SECTION 1 INTRODUCTION

1.1 Preamble

1.1.1 Many of the low lying areas of England and Wales are currently protected from salt water inundation by artificially maintained sea or tidal defence structures. A significant proportion of Britain's richest coastal ecological sites are also situated in these low-lying areas, either to the seaward side of the defences, or immediately behind them. Environmental resources in the coastal zone have been seriously depleted over recent centuries, largely as a result of human activities. If rates of sea level rise increase as predicted in the recent Intergovernmental Panel on Climate Change Reports on global climate change (IPCC, 1990), further losses might be anticipated because coastal habitats will be "squeezed" in the narrowing areas of land between mean low water mark and the defence structures. A significant opportunity to reduce the overall impact of both past and anticipated habitat losses might, however, exist if some coastal land areas are made available for habitat creation or restoration. These benefits could be realised if Britain accepts the principle of retreating from the existing line of flood defence in carefully targetted areas.

1.1.2 In general terms, where an existing flood defence has a low residual life, current practice comprises an appraisal of various structural solutions. Such solutions generally involve the carrying out of engineering works - in other words, intervening to improve the defences. Various options, or one preferred option, will then be compared to the implications of doing nothing (i.e. allowing the defence to deteriorate and fail).

This report explores the possibility that there is a third alternative. This alternative may also involve intervening, in so far as planning, design and engineering works might be required. But rather than those works being undertaken to maintain or improve a flood defence, their objective would be to create, restore or enhance environmentally important habitats. The report examines, in principle, the opportunities which might arise if a retreat from the existing line of flood defence is accepted as an option. In particular, the issues surrounding the concept of a "managed" retreat designed to maximise nature conservation and landscape benefits are investigated. The degree of management which might be required is discussed, areas of uncertainty are highlighted, and conclusions are drawn in respect of the technical, legal and economic viability of this type of environmental enhancement initiative.

1.1.3 The report, in accordance with the Terms of Reference set out in the Project Investment Appraisal (see Appendix A1.1), aims to draw together information from a wide range of disciplines, reviewing the available data in the context of the retreat option. Relevant information is therefore presented in a form which clearly identifies whether or not, and under what circumstances, it may be realistic to pursue a managed retreat from the existing line of flood defence. In this respect, the report provides a framework for the consistent and informed future evaluation of the managed retreat option.

1.2 Report Structure

1.2.1 The remainder of Section 1 of this report determines the geographical scope of the study and defines areas where retreat might be considered as an option in the future. The terminology used in the report is discussed and other important assumptions are highlighted.

Section 2 of the report sets out the background to the report in respect of climate change scenarios and nature conservation interests. Section 3 evaluates the technical viability of the retreat option, discusses possible constraints and determines likely biological, physical and chemical requirements for habitat creation and restoration.

Section 4 examines the various issues surrounding the evaluation of retreat options. Ecological desirability criteria are reviewed, qualitative and quantitative evaluation procedures are briefly explored, and the principles of economic valuation are appraised. Six environmental economics techniques are also assessed.

Section 5 investigates a series of options for the implementation of the managed retreat option. The legal situation is examined, the respective roles of NRA and other interested parties (statutory and voluntary) are discussed, and their existing and possible future policies on retreat are assessed. Finally, Section 6 of the report presents the study's conclusions and recommendations.

1.3 The Scope of the Study

1.3.1 Geographical Study Limits

This report deals largely with issues which are broadly consistent on a national basis throughout England and Wales. Where it has been necessary to focus on smaller geographical units, however, the National Rivers Authority's (NRA) Regions have provided a common basis for such assessments. It was not within the brief of this study to consider issues on an intra-regional basis.

