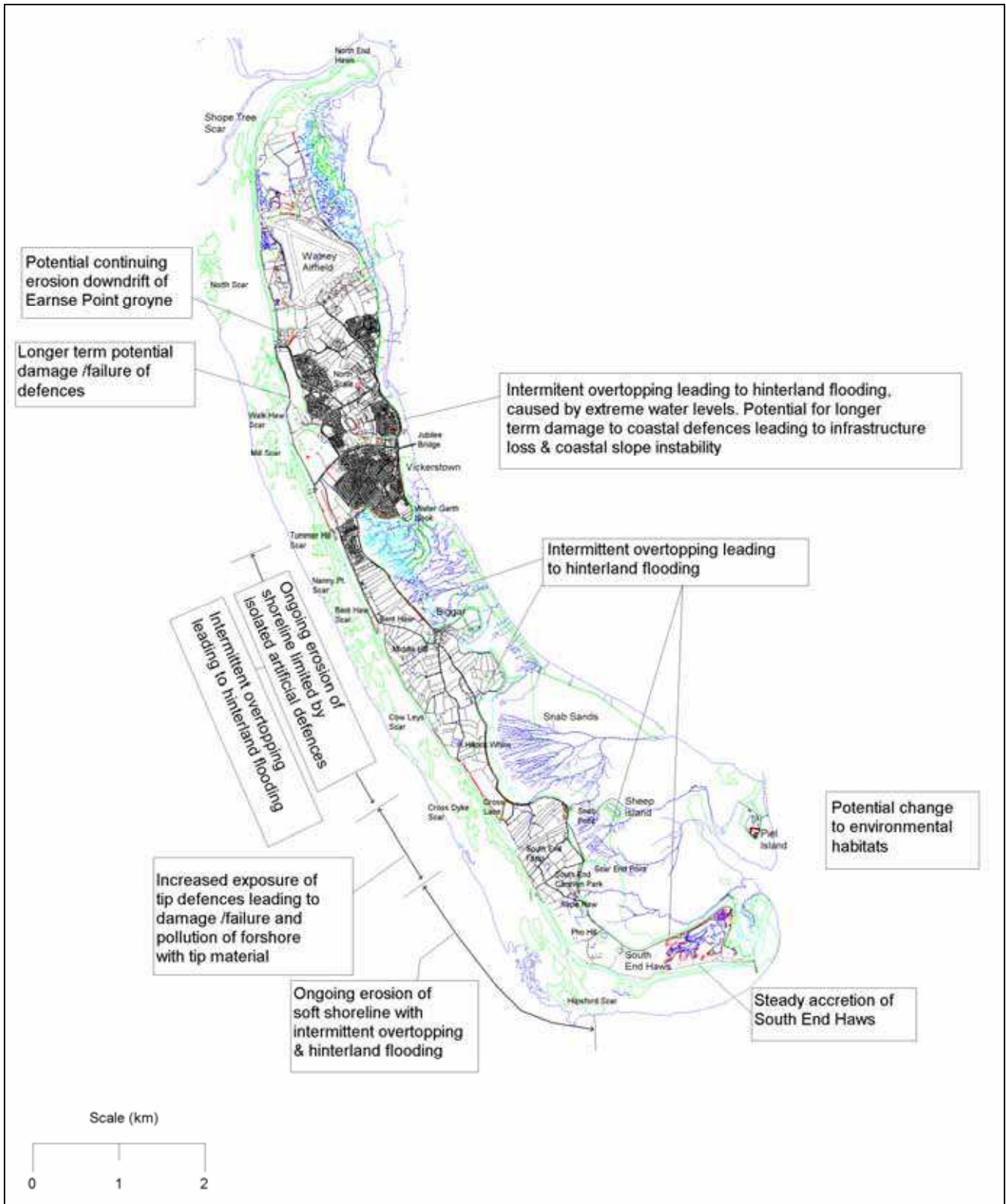
The aerial photographs that are available represent an important data set in this respect and it is proposed that they would be analysed in further detail to establish with greater accuracy historical recession rates for confirmation of the work carried out to date.

Utilising the above data with regard to standard of service, condition of existing defences and potential shoreline recession it is possible to provide an initial prediction of the consequences of adopting a do-nothing policy within each Strategy Unit, as detailed in Table 5.4 below and shown graphically in Figure 5.3.



BBC OS Licence No. LA077062

Figure 5.2 – Predicted Do-Nothing Recession Limits



BBC OS Licence No. LA077062

Figure 5.3 – Predicted Do-Nothing Consequences



Table 5.4 – Implications Of Do-Nothing Policy				
Strategy Unit / Effect	Timescale	Potential Effects	Dependencies	Data Required to carry out detailed evaluation
SU1 - Changes to Shoreline form and shape	Short to long term	Changes to shingle and dune habitats	Environmental conditions.	Monitoring Information
SU2 – Continued erosion downdrift of Eamse Point groyne	Short to medium term	Loss of access to north end. Potential loss of chalet sites.	Future sediment drift.	Confirmation of sediment movement studies. Monitoring Data
SU3 – Potential failure of Walk Haw Scar defences	Medium to long term	Erosion of golf course.	Environmental conditions.	Confirmation of sediment movement studies.
SU3 - West shore erosion (Sandy Gap to Bent Haw)	Short to long term	Loss of 0- 15 metres of open space land. Potential longer term threat to highway and properties. Potential exposure of historic landfill tips. Allow continued supply of cliff material to shoreline drift. Progressive roll-back of coastal habitats (e.g. saltmarsh).	Environmental conditions. Shoreline morphology.	Recent historical recession information. Shoreline ground conditions. Highway usage. Property values.
SU3 - West shore erosion (Bent Haw to Hillock Whins)	Short to long term	Loss of 10 – 150 metres of agricultural land. Flooding of hinterland during extreme events with return period of 5 years or more initially with longer term erosion leading to reduced level of defence, more frequent inundation and change of land use. Eventual outflanking of present isolated defences. Potential exposure of historic landfill tips. Allow continued supply of cliff material to shoreline drift. Progressive roll-back of coastal habitats.	Environmental conditions. Shoreline morphology.	Recent historical recession information. Shoreline ground conditions. Effects of isolated hardening. Specific land usage / valuation data. Identification of landfill tip positions
SU3 - West shore erosion (Hillock Whins to Hare Hill - Tip frontage)	Short to long term	Beach lowering. Increased exposure of defences. Damage / Failure of defences. Release of landfill material onto shoreline.	Environmental conditions. Shoreline morphology.	Defence construction details. Details of landfill materials.

**Table 5.4 – Implications Of Do-Nothing Policy**

Strategy Unit / Effect	Timescale	Potential Effects	Dependencies	Data Required to carry out detailed evaluation
SU3 - West shore erosion south of Hare Hill	Short to long term	Loss of 20 – 100 metres of open space / agricultural land. Potential affect on vegetated shingle habitats. Allow continued supply of cliff material to shoreline drift. Progressive roll-back of coastal habitats.	Environmental conditions. Shoreline morphology. Potential increased flooding risk.	Environmental conditions. Shoreline morphology. Specific land usage / valuation data.
SU3 – Accretion at South End Haws	Short to long term	Changes to shingle and dune habitats.	Environmental conditions. Shoreline morphology.	Confirmation of sediment movement studies.
SU3 –Tidal flooding from east coast	Intermittent, generally for water levels with return periods of greater than 25 years.	Interference with access to south end. Flooding of low lying agricultural land. Flooding of important environmental habitats. Flooding of caravan park properties, properties in Biggar Village, and intermittent farm buildings. Flooding and damage of Oyster Farm buildings. Changes to environmental habitats. Flooding and damage of properties at Tummer Hill. Development of wet grazing marsh from increased flooding. Progressive roll-back of coastal habitats (e.g. saltmarsh).	Environmental conditions. Adequacy of existing defences.	Topographic survey data. Property type and threshold levels. Specific land usage / valuation data. Floodbank construction and profile details. Nature reserve visitor details.
SU4 – Extreme tidal levels along Vickerstown and North Scale frontages	Intermittent, generally for water levels with return periods of greater than 15 years.	Interference with and potential damage to highway and associated infrastructure. Property flooding.	Environmental conditions.	Topographic survey data. Property type and threshold levels. Traffic flows and alternative route details.
SU4 – Damage to Vickerstown defences	Medium to long term	Loss of highway and infrastructure leading to potential coastal slope slippage.	Environmental conditions. Adequacy of existing defences.	Topographic survey data. Ground conditions.
SU4 – Increased exposure of natural defences at North Scale	Medium to long term	Potential coastal slope slippage	Environmental conditions	Topographic survey data. Ground conditions.

