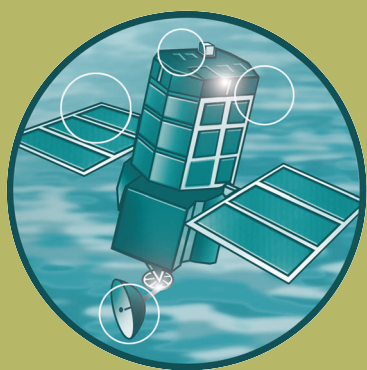


Changes in asset values on eroding coasts



R&D Technical Report FD2623/TR



Joint Defra/EA Flood and Coastal Erosion Risk
Management R&D Programme

Changes in asset values on eroding coasts

R&D Technical Report FD2623/TR

Produced: February 2009

Authors: Risk & Policy Analysts Ltd
Watsons
University of Newcastle

Statement of use

The objective of the study is to provide information and analysis that will help improve understanding of how property prices respond to coastal erosion risk. The study considers two specific contexts: where there has never been a defence and where there has been a decision to withdraw public investment from publicly funded coast protection works. The research benefits Defra by providing a reasoned, robust and transparent assessment of the impacts of erosion on asset values, where this will feed into on-going work on adaptation. Taxpayers will benefit from a more comprehensive and consistent approach to appraisal that will help promote and enable the uptake of adaptive options, reducing the need for increased funding in the future, but also providing the basis for spending existing funds in a fairer manner.

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Defra project officer: Tim Collins/Alison Rennie

Publishing organisation

Department for Environment, Food and Rural Affairs
Flood Management Division,
Ergon House,
Horseferry Road
London SW1P 2AL

Tel: 020 7238 3000

Fax: 020 7238 6187

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Executive summary

Background to the study

Defra is assessing a number of options designed to enable coastal communities to adapt to coastal erosion risk. To ensure that the assessment of the options is based on the best information available, there is a need to better understand how coastal erosion risk affects local property values. In particular, Defra needs to understand how property values change over time as erosion progresses and as properties are brought closer to the edge of the cliff up to the point that they are lost (either because they fall over the cliff or because they are demolished).

This study has been undertaken by Risk & Policy Analysts with specialist valuation expertise from Watsons (valuers and estate agents) and statistical advice from Ken Willis, University of Newcastle.

Main aims and objectives

The objective of the study is to provide information and analysis that will help in the understanding of how property prices respond to coastal erosion risk. The study considers two specific contexts: where there has never been a defence and where there has been a decision to withdraw public investment from publicly funded coast protection works.

The aim of the study is to answer two overall study questions:

1. How do asset values respond to coastal erosion risk?
2. How do asset values in England respond to coastal erosion risk and in particular to a decision to withdraw investment in publicly funded coast protection works?

Results and conclusions

How do asset values respond to erosion risk?

Theory, practical UK evidence and literature from overseas (mainly the US) all suggest that property values decline as the residual life of the property declines. Reductions in value of between 10% and 25% have been reported during the study once the risks of erosion became known. The reductions are expected to increase as the residual life of a property decreases. Since many mortgage lenders require a residual life of 60 years; a property with a residual life of (around) 60 years may only be available to a reduced number of potential buyers (i.e. those who do not require a mortgage). This would reduce demand for the property and is likely to result in a reduced price. It is important to note, though, that buyers are not always fully informed (and may not fully understand) the risk. This can result in *all* properties within a parish seeing a reduction in value – even those properties not at risk of erosion. This is particularly true where potential buyers come from outside the local area.

The condition of the market is also an over-riding factor in how property values respond. A strong market is one defined by a surplus of buyers, hence, the impact of erosion risk may be masked due to a lack of available properties. Conversely, a weak market (with a surplus of sellers) may exacerbate the property value reduction as buyers look elsewhere, avoiding risky or problem properties.

As a result, it is difficult to precisely define how the erosion curve may relate to a theoretical depreciation curve. Factors, such as premiums paid for sea views may mask the effect of property value reductions such that the erosion curve could lie above the depreciation curve. This is more likely in a strong market. In a weak market, the erosion curve could lie significantly below the depreciation curve.