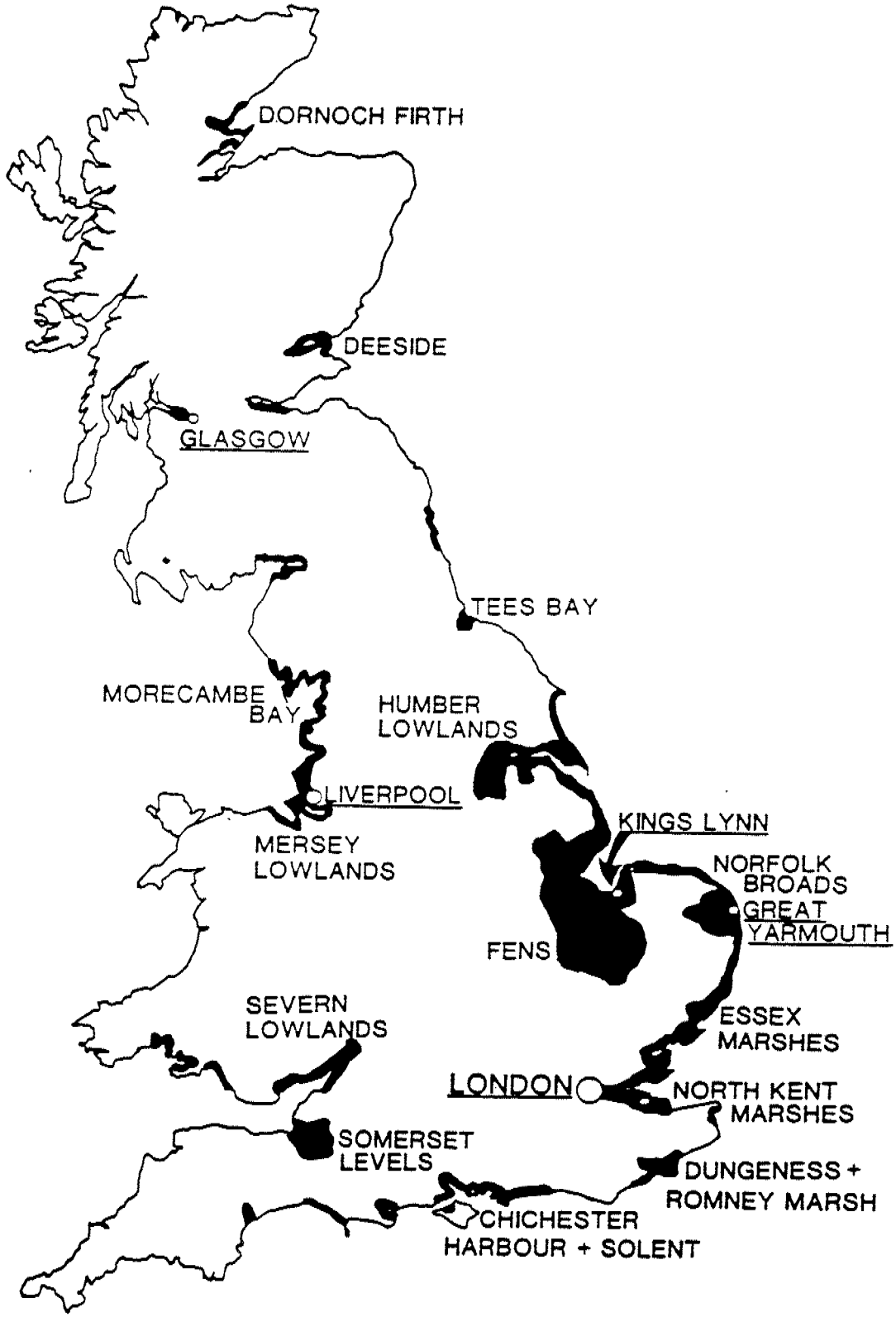
1.3.2 Defining Areas Where Retreat may be an Option

The low-lying coastal areas towards which this study is directed can be broadly defined in the following terms:-

- land areas at or below the 5m AOD contour (e.g. those identified by the Institute of Terrestrial Ecology, see Figure 1.3.1).

- land areas protected against saltwater or brackish inundation by sea defences (typically on open coasts) or tidal defences (typically within estuaries).

Figure 1.3.1 Areas of Great Britain Vulnerable to a Rising Sea Level



Source: Institute of Terrestrial Ecology. Climatic Change, Rising Sea Level and the British Coast (1989).

In theory, any (part) of the areas identified on Figure 1.3.1 could be considered as a potential candidate for a retreat from the existing line of flood defence. In practice, in the short term at least, various constraints are likely to operate. The current standard of protection and the quality of the defences themselves are, for example, likely to be important considerations. The recent National Rivers Authority Sea Defence Survey provides an opportunity to assess the current situation, but only in respect of areas protected by sea defences. At this stage, no equivalent information is available on a national basis in respect of tidal (estuarine) sites.

1.3.3 Preliminary results from the NRA's Sea Defence Survey (I. Whittle, NRA, personal communication, 1991) indicate that a total of approximately 40km protecting more than 10,000ha of land around England and Wales meet the following criteria:-

- The overall condition of at least one element of the existing defence is poor or bad.
- At least one element of the defence has a residual life of less than five years.
- The defences protect land which is primarily in agricultural or other non-domestic/non-commercial use. Urban areas are excluded.