It should be noted that across all strategy units, the do-nothing scenario results in coastal processes operating in a more natural state.



5.3.5 Valuation of Losses Under the Do-Nothing Policy

A number of the affects of carrying out a do-nothing policy can be readily valued using standard techniques for benefit evaluation as described in FCDPAG3. However, these affects require specific data and assessments to be carried out, particularly with regard to establishment of:

- The rates of shoreline recession,
- The timescale to when specific losses occur,
- The frequency with which flood events occur (different areas will be affected by different return period events),
- The areas that would be flooded, and
- The depths and duration's of the floods.

In order to establish the basis for evaluation of options for on-going management actions it is necessary to establish the value of land, property and infrastructure that is at risk from the effects identified in Table 5.4. Separate assessments have been carried out for each strategy unit, with the following assumptions deemed to apply with regard to physical behaviour and the areas and value of assets at risk:

5.3.5.1 Strategy Unit No. 1

- No tangible assets at risk

5.3.5.2 Strategy Unit No. 2

- Recent Earnse Groyne Improvements are considered likely to hold shoreline in present position, although some realignment could occur on north side, which would lead to the following:
 - Loss of vehicle access and section of highway in front of West Shore Park.
 - Loss or relocation of front row of chalets (28 No.)

Above assumed not to occur until year 25

- South of Earnse Point, existing defences are likely to become life expired in the next fifty years allowing some localised retreat of the shoreline across the frontage and damage to a number of holes on the golf course. This would not be expected to occur until beyond year 30.

5.3.5.3 Strategy Unit No. 3

- Continuing west coast erosion is assume to take place at the following average rates:
 - Mill Scar to Bent Haw 0.1m per annum
 - Bent Haw to Hillock Whins 0.5m per annum
 - South of Hare Hill 0.5m per annum
- Approx. 100 hectares of agricultural dairy grazing land vulnerable to flooding on a ten yearly basis between Bent Haw and Hillock Whins. Potential for longer-term permanent inundation due to lowering of crest level of defences across this frontage.



- Present defences at Bent Haw, Middle Hill and Cow Leys will become detached from the shoreline and although they will provide some degree of protection, erosion of the land will continue behind.
- Defences between Hillock Whins and Cross Lane will fail within the next ten years leading to erosion of the landfill and pollution of foreshore with material. On-going slumping of the fill will occur over the remaining period.
- Flooding of sheep grazing agricultural land south of Hare Hill will take place every five years, (say 50 hectares).
- Flooding from the east coast predicted to occur twice within the next fifty years, causing flooding to the following buildings:
 - South end caravan park (100 static vans)
 - South end Bungalow
 - Approx. 12 dwellings at Tummer Hill

In addition, this would lead to increased flooding of agricultural land (100 hectares) at the southern end of the island, including that which would occur as a result of inundation from the west coast. The above assumed to be affected to a depth not exceeding 300mm.

- Agricultural land that is flooded assumed to be out of commission for a period of one year.
- The following values are assumed to apply for land:
 - Agricultural dairy - £1000 per hectare
 - Agricultural sheep - £ 200 per hectare

With regard to loss of land from erosion it is assumed, due to the low stocking rates, that the capacity lost could be taken up in the remaining land available and no value has therefore been taken in this respect.

5.3.5.4 Strategy Unit No. 4

- Overtopping of revetment north of Jubilee Bridge assumed to occur every ten years leading to short term traffic diversion and localised flooding of approximately 25 properties on promenade, to a depth < 300mm.
- Failure of defences assumed to occur at year 30 leading to permanent loss of highway, loss of interceptor sewer, pollution of the Walney Channel and surrounding environment and damage to up to 100 properties.

The above analyses are considered to represent a best estimate or minimum damage scenario under the do-nothing option, particularly with regard to Strategy Unit 3.



Under a worst case scenario with the higher recession rates applying the following would be likely to apply:

- Permanent inundation of approximately 100 hectares of low lying land between Middle Hill and Biggar, at times of normal high tides, which may cut off the southern half of the island under certain conditions. The extent of inundation would vary with tidal level applying. A further 400 hectares could be subjected to flooding say every five years. Conditions to be as for the minimum scenario for say the first ten years but as described thereafter.
- Recession of up to 150 metres from the present shoreline position with Hillock Whins promontory set back to the same line, as the tip defences to the south. It is likely that the degree of recession could be slower just to the north of Hillock Whins, where the existing defences may assist in regulation at least in the short to medium term.
- Erosion of Hare Hill back to the boundary of South End Farm buildings and loss of old South end Farm to the south. This would outflank the defences to the Low Bank tip frontage causing pollution from that section of tip as well. Increased pollution of shoreline to occur requiring more frequent removal of debris after year 15.
- Increased erosion of land to the south of Hare Hill with greater potential for more frequent inundation and farther reaching inundation

Other benefits applying can be termed intangible or not readily quantifiable in monetary terms. Items such as:

- losses or gains in environmental habitats, and
- loss of recreation open space or beach usage

may have what are called functional or existence values by virtue of their use or being.

The effects on the natural environment are dealt with specifically in section 5.3.6.

Evaluation of the first of these criteria requires more detailed collation of data with regard to specific habitats around the island in order that the relative importance of the effects of different processes on the environment can be better understood, e.g.:

- Is there an optimum balance between loss of hinterland and feed to the inter-tidal zone?
- What effect does continued longshore transport of shingle have on the habitats that have been created at the south end of the island?
- Is there a certain level of flooding of the hinterland beyond which environmental benefit becomes a dis-benefit?
- What is more acceptable - preventing natural erosion and pollution from shorelines that have been used for landfill or allowing natural processes to continue un-hindered and accepting that undesirable material may be eroded?

The above questions and others require addressing as the Strategy develops in order that appropriate management solutions that achieve the best balance between economic and environmental criteria can be identified.



Contingent valuation methods of assessment have been used to establish the worth of shorelines in terms of their recreation and amenity value. However, in this case the loss of usage of the open space land as a result of erosion along the frontage is, like the agricultural land, assumed to be taken up in the land remaining.

Economic assessment of the do-minimum damage scenario has been carried out for all four strategy units and a worst case scenario has been examined for Strategy Unit No. 3, as this represents the area where there is the greatest uncertainty with regard to the likely consequences of adopting the do-nothing option.

Information on the above has been processed with asset values discounted to the present day, using a test discount rate of 6%. This is provided in Appendix O with a summary provided in Table 5.5 below.

Table 5.5 - Summary of Preliminary Assessment of Do- Nothing Damages			
Strategy Unit No.	Case	Value of Damages applying (£)	
		Total	Discounted
1	Best Assessment	0	0
2	Best Assessment	675,000	120,000
3	Minimum	850,000	220,000
3	Worst Case	4,500,000	1,000,000
4	Best Assessment	10,500,000	1,700,000

The ‘discounted’ value of damages applying is a way of representing the present day value of an event that will occur in the future. For each year from now that the event occurs in the future, a proportion of the value of damages that occur is ‘discounted’ (or subtracted) from the total value. Current Treasury guidance indicates is that this discounting proportion should be 6% per annum.

5.3.6 *Effects on the Natural Environment*

Evaluation of the effects on the natural environment of adopting a blanket Do-Nothing policy, or in fact any other policy, requires detailed collation of specific location and population data with regard to the many and varied specific habitats around the island in order that the relative importance of the effects of natural processes and different policies on these habitats can be better understood. It has not been possible to obtain, nor has it been appropriate to carry out a detailed habitat audit at this stage of strategy development. Such work is proposed to be carried out during the second stage and will address such questions as:

- Is there an optimum balance between loss of hinterland and feed to the inter-tidal zone?
- What effect does continued longshore transport of shingle have on the mobile shingle habitats that have been created at the south end of the island?
- Does continued gravel extraction of non mobile shingle provide an overall benefit or disbenefit environmentally?
- Is there a certain level of flooding of the hinterland beyond which environmental benefit becomes a dis-benefit?
- What is more acceptable environmentally - preventing natural erosion and pollution from shorelines that have been used for landfill or allowing natural processes to continue un-hindered and accepting that undesirable material may be eroded?