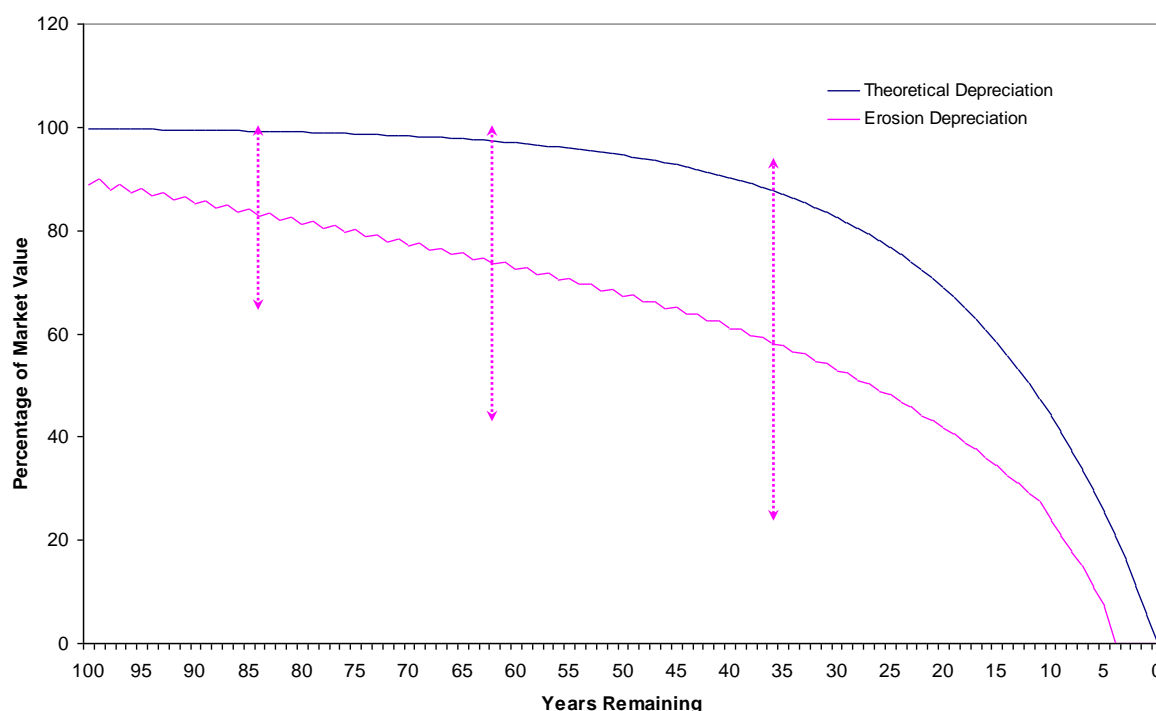


Figure 1 Erosion depreciation compared with theoretical depreciation (the arrows highlight the direction of uncertainty, not the magnitude)

How do asset values respond in particular to a decision to withdraw investment in publicly funded coast protection works?

Before a decision is made to withdraw investment in defences, a property is usually assumed to have a residual life of ‘in perpetuity’ giving it 100% of its not at risk property value. It is unlikely that any discount would be attributed to the property because there would be no assumption that the property is at coastal erosion risk (due to the presence of defences) (shown at point X₁ in Figure 1).

If a decision is then made to withdraw funding for defences, the residual life of the property would have to be reassessed. In Figure 2, the residual life is shown to decrease to 60 years (X₂). In reality, there would be uncertainty over the residual life and this lack of information and knowledge of the risk could mean that the residual life is over-estimated (i.e. assumed to be longer) such

that any property price reduction is lower. Conversely, the residual life of the property could be under-estimated (i.e. assumed to be shorter) so the property price reduction would be greater. As well as uncertainty over the erosion rates, there is also subjective interpretation of information; this can both increase and decrease the property value.