In all these cases, a decision will therefore need to be made in respect of possible investment within the next five years.

On a Regional basis, the above figures break down as shown on Table 1.3.1. It should be noted, however, that both the above definitions of "poor" and "bad" quality and the estimates of residual life are somewhat subjective and may vary from region to region. The table should therefore be regarded as being indicative only.

Table 1.3.1 Regional Breakdown of Sea Defences with a Residual Life of Less than Five Years

REGION	LENGTH[1] KM	AREA[3] HA
Anglia	16.43	2850
North West	0.00	0
Northumbria	3.04	200
Severn Trent	1.10	25
South West	2.00	75
Southern	12.05	7300
Welsh	0.66	25
Wessex	3.97	200
Yorkshire	0.87	50
TOTAL	**40.12**	**10725**

Notes (1) The inclusion of a defence in the above analysis means that an element of that defence meets the above criteria. It is probable that if appropriate work on that element is undertaken, the defence may once again be returned to a state of full effectiveness.

(2) Length of defence containing elements meeting above criteria.

(3) Area of land protected by defences containing elements meeting the above criteria.

1.3.4 In addition to extracting information from the Sea Defence Survey, a series of meetings was held with Regional NRA and Nature Conservancy Council (NCC, now English Nature and Countryside Council for Wales) personnel. The purpose of these meetings was to collect data specific to each Region and to identify possible case study sites at which more detailed investigations might be undertaken to test the results of this report. These case studies were carefully selected to include both "typical" sites and those which might require special consideration because of peculiar or unique characteristics. The individuals involved in these Regional Meetings are among those listed in Appendix A1.2 and the results of this element of the consultation exercise are presented detail in Table B1.1, Appendix B. It should be noted, however, that the list of potential candidate sites for retreat is not intended to be definitive.

Table 1.3.2 lists, in summary, the number of sites identified as candidates for possible detailed investigation of the retreat option within each of the NRA Regions. This does not mean that retreat will necessarily be selected as the best option at these sites, simply that it might be evaluated with a view to possible implementation if circumstances are appropriate. Where these sites are currently protected by sea defences, there will be some overlap with sites highlighted on Table 1.3.1 but the consultation process also pinpointed many estuarine sites which are currently protected by tidal defences of varying standards. Most of the sites identified are outside of built up areas because retreat involving the extensive loss of property is unlikely to be a politically realistic option. One of the sites identified has, however, been zoned for industrial use but no development has yet taken place. Habitat creation here would represent a major benefit in an area which has, to date, suffered a significant loss of nature conservation assets.

Table 1.3.2 Potential Case Study Sites for the Retreat Option

Region	Number of Sites	Comments
Anglian	9+	Generally agricultural sites; some existing nature reserves.
North West	2+	Areas originally claimed from sea; some private defences.
Severn Trent	6	Estuarine sites; navigation and retention of flood storage function both important.
Southern	7	Estuarine and coastal sites; some private defences.
South West	5+	Mostly estuarine sites; some with existing nature conservation interest. Also sites on the Isles of Scilly.
Thames	N/A	
Welsh	3	Coastal and estuarine sites on agricultural land.
Wessex	4+	Variety of sheltered and exposed sites.
Yorkshire and Northumbria	7+	Some (former) industrial sites; some potential enhancement of sites with existing environmental interest.

It should be noted that the case study sites vary in size quite significantly - from less than 20ha to more than 500ha. This reflects the likelihood that the size of sites considered for future retreat will vary widely. The upper size limit is likely to be determined by what is politically acceptable. For certain types of habitat a lower size limit will also apply - a limit determined by environmental worthwhileness. Site size is discussed in more detail in Section 3.3.8. Finally, the case study sites also include both intensive and extensively farmed agricultural land. This is important because many intensively farmed sites are of less existing nature conservation value than low-input agricultural land and the former may therefore offer the most scope for significantly improving environmental interest.

1.3.5 In the short term it is felt that the results of this study might be applied in some of the areas indicated in Tables 1.3.1 and/or 1.3.2 above. If, however, the deterioration of the defences protecting other areas is accompanied by an increase in the rate of sea level rise (see Section 2.2), it is anticipated that a number of additional areas might become candidates for a consideration of the retreat option in the medium term. This latter scenario will ultimately be determined not only by climatic conditions, but also by political and economic factors. The Dutch, for example, have recently decided that coastal recession must be stopped and have adopted a coastal defence policy based essentially on preserving the existing line of flood defence (i.e. holding the coastline at its present location) (Ministry of Transport and Public Works, 1990). Quite obviously the situation in the Netherlands is very different to that in Great Britain in terms of the total proportion of land at or below sea level. As Section 2.3 will demonstrate, however, the consequences for coastal nature conservation interests if a "defend at any cost" policy were to be introduced in Great Britain could, potentially, be severely detrimental.