Notwithstanding the above, a generalised view of the effects of adopting a Do-nothing policy on the environmental interests associated with each strategy unit is provided below:

5.3.6.1 Strategy Unit No. 1

- On-going natural changes to shingle and sand dune habitats

5.3.6.2 Strategy Unit No. 2

- Potential covering up of scar features

5.3.6.3 Strategy Unit No. 3

- Pollution of shoreline habitats from erosion of landfill(s)
- On-going natural changes to shingle and sand dune habitats
- Intermittent flooding and natural change to habitats above HWM
- Changes to status of hinterland and effects on habitats.

5.3.6.4 Strategy Unit No. 4

- Damage to intertidal and sub tidal habitats from potential long term pollution should defences fail.

In addition there is the potential for reinstatement of natural process / shoreline interaction in the longer term along some but not all presently defended lengths

A number of these effects will clearly be seen as beneficial to environmental interests and will meet the objectives for maintaining the shoreline in “favourable” status. Others clearly will not do so.

The above questions and others require addressing as the Strategy develops in order that appropriate management solutions that achieve the best balance between economic and environmental criteria can be identified.



5.3.7 *Summary of Do-Nothing Effects*

What is evident from the above preliminary assessment of the effects of adopting a do-nothing policy across the whole of the island is that:

- a) There is unlikely to be a basis for large scale intervention works on Walney Island.
- b) The economic viability of carrying out works on the west coast is largely dependent on the justification to protect undeveloped land, the need to prevent pollution of the shoreline and the objective of securing favourable condition of the nature conservation interests.
- c) There is unlikely to be any basis for action other than monitoring, maintenance and routine improvement of defences around Earnse Point.
- d) There is no basis for intervention across the north end of the island
- e) There is a potential conflict, particularly on the west facing coast, between the need to protect agricultural land and allowing morphological processes to continue unhindered.
- f) If a do-nothing policy was adopted along the eroding section of the west facing coast then the potential for pollution of the shoreline from historic and current landfill tips is high.
- g) The provision of an appropriate level of flood defence on the eastern side of the island requires an assessment of hinterland topography to evaluate the risks from different event occurrences in order to define the appropriate standard of service that should be provided.
- h) Actions on the west coast will, under certain conditions, influence behaviour across the whole of the island.
- i) The perceived negative effects of the Earnse Point Groyne are considered to be localised and will require on-going monitoring to identify any future requirements.
- j) The potential effects of allowing the defences on the east coast at Vickerstown to deteriorate could cause significant disruption to the most densely populated part of the island, however this is unlikely to occur in the short term and a regime of monitoring and inspection can be instigated to identify the appropriate time for action.
- k) Adoption of such a policy would provide for changes in the natural environment and habitats some effects of which are likely to be beneficial to conservation objectives whilst others may provide a dis-benefit.

If a strategy for future coastal management is to be provided then these are the primary criteria that need to be considered in the assessment of different management actions for the frontage.

5.3.8 *Options for Future Management*

Present artificial defences around Walney Island are largely linear in nature, intermittent in position and provide protection to specific developments or areas of land. Previous attempts at carrying out cross shore intervention have generally met with only limited success, with most of these structures, although still evident, now defunct (e.g. at Walk Haw Scar and south of Hare Hill). This is largely due to the inappropriate types of structures that have been employed, i.e. long thin slender structures that are vulnerable to damage from coarse upper beach sediment drift and which require on-going maintenance, in such a high energy environment, to maintain their usefulness.



The groyne at Earnse Point represents a more substantial form of cross shore structure than the others and one which was appropriately chosen to reduce nearshore exposure conditions and arrest the beach lowering that had been occurring since the original linear defences were erected in the 1930's. Notwithstanding the above, it is considered likely that the groyne might not have been built had present funding criteria been applied to justify construction, and that an alternative strategy of gradual shoreline re-alignment and relocation of assets may have been considered more appropriate.

With so much of the shoreline not under any form of artificial restraint, it is appropriate to obtain answers to the following questions in order to define appropriate management strategy actions for the future:

- Are artificial defences required to protect each specific developments / land use area?
- Is the form of construction appropriate for the asset being protected?
- Are there any other options that could be considered? (This might include non coastal defence initiatives)
- Should artificial defence be considered along any natural shorelines where developments are potentially at risk?

It is clear from the work carried out so far that large scale intervention along the majority of the Walney Island coastline is neither likely to be justifiable in economic terms nor appropriate. Due to the relatively low level of tangible assets identified as being at risk from shoreline erosion and/or coastal flooding, combined with the need to maintain, as far as is possible, the high value environmental habitats around the island, the options for future coastal management will be limited in scope and more likely to be tailored to low level investment over a long time period rather than high level capital schemes with high initial costs. Also, the timing of works will be critical in obtaining value for money from both new and existing defences.

Option consideration must, however, recognise the strategic importance of the island as a whole and the need to maintain it as an entity and as an integral element of the shoreline of the south west tip of Cumbria.

A range of options has been considered for each strategy unit in turn, with those that are clearly not viable economically or otherwise, dismissed at an early stage so that greater emphasis can be placed on those options that are more likely to meet the objectives for the shoreline. Evaluation starts from the present position and identifies what the specific needs are for each section of shoreline, what actions are presently being carried out and what actions are most appropriate to meet the specific objectives that have been set.

The options include:

- Maintenance of existing linear defences
- Selective removal of isolated defences
- Construction of retired line defences inland
- Improvements in level of flood protection by localised raising of existing defences, bunds etc
- Beach management / recycling
- Artificial beach reinforcement

In addition, in areas where landfill operations have taken place, the potential for removal of the tip to another site should be considered.



Option evaluation requires examination of a number of 'what if' scenarios that could involve consideration of the effects of combining one or more of the above within each strategy unit. Where appropriate, preliminary estimates of cost have been identified for consideration against the do-nothing benefits identified previously (see section 5.3.5).

A preliminary assessment of the risks involved with all options, including the do-nothing alternative, is provided later in this section of the report.

5.3.8.1 Strategy Unit No. 1

There are no artificial defences across this unit at present, nor have there been any in the past. Coastal defence is provided by a natural shingle bank backed by dunes and heath on the seaward facing coast. On the east facing coast, saltmarsh has formed in the lee of the north spit of the island.

The only tangible asset within the area is the elevated Walney Airfield (ground level, from OS spot levels, approximately 9.0m AOD) the boundary of which is 200-300 metres from the present stable shoreline and is at no risk from flooding or erosion. Between the north west end of the airfield and the shoreline, approx. 4 hectares of land was used between the late 1960's and the mid 1990's as a landfill tip.

The specific objectives relevant to this strategy unit are:

Primary Objectives

To minimise the effect that artificial coastal defences have on the natural behaviour of coastal and geomorphological processes across the island.

To evaluate whether it is appropriate to provide artificial flood protection to low-lying land that is vulnerable to tidal inundation, and if so, what the standard of protection should be.

To take appropriate measures to prevent pollution of the shoreline from historic or active landfill sites adjacent to the coast.

To ensure that in planning and managing the coast protection and flood defences on Walney Island, all necessary sustainable steps are taken to help the internationally and nationally important nature conservation interests around Walney Island (SPA, cSAC, Ramsar, NNR, SSSI) to achieve favourable condition, subject to natural change.

Secondary Objectives

To continue to monitor the effects of the Earnse Point Groyne and its potential effect on downdrift frontages and provide appropriate coastal management measures where appropriate.

To take due account of the historic resource of the island in any future coastal management actions

To inform the statutory planning process with regard to areas at risk from erosion and/or flooding.



With no tangible assets at risk, there is no basis for publicly funded intervention measures. In the event that recession of the shoreline took place in the future, a number of options could be considered:

Removal of tip material - The amount of material in the tip is unknown but assuming from photographic evidence that a nominal depth of 5 metres of fill has been placed this would provide an estimate of 200,000m³ or 350,000t of material deposited. Assuming a rate for excavation, loading, transporting and disposal at another site, within say 25 miles if one was available, of say £4 per tonne, this would cost £1.4 million.

Linear intervention - Provision of a linear armour defence, similar to that employed along the tip frontage at low bank is estimated to cost of the order of £100-150,000.