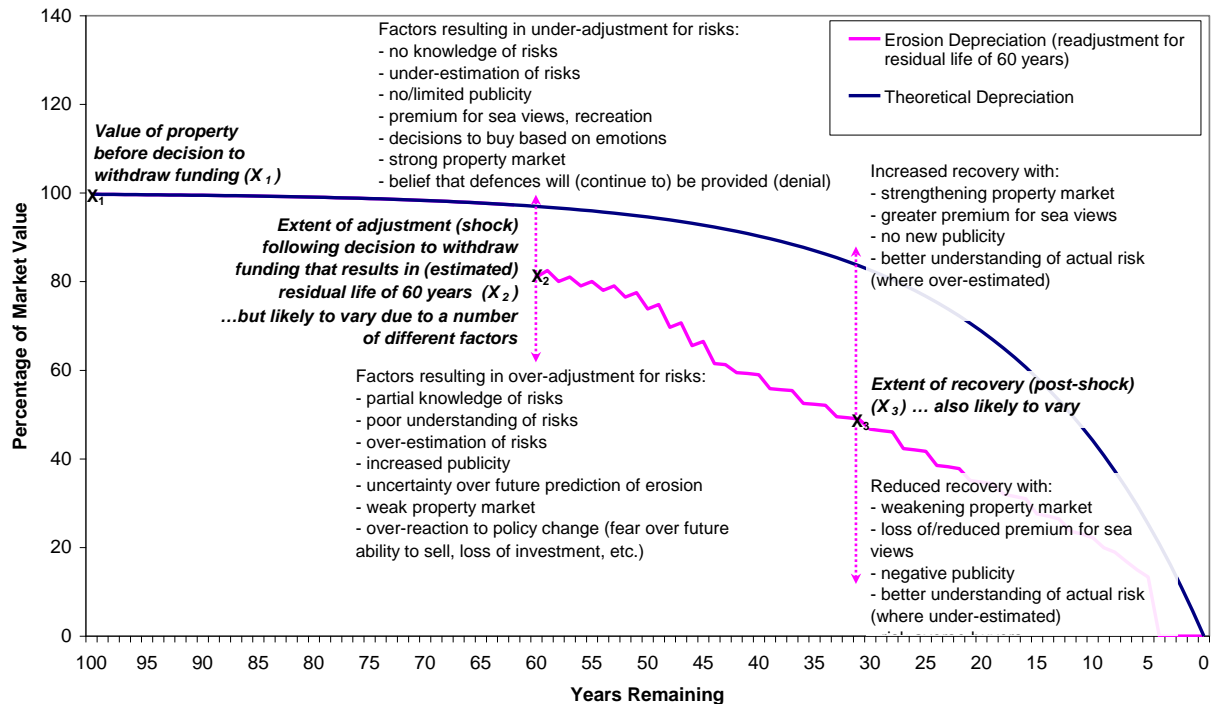


Figure 2 Readjustment of property values due to coastal erosion risk and the decision to withdraw investment in coast protection works

The potential recovery of property values following the initial ‘shock’ associated with a decision to withdraw funding is similarly difficult to identify with a high degree of confidence. The same factors as applied to the initial reduction also affect the likely recovery. A lack of example sites (and sufficient time between decisions to withdraw funding and this study) mean that the extent of any ‘shock’ period is also uncertain. Figure 2 shows an indicative point X_3 which suggests that the recovery could be to a value greater than that suggested by the theoretical depreciation curve (e.g. in a strong property market with significant premiums attached to sea views). Conversely, the recovery could be limited (e.g. in a weak market where many buyers are risk averse or over-estimate the risks).

Overall, the combined (and potentially conflicting) result of all the factors affecting property values is that a decision to withdraw funding could (where the negative factors predominate) result in a significant property price reduction.

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Appendix 1: Findings of the literature review

Appendix 2: Detailed analysis of questionnaires

Appendix 3: Workshops report

Appendix 4: Locations where individual property prices were considered

1. Introduction

1.1 Overview of the study

Defra is assessing a number of options designed to enable coastal communities to adapt to coastal erosion risk. To ensure that the assessment of the options is based on the best information available, there is a need to better understand how coastal erosion risk affects local property values. In particular, Defra needs to understand how property values change over time as erosion progresses and as properties are brought closer to the edge of the cliff up to the point that they are lost (either because they fall over the cliff or because they are demolished).

This study has been undertaken by Risk & Policy Analysts with specialist valuation expertise from Watsons (Valuers and estate agents) and advice from Ken Willis, University of Newcastle.

1.2 Aims and objectives of the study

The objective of the study is to provide information and analysis that will help in the understanding of how property prices respond to coastal erosion risk. The study is to consider two specific contexts: where there has never been a defence and where there has been a decision to withdraw public investment from publicly funded coast protection works.

The aim of the study is to answer two overall study questions:

1. How do asset values respond to coastal erosion risk?
2. How do asset values in England respond to coastal erosion risk and in particular to a decision to withdraw investment in publicly funded coast protection works?

In addition, there are seven related questions that consider specific aspects of the response to coastal erosion risk:

- Are there regional variations in how property prices respond to erosion risk throughout England?
- When (i.e. how soon before loss) do property prices start to change as a result of erosion risk?
- Is there an initial 'shock' effect of a decision to withdraw public investment in coastal defences? If so, how large (in terms of both value and duration) is it and do property prices recover? If so by how much?
- To what extent has the property market in England fully understood and adjusted to erosion risk?
- Is there any regional variation in the extent to which the property market has understood and adjusted to erosion risk?
- How long is the average period of property ownership on an eroding coast?
- Does the period of ownership change as a property becomes closer to the cliff top?