1.4 Terminology

1.4.1 ■ Sea and Tidal Defences

In order to ensure that the terminology used in this study is consistent with that of the National Rivers Authority where this is appropriate, it should be noted that "sea defence" is defined in accordance with the Schedule 4 boundary of the 1949 Coast Protection Act. "Tidal defence" relates to the length from the Schedule 4 boundary to the Ministry of Agriculture, Fisheries and Food (MAFF) agreed limit of tidal dominance on main rivers (i.e. the limit above which fluvial flooding predominates). Sea defences are located on the coast, with tidal defences in estuaries and along tidal river systems. NRA and MAFF responsibilities in respect of sea and tidal defences are further discussed in Section 5.2 and 5.3.3.

1.4.2 ■ Defence Structures

As far as possible throughout the report, the term "defence structure" has been used to identify defences which have been constructed or are artificially maintained by man. Where "defences" is used, this includes a range of flood protection features including natural sand dunes and shingle ridges.

1.4.3 ■ **Restoration and Creation**

For the purpose of this study, restoration is defined as the process of re-creating a habitat which was found on the site in question until relatively recently. The definition of "relatively recently" will vary from place to place. It assumes, however, that some important physical and biological characteristics (e.g. soil salinity, fauna, etc.) remain receptive to the restoration process.

Creation is defined as imposing something new on a site. The "new" habitat might, in fact, have been present on the site at some stage in the past, but the term creation is used to imply that characteristics such as salinity, soil nutrient status and seedbank will have changed significantly. This is particularly important where land claim, for agricultural use for example, took place several hundred years ago.

1.4.4 ■ **Managed Retreat**

The term "managed retreat" should not automatically be interpreted as meaning that extensive and/or expensive engineering works will be required on a particular site. Managed retreat is used to imply a level of awareness and, if appropriate, control. The concept of pro-active or forward planning is fundamentally important if nature conservation benefits are to be maximised and a high quality habitat achieved. Managed retreat might, in some cases, mean heavy engineering works and high capital costs, but it is equally likely to be applied to sites which require little more than pre-retreat survey, post-retreat monitoring, and possibly the management of public access.

1.4.5 ■ **Do Nothing**

Do nothing refers to the option of abandoning the defences without intervening in any way at the time of, or following, failure.

1.4.6 It is appreciated that the line dividing do-nothing from a minimum intervention managed retreat is a very fine one. In some cases, the do nothing approach may lead to the natural development of valuable habitats but without monitoring, little will be learnt from such areas. Section 3.2 demonstrates that there are many examples of historic breaches and defence failures around Great Britain. Some of these sites are now deemed to be of ecological significance, some are not. What is conspicuous, however, is that many of the sites which are now considered to be of greatest value from a nature conservation point of view, are currently managed -as RSPB reserves, National Nature Reserves and Local Wildlife Trust reserves. In a similar context, research undertaken in the United States (see Section 3.1.5) has demonstrated that understanding and careful planning are likely to be two of the most important criteria determining the success of habitat creation/restoration initiatives. **Good management does not necessarily involve intervening in the natural processes of site evolution.**

1.5 Climate Change Scenarios

1.5.1 For the purposes of this study, the climate change and sea level rise predictions described by the Intergovernmental Panel on Climate Change (IPCC, 1990) as being most likely under their "business as usual" scenario have been adopted. These are discussed further in Section 2.2. It has also been assumed that both increased storminess and increased saline intrusion might be anticipated in the coastal zone as a result of global warming.