Beach Recharge - Recharging the beach to maintain the level of defence is an alternative that would allow for natural shoreline processes to continue unhindered but would prevent natural interaction with the shoreline from occurring and halt any retreat. However, the need to consider this option would mean that more material was passing out of the north end of the frontage than was entering from the south. Therefore, any material placed would need to be replaced at regular intervals, unless it was coarser than the existing shingle and therefore better able to resist the wave and current forces acting on it.

Cross shore intervention to hold the material in place and avoid the need for replacement could be considered but would hinder natural coastal process/shoreline interaction behaviour to either side.

A number of alternative methods could be considered for obtaining recharge material, including:

- Recycling material from other parts of the island
- Importing natural material that matches the indigenous shingle material
- Use of a different material (e.g. dredging arisings from the Walney Channel)

The acceptability of the recycling option depends on the source material. Removal of material from active areas of shingle on the foreshore is likely to disturb areas of vegetated shingle that are a designated habitat within the Morecambe Bay Marine Site. Any such extraction operation may also affect the natural defence capability provided by the shingle.

Removing material from non mobile areas may cause less disturbance and could have less effect on habitats. Such extraction is currently taking place at the south end of the island where additional lagoon areas have been created. Planning permission has been granted for extraction of 30,000tonnes per annum, up to a total of 200,000tonnes. Permission was first granted in 1985, and this was extended in 1996 to run until 2004. No extraction is allowed below -6mODN and the site covers 5.3 hectares. Utilising such an operation to provide beach recharge would be a long term commitment, as material placed on the foreshore would migrate to other environmentally sensitive areas of shingle. As stated above, it would most likely not be acceptable to retrieve shingle from such areas, thereby requiring further excavation from non mobile sources to maintain the policy.



At this stage it has not been possible to establish the likely effects of these actions due to lack of information on habitats, rates of drift etc. More detailed consideration will be given within Stage 2, however the potential influence of such an operation would require appropriate assessments under the Habitats Regulations to be carried out before actions could be considered. Such assessments are outside the scope of the Strategy, which would have to make recommendations for them to be carried out should other indicators identify the option as being potentially viable.

Importing Material

Importing natural material to provide protection has been carried out elsewhere in the United Kingdom using similar material to that on the foreshore. The option relies on identification of a suitable source, usually land based, that meets the requirements. If this is not available locally, which is likely to be the case, then the expensive costs of transport will make the option not viable.

Use of Dredging Arisings

The use of dredging arisings would provide a finer material than the existing and this has particular disadvantages:

1. It would cover up the shingle and therefore disturb the habitat, and
2. As it is finer, it would be more easily removed and require more frequent replenishment
3. It may not be suitable for other reasons e.g. contamination

This option is, however, potentially cheaper than artificial recharge, as the costs of transportation and placing of the material may be offset against the use of an alternative disposal site offshore. It also involves recycling of material that would otherwise be dumped at sea.

These options have not been costed at present due to the uncertain nature of their potential use. However, a qualitative risk analysis of the various options identified for this unit is provided in Table 5.6 below:



Table 5.6 – Qualitative Option Risk Assessment – Strategy Unit No. 1

Risk	Options				
	Do-Nothing	Linear Defence	Beach Recharge (recycling)	Beach Recharge (imported)	Beach Recharge (dredging arisings)
Lack of understanding of coastal process / shoreline interaction	Low	Low	High	High	High
Uncertainty over rate of shoreline movement	Low	Low	High	High	High
Effects of policy in adjacent SU's	Low	Low	Low	Low	Low
Priority for different sections within SU	Low	Low	Low	Low	Low
Shoreline pollution	Low	No risk	Low	Low	Low
Damage to MBES habitats at site	Low	Medium	High	Medium	Medium
Damage to MBES habitats remote from site	Low	Low	High	Low	Low
Damage to habitats above HWM at site	Low	Medium	Low	Medium	Medium
Damage to habitats above HWM remote from site	Low	Low	High	Low	Low
Interference with natural processes	No risk	High	Medium	Medium	Medium
Valuation of scheme damages	Low	Low	Low	Low	Low
Unknown future costs	No risk	Low	Medium	Medium	High
Overall	Low	Medium/Low	High/Medium	Medium/Low	Medium
Notes					
MBES – Morecambe Bay European Site					

Under present circumstances, there is no case for intervention within this unit as the do-nothing option for coastal defence provides the most cost effective way forward and has the lowest overall risk associated with it. However, there is a clear need for on-going monitoring within this unit to provide early warning of changed conditions and more detailed consideration of the alternative actions identified here. Furthermore, it should be remembered that this area is subject to pressures other than those from the sea and appropriate management actions that work in tandem with this strategy should be maintained or improved.



5.3.8.2 Strategy Unit No. 2

This strategy unit represents the developed section of the west coast north of Mill Scar to the south west boundary of the airfield. The section of shoreline has been largely defended since the 1950's with the earliest defences predating this by some 20 years. The form of these defences – impermeable rigid walls - prevented erosion of the coastline but caused beach lowering, which in turn increased the exposure of the defences leading to failure. The integrity of this section of shoreline was secured by the building of a shore connected rock groyne in the early 1990's that trapped drift to the south and reduced exposure of the shoreline. On the north side the groyne, the groyne appears to have caused some localised beach starvation, by preventing nearshore drift from continuing, with the consequence that there has been an increase in exposure conditions and erosion of the shoreline that requires on-going monitoring.

Continued erosion of the shoreline would put at risk a number of holiday homes on the West Shore Park and would sever the present access road to the old tip area. On the south side of the groyne there is the potential for longer term failure of the older defences, although they are well protected by the natural beach in this area and any problems are considered to be long term.

The specific objectives identified as being relevant to this strategy unit are:

Primary Objectives

To minimise the effect that artificial coastal defences have on the natural behaviour of coastal and geomorphological processes across the island.

To ensure that in planning and managing the coast protection and flood defences on Walney Island, all necessary sustainable steps are taken to help the internationally and nationally important nature conservation interests around Walney Island (SPA, cSAC, Ramsar, NNR, SSSI) to achieve favourable condition, subject to natural change.

Secondary Objectives

To continue to monitor the effects of the Earnse Point Groyne and its potential effect on downdrift frontages and provide appropriate coastal management measures where appropriate.

To avoid adverse interference with navigation into and out of the Port of Barrow as a result of future coastal management actions.

To take due account of the historic resource of the island in any future coastal management actions

To maintain and where possible improve the provision of appropriate access to the foreshore at Earnse Point and other points around the island, for use by emergency services vehicles and other shoreline users, subject to environmental restraints applying.

To avoid adverse affects on bathing water quality off the island as a result of future coastal management actions.



To inform the statutory planning process with regard to areas at risk from erosion and/or flooding.

The Shoreline Management Plan identified a policy of hold the line for the management units within this Strategy Unit and given the present condition and level of protection this policy is likely to be achieved with minimum expenditure.

A policy of retreat could be considered, but this would require expensive of existing defences and re-siting of present developments like the West Shore Park and parts of the golf course. Given the expenditure that has already been incurred to refurbish defences across the frontage in the past ten years such an approach is unlikely to be economically suitable or socially acceptable and has therefore been dismissed.

A policy of holding the line, with minimum expenditure, would comprise a number of elements:

- Maintenance of all existing defences – Estimated cost < £5,000 per annum
- Possible new defences across West Shore Park. This section appears to be suffering from interruption of drift as a result of the groyne works and requires monitoring in the future to identify whether further intervention or possible relocation of assets may be required. Alternative courses of action could be considered, such as:
 - Linear defences, as discussed in Strategy Unit No. 1
 - Beach recharge, also considered in Strategy Unit No. 1
 - Removal or alterations to the shore connected arm of the groyne. This might assist in reinstating upper beach drift and negate the need for longshore intervention works.

Monitoring would provide data such that the alternative actions could be evaluated, however not withstanding the above capital expenditure of typically £50-100,000 could be expected.

- Possible refurbishment / bolstering of masonry defences south of Earnse Point. Alternative forms of construction that may be considered will depend on the overall integrity of the structure, but could include:
 - Beach recharge – as discussed earlier, options as for SU1 apply.
 - Bolstering the lower parts of the structure with graded stone or complete reconstruction in a linear revetment.

It is considered likely that subject to review and with appropriate maintenance the life of the structure could be enhanced without the need for significant future actions.