1.3 Background to the study

Defra's Making Space for Water Strategy for Flood and Coastal Erosion Risk Management (FCERM) emphasises the importance of using an integrated portfolio of approaches to:

- reduce the threat to people and their property; and
- through the overall programme of risk management measures, deliver the greatest environmental, social and economic benefit, consistent with the Government's sustainable development principles.

Adaptation measures are identified as approaches that could play an important role in delivering these goals. For example, adaptation measures could be used to help manage risks to communities following a decision to withdraw public investment in coast protection schemes. This research supports the Making Space for Water Strategy by assessing how the value of assets changes as they move closer to the cliff edge. The findings of the research will provide the evidence base for answering the two study questions and seven related questions to improve understanding on the response of property prices to increasing coastal erosion risk. Wherever possible, the research uses statistical and economic techniques to quantify changes in asset values. The quantitative results are combined with qualitative data to provide a more comprehensive evidence base.

1.4 Organisation of this report

The remainder of this report is organised as follows:

- Section 2 summarises the approach to the study;
- Section 3 provides the null hypotheses which are to be tested;
- Section 4 sets out the theories associated with asset values and the implications of these theories for the study;
- Section 5 provides an overview of the valuation data collected for the study and the implications of these data;
- Section 6 discusses literature which details the impacts of risks on assets;
- Section 7 provides details of the qualitative information collected;
- Section 8 discusses the findings of the research in the context of the study questions;
- Section 9 presents the conclusions and implications of uncertainty; and
- references are given in Section 10.

All of the data collected and reviewed are provided in the appendices to this report. This ensures that all the research undertaken as part of the study is recorded such that there is a transparent evidence base. As a result, any future additional research that adds to the evidence base can be used to update and extend the results of the study.

2. Summary of the methodology

2.1 Overview

This section of the report sets out our approach to the study and the methodology applied when collecting the evidence that is used to support the findings of the study. The results drawn from the evidence collected are set out in Sections 5, 6, 7 and 8 of this report. This section also describes the sources of uncertainty within the data, but it is important to note that we are confident that the broad conclusions (Section 9) set out in this report are more likely to be confirmed by further study than invalidated.

2.2 Valuation

2.2.1 Methodology

The core basis for the opinions expressed here is a consideration of sale prices achieved on individual property sales over the past eight years (the time period over which sales data are available) in selected locations on:

- the Yorkshire coast;
- the East Anglia coast; and
- the coast of the Isle of Wight.

Supplementary consideration is given to historical recorded information (for example the major Scarborough slippage in the 1990s which resulted in the loss of the Holbeck Hall Hotel and attracted national media coverage), to the results of interviews with local professionals and community representatives and to responses to questionnaires sent both to those groups and also to mortgage lenders and insurers.

Anecdotal evidence has also been included where considered reliable based on professional judgement and experience.

Evidence of sale prices actually achieved have been further supplemented by limited enquiries concerning properties currently (November/December 2008) on the market for sale, but unsold.

Sale price information is derived from Land Registry information as collated and presented by Hometrack.

Individual properties identified in the selected locations from the Hometrack¹ data have been inspected externally (from the public highway) and photographed by the valuers during November 2008 for the purpose of more accurately identifying the nature of the properties recorded as having been sold

¹ Hometrack provides information, including automated valuation to the UK housing and mortgage industries. The data is based on that collected by the Land Registry but is rigorously checked and cleansed to provide high quality data. This approach removes some of anomalies within the Land Registry data. Data can be found at www.hometrack.co.uk.

and assessing other factors, particularly locational, which may bear on their value.

Where the sales of individual properties have been compared one with another, transactions with similar sale dates have been used to exclude the effect of market changes during the eight years over which the data have been collected.

Individual property prices achieved were then compared:

- first, one with another to identify whether, within the study years, similar properties were realising lower prices in a location with a shorter life expectancy when compared with those a little further removed from the risk of erosion; and
- second, with average prices for a larger sample of 'control' properties, essentially similar to those individually inspected but in nearby non-coastal areas considered generally comparable in market appeal.

General Hometrack figures for prices in the areas in which properties have been individually considered were then also compared with adjoining areas to identify differences between them in terms both of price levels and movements in prices achieved under different market conditions. However, the large degree of variability between properties has made it difficult to clearly distinguish differences. These difficulties and the uncertainties that they introduce are discussed alongside the results.