1.5.2 Because of the difficulties in predicting the impact of a relatively small rise in sea levels, many of the discussions about the regional implications of climate change focussed on the likely consequences of a rise in sea levels of up to 0.5m. It is acknowledged that, according to the IPCC predictions mentioned above, such a rise is unlikely to occur within the next few decades. It is also important to recognise, however, that coastal habitats might take upwards of 20 years to become properly established. The results of early habitat creation initiatives in the United States, for example, demonstrate that it is relatively difficult to replicate all the characteristics of a natural wetland ecosystem, at least in the short to medium term (P. Williams, J. Zedler, personal communication, 1990). **In Great Britain, although a great deal can be learnt from overseas experience, some experimentation will be required simply to establish which management techniques are likely to be most successful. If the country is to sustain its coastal ecological resource in the face of rising sea levels, it would therefore be prudent to explore opportunities for creation and restoration sooner rather than later.**

1.6 Soft Engineering Options

1.6.1 Many habitat creation or restoration initiatives - artificial reefs, saltmarsh creation and sand dune restoration for example - could equally be interpreted as soft engineering options for flood defence or coastal protection purposes. This study is concerned, however, with habitat creation and restoration initiatives **landward of the existing defences**. The potential role of other soft engineering options in enhancing the water's edge environment, possibly improving the wildlife interest and reducing visual intrusion is therefore acknowledged, but no further account is taken of these options in this report.

1.7 Reversibility Criteria

1.7.1 Many of the sea or tidal defences around the English and Welsh coasts, whether natural or artificial, currently protect areas which are dependent to some extent on freshwater. If a defence fails these areas will be subjected not only to increased levels of salinity but also to tidal action and other physical disturbance. The scenario of creating saline or brackish water habitats in areas which were formerly protected against inundation therefore forms the principle basis of the report. Increased freshwater flooding, due to phenomena such as increased tidelocking under a scenario of sea level rise, is not considered in detail. Freshwater flooding may or may not be considered beneficial from the point of view of nature conservation. What is more important in terms of this report, however, is that it is potentially reversible.

Agricultural land which is subjected to an increased frequency of freshwater flooding can, if necessary, be returned to agricultural use relatively easily and cheaply. Once an area has been subjected to brackish or saltwater inundation for any length of time, options for such reclamation are significantly reduced. Enclosure is possible, but it is expensive and time consuming. Retreat for nature conservation benefits in the coastal zone has significant implications for agricultural land-use over the medium term and the needs of both interests must therefore be very carefully assessed at local, regional and national levels.

1.8 The United States Experience

1.8.1 Throughout this report, the situation in England and Wales is compared to that in other countries, notably the United States. The emphasis on the US stems largely from the requirements of their 1972 Clean Water Act which introduced a requirement for mitigation on development projects damaging wetland resources. As a result of this Act, the Americans have built up an extensive literature on habitat creation and restoration and, although it is recognised that care needs to be taken in applying the results of this research in Great Britain, the US nevertheless provides an invaluable source of information of direct relevance to this study.

1.9 Study Limitations

1.9.1 This study, as specified in the Project Investment Appraisal (Appendix A1.1), covers a very broad range of issues. An extensive consultation exercise was undertaken during the preparation of the report (see list of organisations and individuals contacted, Appendix A1.2), and this process raised a number of additional questions. Most such questions have now been investigated and the results are presented herein. There are, however, some cases in which the amount of detail provided is limited. This is because the study team have concentrated on the interests of the sponsoring agencies.

In particular, the issue of privately-maintained flood defences was raised on several occasions. Although the study concentrates on those defences currently maintained by the NRA, the technical considerations in respect of the retreat option will apply irrespective of who maintains the defence. The legal requirements might vary, however, and the interactions between the NRA and the individual or agency responsible for maintenance have therefore been explored (Section 5.2). Similarly, a significant increase in the rate of sea level rise might lead to more requests for the NRA to take over responsibility for some of these defences. If this is the case, it is assumed that the decision making process promoted in the report in respect of the retreat option would be applied to newly acquired sea and tidal defence structures.

1.9.2 Finally, the study identified a wide range of coastal information relating to climate change and sea level rise, which is currently held on various databases and Geographic Information Systems around the UK. Although it was not within the scope of the study to review all of the information available, an inventory of such databases is provided in Appendix A1.3.

1.10 **Nature Conservancy Council**

1.10.1 The Environmental Protection Act (1990), which came into force on 1st April 1991, disbanded the NCC and created instead three independent agencies for England, Wales, and Scotland with British coordination being provided by a new Joint Committee. In Wales, the NCC and Countryside Commission have been merged to create the Countryside Council for Wales. The functions of the Joint Nature Conservation Committee, English Nature and the Countryside Council for Wales are, however, predominantly the same as those provisioned under the 1981 Wildlife and Countryside Act and previous Acts (see below).

The majority of the research carried out for this report, including the production of the draft report, took place prior to February 1991. Given that most of the functions of the new organisations set up under the 1990 Act will be the same as existed previously, and that many of the results of this report will apply to Wales as well as England, references to NCC throughout the text remain generally unchanged.