Allowing for maintenance of structures, appropriate monitoring (apportioned across the whole of the island), and an allowance for capital works across West Shore Park in the future provides a net discounted cost over 50 years of approximately £100,000. This is slightly less than the do-nothing benefit calculated for this unit and, therefore, this do-minimum approach is considered likely to present, based on the preliminary examination of data carried out, the only cost effective approach to future management for this unit.

A qualitative risk analysis of the options considered for this unit is provided in Table 5.7 below:



Table 5.7 - Qualitative Option Risk Assessment – Strategy Unit No. 2		
Risk	Options	
	Do-Nothing	Hold the Line – Do minimum
Lack of understanding of coastal process / shoreline interaction	Medium	Low
Uncertainty over rate of shoreline movement	Low	Low
Effects of policy in adjacent SU's	Low	Low
Priority for different sections within SU	Medium	Low
Damage/failure of existing defences	Medium	No risk
Damage to MBES habitats at site	Low	Low
Damage to MBES habitats remote from site	Low	Low
Damage to West Shore Park properties and access	Medium	No risk / Low
Damage to Earnse Point defences	Low	No risk / Low
Loss of Golf Club land	Medium	No risk / Low
Interference with natural processes	Low	Low
Valuation of scheme damages	Medium	Low
Unknown future costs	No risk	Medium
Overall	Medium / Low	Low
Notes MBES – Morecambe Bay European Site		

Under present circumstances there is no case for any further intervention within the unit in the near future. However, the on-going policy to be adopted is one of maintaining the line with only a minimum investment cost stream likely to be viable. The extent of any maintenance can only be identified by an on-going practice of beach monitoring and structural surveys to provide early warning of changed conditions.

5.3.8.3 Strategy Unit No. 3

Strategy Unit No. 3 represents the most complicated section of shoreline around Walney Island due to a number of key factors:

- Potential linkage of tidal water across the island from west to east coast
- Varied geomorphology and topography
- Longshore drift mechanisms that feed the southern spit with material eroded from the west coast
- Extensive historical and current use of the hinterland for landfill purposes
- Much of the inter-tidal zone and a large part of the hinterland at the south end are designated of particular conservation importance



Since approximately the 13th century, attempts have been made to restrain the west facing shoreline to protect the land available for agricultural purposes. In the more recent past the need to find places to dispose of human generated waste has led to significant areas of land, much of which abuts the shoreline, being used for this purpose. At present there are two known sites:

1. An historic tip on the site of the present Bent Haw Car Park, that is thought to have been operative for a period between 1950 and 1970.
2. Land between Hillock Whins and Hare Hill filling of which commenced in the late 1960's and is due for completion before the end of the year 2000.

As these tips were placed directly adjacent to the shoreline, they necessitated the construction of coastal defences to prevent waste being eroded and deposited on the shoreline. This has been achieved by the erection of linear defences, although originally a groyne system was erected between Bent Haw and Middle Hill, in an attempt to hold a beach in front of the tip area and prevent / slow down the longshore drift of material. This appears to have been successful for the period the tip was in operation. However, since that time the groynes have been dismantled and a linear defence runs across the frontage which is constructed from a mixture of blocks of large stone and lumps of broken concrete. The defence does not appear to protect the whole of the frontage and there is evidence from recent inspection that waste material has started to be eroded.

The defences to the tip between Hillock Whins and Hare Hill were constructed in two phases: The most northerly section between Hillock Whins and Cross Lane at the end of the 1980's and more recently across Low Bank in 1997. From inspection, the former of these appears to be inadequate through poor detailing and/or insufficient elevation.

Elsewhere on the west coast the land immediately to landward is low lying and storms erode the shoreline and wash the shingle bank landwards. In an attempt to stop this armour bunds have been erected along the shoreline at Middle Hill and between Cow Leys and Hillock Whins.

Flood defence on the east coast is generally provided by the natural topography of the land supplemented at low spots by the intermittent earth bunds that are privately maintained. The most significant of these are the earth bank that runs northwards from the village of Biggar towards Tummer Hill (Biggar Dyke) and a 1.5km long embankment around the southern end of the island, built to protect the sand and gravel workings from inundation and which now protects the oyster farm.

The specific objectives identified as being relevant to this strategy unit are:

Primary Objectives

To minimise the effect that artificial coastal defences have on the natural behaviour of coastal and geomorphological processes across the island.

To maintain Walney Island as a strategic defence to the Port of Barrow and the surrounding area.

To evaluate whether it is appropriate to provide artificial flood protection to low-lying land that is vulnerable to tidal inundation, and if so, what the standard of protection should be.



To take appropriate measures to prevent pollution of the shoreline from historic or active landfill sites adjacent to the coast.

To ensure that in planning and managing the coast protection and flood defences on Walney Island, all necessary sustainable steps are taken to help the internationally and nationally important nature conservation interests around Walney Island (SPA, cSAC, Ramsar, NNR, SSSI) to achieve favourable condition, subject to natural change.

Secondary Objectives

To avoid adverse interference with navigation into and out of the Port of Barrow as a result of future coastal management actions.

To maintain and where possible improve the provision of appropriate access to the foreshore at Earnse Point and other points around the island, for use by emergency services vehicles and other shoreline users, subject to environmental restraints applying.

To take due account of the historic resource of the island in any future coastal management actions

To avoid adverse affects on bathing water quality off the island as a result of future coastal management actions.

To inform the statutory planning process with regard to areas at risk from erosion and/or flooding.

The requirements for future coastal defence need to address the following issues:

- Provision of appropriate protection to landfill tips
- The need to maintain natural process behaviour that is sustaining the shoreline and hinterland habitats within the unit
- Provision of an appropriate level of defence to agricultural and other land

The strategy for coastal defence needs to consider the implications of these issues and due to the interaction identified earlier, evaluation of the following options either in isolation or in combination is appropriate:

1. Removal of tip material
2. Beach reinforcement
3. Potential for scar reinforcement
4. Maintenance of linear defences
5. Selective removal of existing defences
6. Upgrading of existing flood defences
7. Consideration of construction of retired line defences



It is unlikely, based on the preliminary examination of the Do-Nothing benefits applying (ref. Table 5.5), that an economic case for significant new intervention can be made and evaluation of suitable options within this management unit therefore needs to concentrate on where defences presently exist and whether they are sustainable in their current positions. With regard to first two options, the arguments made for their use within Strategy Unit No. 1 apply equally here and are not repeated.

The cost for removal of tip material is different due to the different sizes of the tip areas with the following applying within this management unit:

Removal of tip material - The approximate areas of each of the tips taken from aerial photographs, is as follows:

Bent Haw:	20,000m ²
Hillock Whins to Hare Hill:	200,000m ²

Due to the relative level of the land it is considered unlikely that more than 5m average depth of fill was placed at the former site and approximately 7.5m at the larger site. This equates to about 100,000m³ in total at Bent Haw and 1,500,000m³, or 50,000m³ per annum, between Hillock Whins and Hare Hill. Based on the rates allowed for in Strategy Unit No. 1, the costs for complete removal would be:

Bent Haw:	£700,000
Hillock Whins to Hare Hill:	£10,500,000

This level of expenditure cannot be justified against the Do-Nothing benefits applying, although partial removal of some of the material locally could be considered in conjunction with other measures

Maintenance of, in particular, the Hillock Whins to Hare Hill tip is important in the maintenance of Walney Island as a whole, as without the land raising and associated intervention there would have been a potential risk of the island being split in two within the timescale of this strategy.

Potential for scar reinforcement

The artificial reinforcement of the inter tidal zone scars have been considered previously, specifically with regard to proposed coastal defences associated with the planning application to use the area around South End Farm as a landfill tip. The scars already play a role in controlling exposure conditions by attenuating waves. Artificial raising of their level by reinforcement with imported material of suitable size would accentuate this effect, however, the following points are highlighted with regard to such a solution:

- The reinforced scars would slow down erosion rather than prevent it. Whilst this may be preferable where it is thought necessary to achieve a compromise between prolonging the life of an asset and maintaining natural process behaviour, its use where erosion could lead to pollution (e.g. along tip frontages) has inherent risks.
- Reinforcement with glacially derived material of a suitable size and type, that matches the indigenous material of the scars could be difficult to source, as well as potentially expensive.
- Reinforcement would not necessarily remove the vulnerability of the scars to continued erosion of the underlying till in extreme conditions.
- Reinforcement would cover up the communities that provide important habitats, e.g. *Sabellaria alveolata*.



An appropriate assessment, as advocated for the option of beach recharge, would need to be considered for this option to weigh the environmental benefits against the technical and economic criteria applying. It may be appropriate to consider this option further within future stages of Strategy development.

Remaining Options

The remaining options are based on maintenance or modification of existing defences. Therefore it is appropriate to examine these defences in relation to the present environment and then examine the effects the remaining options would have on the lengths of shoreline locally and collectively.

The shoreline can be split down into four sub units, with the boundaries set by specific physical features that apply some degree of control on shoreline behaviour. The proposed sub units are:

1. Mill Scar to Hillock Whins
2. Hillock Whins to Hare Hill
3. Hare Hill to South End Haws
4. South End Haws to Tummer Hill (East Coast)

Mill Scar To Hillock Whins

Available historical evidence confirms Mill Scar as a fixed point on the shoreline, where drift behaviour divides to the north and south. Hillock Whins is the remains of a drumlin that in the past 150 years appears to have eroded at a slower rate than the shoreline to the south, which is now indented some 50 to 100m eastwards.

The shoreline in this sub unit is presently artificially restrained at three locations:

- Bent Haw
- Middle Hill
- Cow Leys to north side of Hillock Whins

At Bent Haw, the defences protect a car parking area and, to a degree, the tip area identified above. The public highway some 80m landward. Middle Hill represents a low spot on the shoreline behind which the land falls in a valley across the island. This provides a conduit for tidal waters to the village of Biggar under extreme conditions. An armour stone bund was constructed along the toe of the cliff in 1988, but this is now being outflanked. Furthermore, the level of the bund is set too low for the exposure conditions applying. Extreme conditions, such as occurred in February 1997, can overtop the defence and cause extensive flooding of the hinterland. The defence at Cow Leys is similar in form and provides a similar function to those at Middle Hill. The land behind is low lying but less pronounced than in the vicinity of Middle Hill.

All the defences along this section provide an erosion prevention function. However, due to the generally porous nature of the constructions (due to the lack of appropriate filter layers etc.), cliff material can be readily drawn through the defences. Furthermore, the assessment of the standard of service in terms of overtopping is also variable. For example, the Bent Haw defences have a higher crest elevation than the other lengths (ref. section 5.3.1.1).

By covering discrete sections of the shoreline, the defences are only 'holding the line' along the defended lengths, whilst the adjacent undefended shorelines continue to erode, with the inevitable consequence that they will in time be outflanked, as confirmed by site inspection.



Maintenance of the present defences in their current position would require the following:

- Initial bolstering of the defences to provide an appropriate form of defence. This would most appropriately be carried out by reconfiguration of the existing structure supplementing the existing material with new material to provide more hydraulically efficient and enhanced structural integrity. The structure at Bent Haw would probably require extension southwards to prevent foreshore pollution from the landfill site.

An estimated initial costs of £500 per m run applies, which equates to £500-600,000 for the lengths currently defended

- Recession of the shoreline to either side would require on-going investment to tie- back the structures to the eroding shoreline to either side. The ultimate consequence would be a series of artificial promontories with recessed bays in between.

An estimate of on-going expenditure of £50,000 every five years has been made to ensure the defences are not outflanked.

Selected removal of defences would have potentially different consequences dependent on the length(s) of defence removed.

Removal of the defences at Bent Haw would have the following consequences:

- Pollution of shoreline from the old tip
- Loss of or re-siting of car parking area inland
- Potential increased rate of erosion

Removal of the defences at Middle Hill and Cow Leys would have the following consequences:

- Lowering of level of defence, which would deteriorate further with time
- Inundation of hinterland on a more regular basis

The cost of removal of defences would be of the order of £50,000 with the potential for material to be utilised elsewhere. In addition there would be costs of relocation of the car park and the damages in terms of hinterland flooding that would occur should such an option be adopted. This would cancel out much of the benefits applying under the do-nothing scenario, with the consequence that low level expenditure only is likely to be viable.

Removal of the present defences and construction of new defences on a retired line would provide for reinstatement of natural process behaviour and interaction with the shoreline across this length.

Relocation of defences along this section could be applied in a number of ways depending on the specific objectives to be met.

Assuming that removal of tip material is ruled out on cost, maintenance of a form of defence across Bent Haw would be necessary if pollution was to be prevented. However, for the defences across Middle Hill and Cow Leys, there is no apparent pollution risk and the provision of a retired line defence would remove the present restraint on the shoreline, thereby reinstating natural processes / shoreline interaction, and would provide necessary defence to limit the areas that would be inundated. This retired defence could, for example, take the form of an earth bund set back an appropriate distance from the present shoreline.



The consequences of this policy are:

- Bent Haw car park and tip area protected
- Armour stone from defences at Middle Hill and Cow Leys could be re-used in improved Bent Haw or other defences
- Some permanent loss of agricultural land
- Retired flood bunds could utilise excavated tip material, covered with locally won earth / topsoil
- Flood plain linkage across island could be prevented by appropriate retired line defences

As an initial estimate, the above could be implemented at a cost of £250-350,000, with potential damages significantly less than those that would apply under a complete removal policy.

Hillock Whins to Hare Hill

Hillock Whins to Hare Hill is the section of frontage along which the integrity of the island has been safeguarded by the use of the hinterland as a landfill tip. This has raised the level of the land removing the flood risk that previously existed. The landfill tip has also effectively bolstered the island at a point where the width of the island had reduced to about 200 metres and had halved in the previous 100 years.

This section of frontage is flanked by the elevated headlands of Hillock Whins to the south and Hare Hill to the north. These are the remains of drumlins that in the past 150 years appear to have eroded at a slower rate than the shoreline in between, which is now indented some 50-100 metres eastwards.

Linear coastal defences have been constructed in order to preserve the integrity of the landfill site. This has prevented the release of sediments to the inter-tidal zone but the effect of this is not considered to be as significant as elsewhere, due to the indentation of the shoreline across the frontage.

For this section, options are limited to the following:

- **Removal of the tip material** has been identified as cost prohibitive.
- **Removal of the defences** could only be considered if pollution of the shoreline was acceptable.
- **Relocation of the defences** would reduce the amount of tip material to be moved but the scope is limited given the width of the island and little would be gained by adopting such a course of action.
- **Maintenance of the defences** clearly represents the cheapest option, although this does require capital investment in the short term to bolster parts of the existing defence that require immediate attention to prevent material from being washed out of the landfill.

The cost of this option is estimated to be less than £100,000, although this figure could be reduced if material from redundant defences elsewhere was available for re-use. All the defences would require on going monitoring and maintenance throughout the strategy period.

Hare Hill to South End Haws

Artificial coastal defence along this section has historically been limited to cross shore intervention in an attempt to slow or halt the littoral drift occurring. Specifically, structures have been erected:

- South of Hare Hill,
- at Hilpsford Point, and
- at South East Point.

The structures were probably erected in response to the 19th century erosion rate analysis that suggested the island could be breached by the middle of the 21st century. At the first two of these locations, the structures have had only limited success due to the high energy environment and a lack of the maintenance that such structures require.



The groynes that were erected may have assisted in slowing down the rate of erosion but, as identified in the initial examination of recent historical recession rates carried out for the preliminary assessment of the do-nothing scenario, the likely rate is between 0.5 and 1.0m per annum. However, interpretation of particular values suggests that a potential upper limit of 2.5 m p.a. could occur.

The inter tidal zone of the frontage and the majority of the hinterland south of Pho Hill are of particular environmental importance, with key habitats of the Morecambe Bay European Marine Site (e.g. sand dunes and vegetated shingle) particularly prevalent. Therefore, any intervention works have the potential to damage these habitats. As identified previously, construction of new defences is inappropriate.

Maintenance of the existing groynes could be considered as a potential option, although some structures are now detached from the shoreline (Photo 17). This option would have the effect of potentially slowing erosion across the frontage and limiting the rate of accretion at the southern end. However, only minimum investment is likely to be viable set against the benefits associated with this part of the island and the estimated cost of this option would be of the order of £150-200,000.

Consideration is likely to be more appropriately given, as between Bent Haw and Middle Hill, to a **retired line defence**. This would provide a degree of protection in extreme events to areas of land used for agriculture, subject to detailed evaluation of land levels and usage. It is estimated that such a defence might cost £50-100,000. Such defences would need to be evaluated in detail including assessment of the lesser threat of flooding from the east coast. With this option, land adjacent to the shoreline would continue to be lost, but the impact of infrequent flooding would be reduced.

South End Haws to Tummer Hill (East Coast)

The natural defence provided by saltmarsh, supplemented in places by human constructions, dictates the level of coastal defence throughout this sub unit. Most of the artificial defences are earth bunds that are privately maintained to protect specific interests. Future requirements will be based on the justification for improved flood defence levels. In a number of places there is potential linkage of flood waters across the island, however, confirmation of the hinterland topography is required to confirm this.

In general, there is no case for removal of any of these defences as they are not, under present conditions, causing 'coastal squeeze' on the natural defences in front of them.

It is, however, appropriate to evaluate the level of service being provided by the defences. This will establish whether there is any justification for improvement either by upgrading or reconstruction. At present, there is insufficient data to identify what improvements may be appropriate throughout this sub unit with any certainty. However, justification for expenditure over the next 50 years, in excess of £100,000, is considered to be unlikely.

At present, there are no specific defences in front of the South End Caravan Park and any proposed works along this frontage should include consideration of whether it would be more appropriate to re-site parts of this development.

Summary

The above assessment provides a range of investment options for different sections of Strategy Unit 3, with expenditure, when discounted over 50 years and including appropriate monitoring, of between £500,000 and £1 million. This compares with a discounted value of benefits of between £200,000 and £1 million. It is clear that justification of future investment requires a 'firming up' of both the costs applying and the value of assets at risk in order to confirm the viability of the options considered. A qualitative risk analysis of the options considered for this unit is provided in Table 5.8.

Table 5.8 - Qualitative Option Risk Assessment – Strategy Unit No. 3

Risk	Options											
	Do-Nothing				Maintain Present Defences				Relocate Defences			
	S3SU1	S3SU2	S3SU3	S3SU4	S3SU1	S3SU2	S3SU3	S3SU4	S3SU1	S3SU2	S3SU3	S3SU4
Lack of understanding of coastal process / shoreline interaction	High	High	High	Low	Med	Low	Med	Low	Med	N/A	Med	Med
Uncertainty over rate of shoreline movement	High	High	High	Low	Med	Low	Med	Low	Med	N/A	Med	Low
Effects of policy in adjacent SU's	High	High	High	Low	Med	Low	Med	Low	Med	N/A	Med	Low
Priority for different sections within SU	Low	Low	Low	Low	Med	Med	Low	Low	Med	N/A	Low	Med
Damage/failure of artificial defences	Med/High	High	Low	Low	Low	Low	Low	Low	Low	N/A	Low	Low
Damage to MBES habitats at site	Low	Med	Low	Low	Med	Med	Low	Low	Low	N/A	Low	Low
Damage to MBES habitats remote from site	Low	Low	Low	Low	Low	Low	Low	Low	Low	N/A	Low	Low
Damage to habitats above HWM at site	N/A	N/A	Low	Low	N/A	N/A	Low	Low	N/A	N/A	Low	Low
Damage to habitats above HWM remote from site	Low	Low	Low	Low	Low	Low	Low	Low	Low	N/A	Low	Low
Intermittent flooding of commercial properties and disruption to infrastructure	Med/High	Low	Low	Med	Low	Low	High	Med	Med	N/A	Low	Low
Erosion of landfill / shoreline pollution	High	High	Low	Low	Med/High	Low	High	Low	High	N/A	Low	Low
Flooding of agricultural land	High	Low	High	High	High	Low	High	High	High	N/A	Med/Low	Low
Erosion of agricultural land	High	Low	High	Low	High	Low	High	Low	High	N/A	High	Low
Interference with natural processes	Low	Med	Low	Low	Med/High	Med	Med	Low	Low	N/A	Low	Low
Valuation of scheme damages	High	High	High	High	Low	Low	Low	Low	Med	N/A	Low	Low
Unknown future costs	No risk	No risk	Low	Low	Med	Low	Med	Low	Med	N/A	Low	Low
Overall	Med/High	Med	Low	Low	Med	Low	Med	Low	Low/Med	N/A	Low	Low
Notes												
MBES – Morecambe Bay European Site												



5.3.8.4 Strategy Unit No. 4

The section of shoreline within this Strategy Unit represents that part of the shoreline closest to the Cumbrian mainland and that which fronts the most heavily developed residential part of the island (Vickerstown and North Scale). The shoreline has developed on a natural coastal slope, with the most elevated areas some 10 metres above the foreshore level across the frontage. The shoreline is sheltered from wave impacts with exposure conditions governed by water levels. Only one section of the shoreline is presently defended, the length for about 1 km north of the Jubilee Bridge which comprises a sloping revetment and footpath that directly abuts the public highway, with extensive residential development behind. This section was built in the 1930's.

Future risk to the coastal defences and associated hinterland development arises from occurrences of increased sea levels either due infrequently to changing atmospheric conditions or potentially more frequently by the effects of global sea level rise.

The specific objectives identified as being relevant to this strategy unit are:

Primary Objectives

To maintain Walney Island as a strategic defence to the Port of Barrow and the surrounding area.

To evaluate whether it is appropriate to provide artificial flood protection to low-lying land that is vulnerable to tidal inundation, and if so, what the standard of protection should be.

To provide an appropriate level of coastal defence to the built up areas of Vickerstown and North Scale.

To maintain in a favourable condition, subject to natural change, all habitats around Walney Island designated as part of the Morecambe Bay Marine Site.

Secondary Objectives

To avoid adverse interference with navigation into and out of the Port of Barrow as a result of future coastal management actions.

To maintain and where possible improve the provision of appropriate access to the foreshore at Earnse Point and other points around the island, for use by emergency services vehicles and other shoreline users, subject to environmental restraints applying.



To take due account of the historic resource of the island in any future coastal management actions

To avoid adverse affects on bathing water quality off the island as a result of future coastal management actions.

To inform the statutory planning process with regard to areas at risk from erosion and/or flooding.

The do-nothing evaluation carried out has identified the potential assets at risk within this unit in the event that the present defences failed. These assets represent the majority of benefits applying across the island. There is a clear case for maintenance of these defences, with some opportunities for improvements to hold the line. As much of the shoreline is undefended at present, it is likely that a policy of do-nothing will effectively achieve this, certainly in the short term. However such a policy is likely to require review in the longer term.

As advocated above, the Shoreline Management Plan identified a policy of selective hold the line and do-nothing for this management unit. Given the present condition and level of protection, this policy is likely to be achieved with minimum expenditure. Clearly, a policy of retreat cannot be considered due to the topography of the hinterland and the extent of development that exists.

As with the older defences on the west coast, appropriate maintenance should extend the life expectancy of defence structures, which may or may not include reconstruction within the strategy period. However, based on the evidence available there would appear to be a need to provide improved flood defence to the most exposed section of the frontage. This could be achieved by the provision of a small flood wall on top of the existing revetment. Subject to foundation considerations, an improvement from 1 in 10 year return period to over 1 in 100 year could be easily achieved at a nominal cost with a positive benefit cost ratio.

Estimated discounted flooding losses amount to approximately £100,000 based on present data with estimated costs for improvements as described likely to be of the order of £75,000 for the frontage required. Reconstruction of the wall, if necessary in time, could be achieved on the same footprint that exists, thereby avoiding unnecessary long term disturbance or interference to the ecological condition of the inter-tidal zone. It is estimated that the capital cost would be of the order of £1-1.5 million.

A qualitative risk analysis of the options considered for this unit, is provided in Table 5.9 below:



Table 5.9 - Qualitative Option Risk Assessment – Strategy Unit No. 4

Risk	Options	
	Do-Nothing	Hold the Line – Do minimum
Lack of understanding of coastal process / shoreline interaction	Medium	Low
Uncertainty over rate of shoreline movement	Low	Low
Effects of policy in adjacent SU's	Low	Low
Priority for different sections within SU	Low	Low
Damage/Failure of existing defences	Medium	No risk / Low
Damage to MBES habitats at site	Low	Low
Damage to MBES habitats remote from site	No risk	No risk
Intermittent flooding of properties and disruption to infrastructure	High	No risk / Low
Damage to sewerage infrastructure	Medium	No risk / Low
Pollution of Walney Channel	Medium	No risk / Low
Loss of residential properties	Medium	No risk / Low
Interference with natural processes	Low	Low
Valuation of scheme damages	High	Low/Med
Unknown future costs	No risk	Low
Overall	Medium	Low
Notes		
MBES – Morecambe Bay European Site		

Under present circumstances, there is a case for detailed assessment to establish the need for an improved standard of service against flooding to the low lying properties behind the promenade. Otherwise the policy does not require further investment until such time that the present structures require replacing. An on-going practice of monitoring to provide early warning of changed conditions and carrying out routine structure maintenance on a regular basis is also required. Furthermore, the adjacent sections of shoreline that presently do not have any artificial defences in place require on-going review in the event that assets come under threat. The appropriate policy to be adopted is one of maintaining the line, with only a minimum investment cost stream and low capital investment in the short term, but with the possibility that further major investment to renew defences may be required in the longer term.



5.3.8.5 Discounted Cost Stream & Policy Summary

Preliminary discounted cost stream spreadsheets for each of the strategy units are provided in Appendix P, with a summary table for the options considered and the range of benefits applying reproduced in Table 5.10. However, further study of intangibles (other costs, benefits and risks that are difficult to quantify, but which are important for the decision making process) is required in Stage 2.

Table 5.10 – Preliminary Economic Summary					
Strategy Unit	Benefits (£000's) Do-Nothing	Option Costs (£000's)			Nominal Range of Benefit/Cost ratios
		Maintain/Improve Existing Defences	Relocate	Remove Tip material	
1	000	Nil	N/A	1,400	N/A
2	120	100	N/A	N/A	1.2
3	220-1,000	1200	600	> 10,000	0.2 – 1.7
4	1,700	500	N/A	N/A	3.4

Note - The preliminary option costing completed is for defences to provide a standard of service of the order of 50years.

Table 5.11 below provides a summary of the options that are considered, based on the preliminary assessment carried out, to provide economically the most viable solution and to provide overall the least risk in relation to the natural, human and built environment, and that best meet the objectives for the strategy unit:

Table 5.11 – Preferred Strategy Policy Summary		
Strategy Unit No.	Overall Policy	Comments
1	Do-nothing	Intervention should only be considered locally in the event of tip erosion. Low risk at present.
2	Hold the line	Minimum expenditure to hold the line.
3	Do-nothing and hold the line or managed retreat	Historic and current tip frontages to be protected to prevent pollution of shoreline. Elsewhere, do-nothing option to be adopted or where defences are fixed, consideration should be given to the option of removal and re-using the material to supplement tip defences. Where there is a risk of severe flooding that potentially links across the island consideration should be given, if viable, to inland flood defences to protect land and infrastructure. The standard of service provided by artificial defences on east coast should be evaluated and any justifiable improvements implemented.
4	Hold the line	Achieved by a combination of selective defence improvement and potential longer term reconstruction.

Notes
All options to include for implementation of appropriate system of monitoring and on-going strategy development



5.4 Strategy Development

Walney Island is the product of natural evolution and it is only during its recent past that interference by man has changed its pattern of behaviour. The island, being a product of glacial and post glacial deposits, has always been vulnerable to winds, waves and tides and has been subject to various geomorphological changes in the past. Development of the Port of Barrow clearly recognised the strategic importance of the Island providing natural protection to the south west tip of the Furness peninsula. However, it is only over the last 100 years or so that a potential threat to this protection has been considered.

The positive and negative effects man has had on the island can be argued about, however, it must be recognised that the island's present form is largely due to natural processes rather than any significant influence by man. It should also be recognised that the action of Man may have slowed down nature's attempt to split the island in two. Had development of the mainland not occurred then such an event might not have been significant. On the basis that the effects on Barrow of a breach of the island would be devastating, intervention in this respect could be seen as positive on balance.

The fundamental criteria in developing a coastal management strategy for Walney Island for the next 50 years is to attempt to achieve a balance whereby human activity and nature conservation can co-exist in reasonable equilibrium. The key to achieving this is to firstly understand the factors that are currently shaping the island naturally. Then evaluation of the effects that intervention by man to serve local communities would have on these natural processes should be completed with a view to identifying the best balance between the two.

The work to date has included preliminary examination of the historical data and, as far as possible, identified the conditions that are currently applying. An attempt to understand present conditions also forms the basis of estimating likely future behaviour. However, whilst all the historical data and commentary supports a general behaviour scenario, the exact mechanisms that are taking place are not completely evident from the data examined.

Specifically, the agreed form of behaviour is one of erosion of the west face of the island with redistribution of sediments to the extremities. However, wave data indicates that over 50 % of waves are approach 15° either side of 90° to the shoreline, indicating that resulting wave induced currents are likely to be minimal. If this is the case, and the waves are the mechanism for sediment mobilisation only, it must be assumed that currents are the primary mechanism that is moving the material away longshore. Furthermore analysis of the areas of erosion and accretion is required to establish whether there is a balance between material eroded on the west coast and that deposited at the extremities of the island. This can be considered to be more applicable at the southern end, although the influence of the Duddon Estuary (north) and Morecambe Bay (south) appear to be having an effect on behaviour at both ends as well.



The first stage of strategy development has confirmed that a number of the criteria laid down in the MAFF guidelines for strategy development have been met, specifically:

- Problems and solutions need to be considered in the longer term and over a wide geographic area.
- Implementation of a programme of works or management is, due to the relatively low level of assets at risk adjacent to the shoreline, most likely to be carried out over a long rather than short timescale.
- There is a hydraulic or process connection between management units.
- There is a potential physical interconnection between potential benefit areas, particularly where the island is narrow.
- Problems require addressing in an integrated manner.
- The island is environmentally important on an international, national, regional and local scale. Future intervention may affect the integrity of sites designated under the Habitats Directive or other protected area.

The data used to examine the economic case have provided ranges of values that confirm low level investment in coastal defence may be viable. However, the options available are limited and clearly need more detailed examination to confirm their viability to determine the most appropriate course of action. This examination should identify:

- The timescale for future intervention, where appropriate
- The true value of assets being protected
- The effects on the environment of allowing present conditions to prevail and of pollution from the current and historical landfill tips
- The environmental effects in terms of a habitat budget any future changes may have.

In some areas there appears to be the potential for large scale damage to occur, either in terms of tangible damage to infrastructure and property or due to pollution of the inter-tidal zone that could have a devastating effect on the environmental conditions applying. However, the present level of data analysis does not allow for an appropriately accurate assessment of these effects to be made.

Furthermore, in order that future investment can be made wisely and for the appropriate priorities to be placed on specific elements across the island, it is necessary to define future actions from the best possible knowledge base. It is considered that the present database does not provide sufficient confidence in our knowledge of existing conditions, or the likely consequences of doing nothing, to enable a reliable judgement to be made. The additional costs of extending the work already carried out (£50,000) represents of the order of 2% of the likely net present value of the damages to assets at risk if a policy of do-nothing was adopted.

It is therefore recommended that further work is required to provide the best baseline position for detailed technical, economic and environmental assessment to be carried out.

This work can be split into two discrete categories as follows:

- That necessary to provide sufficient understanding of coastal process / shoreline interaction to allow for better assessments of the consequences of different courses of



action to be evaluated and for a detailed management strategy to be developed.

- That necessary to allow for on-going confirmation of the strategy policies and for appropriate prioritisation of future management actions.

Specifically, the following elements have been identified within these categories.

Initial Strategy Development

- Improve the understanding of coastal process/shoreline interaction by correlating the available offshore wave data with erosion rates along the island.
- Use of historical and new ground/site investigation information to establish longshore and inshore variance in ground conditions applying.
- Evaluation of land topography, using data from either satellite or photogrammetric techniques, supplemented with physical recording of levels for confirmation.
- Detailed assessment of aerial photographs to establish historical rates of cliff erosion over the past 50 years. This will enable a more robust prediction of likely future behaviour, for use in better evaluating the effects of the scheme options and the Do-Nothing scenario and in determining morphological changes in features, e.g. scars.
- Determination of likely future shoreline evolution utilising the above.
- Carrying out of a habitat audit to identify likely gains/losses in habitats associated with different courses of actions
- Updating of the Strategic Option Assessment and production of the completed Strategy document

A scope of the proposed Stage 2 work is included in Appendix Q. This updates and supplements the scope of work originally submitted in WS Atkins' tender proposal.

Long Term Strategy Development (to be refined as Stage 2 progresses)

- Improvement of present shoreline monitoring, e.g. to include specific cliff recession measurements, habitat mapping, inspection/monitoring timing, and to quantify sediment movement around the island.