The aim has been to identify if, and to what extent, a given type of property with a shortened life expectancy performs differently to one with a longer life expectancy, and to determine whether either or both are performing identifiably differently to properties wholly outside the coastal zone.

2.2.2 Potential shortcomings/areas of uncertainty

Whilst we are confident as to the broad conclusions set out here, the study which has been undertaken is limited. There are both areas in which further investigation may make the conclusions more robust and reliable, and areas in which there will inevitably remain a degree of uncertainty which must be borne in mind in considering our conclusions.

These areas include:

- sample size. Over 350 properties were considered individually but this remains a small total sample given the wide variation in property type (and location); very few of these properties are at short-term risk (because, in the 8 year period for which figures were made available, very few such properties will have changed hands); and we have had access to information on negligible numbers of actual transactions relating to agricultural or commercial properties. While the sample size itself is significant, the level of knowledge on individual properties within the sample is an important issue and affects the extent to which firm conclusions can be drawn.

- sample complexity. Many of the individual properties are of so non-standard a size and nature as to be difficult to compare with other transactions or with each other. To overcome this, the main statistical conclusions provided here relate to the more generic 2/3 bedroom semi-detached house, 2/3 bedroom detached bungalows and 3/5 bedroom detached standard houses;
- limited information on 'control' properties not individually inspected. Whilst we have been able to compare with some degree of accuracy (but see further below) individual properties that we have inspected in varying locations relative to the risk of erosion, we cannot be certain as to the make up of the larger 'control' samples from inland areas where properties have not been individually inspected;
- limited information on individual properties. Even the properties which have been inspected have been assessed only from the road externally and we have no detailed knowledge as to their standard of appointment, condition etc. or, for example, as to whether properties may include additional areas of land;
- data errors. Of the properties inspected, at least a small number proved to have a different description than that recorded by the Land Registry. This would presumably be the same for properties in the control group which have not been inspected;
- alterations to property subsequent to sale. Some properties have clearly been improved and/or extended recently and we cannot tell with certainty whether what was sold was essentially similar to that now inspected. At least one property appears to have acquired a row of holiday cottages in the form of an extension; two others now represent new dwellings under construction so it is presumed that the condition of whatever those dwellings replaced would not have been good at the time of sale;
- locational factors other than erosion bearing on value – such as a sea view. For example, it would be easy to say that if a detached bungalow five miles inland typically sells for £200,000 and a detached bungalow close to the coast sells for the same figure, there is no adverse impact from coastal erosion. But it may well be that the coastal bungalow would have sold for £300,000 to reflect its sea-view if located in a position not exposed to erosion;
- the shortness of the period for which data was available – essentially seven to eight years for property sales that could be interrogated at the necessary level of detail for this study. An analysis over a greater period would help to screen out other factors such as the present weakened property market. It would also allow consideration of sequential transactions for at least a limited number of properties (although there would still be the problem of alterations to the property between transactions). For example, if, having adjusted recorded prices for overall movements in property prices, a named property is known to have sold for £100,000 in 1960 when having a life expectancy of 80 years, for £90,000 in 1980 when having a life expectancy of 60 years and for £60,000 in 2005 when having a life expectancy of 35 years, certain conclusions might be derived which it has not been possible

for us to consider from the data available at this point. (We do now understand that more historic data (going back to 1995) has just become available from the Land Registry and it may be worth seeking to undertake further work in this area);

- imperfections and variations in the knowledge of purchasers. A property perceived to have a problem in the year 2000 might no longer be seen as vulnerable in 2008 with improved knowledge on the risks from, for example, better provision of data on the risks, even though that property may technically be closer to the shore;
- there are very few locations in which there is sufficient certainty of a likely planned change in policy to be able to assess the impact of that knowledge, and in the area where, arguably, there is that certainty (Mundesley, Overstrand and Bacton in Norfolk, and Corton in Suffolk) insufficient time has passed since the change to identify a reaction with any degree of precision. Generally, in these areas, it is probably “too early to say” what the impact of that change will be because the market appears still to be dominated by a lack of belief in the likely impacts of the change and a lack of awareness of the potential problem. It may well be that a very different picture will be painted in these areas in, say, ten years time;
- inevitable limitations in the knowledge of the valuation team. The valuers are East Anglian based and therefore have a good working knowledge of issues relating to the East Anglian coast. Their knowledge of the other two study areas is less;
- certain specific factors likely to impact upon value have not been investigated, for example the possibility that some of the properties in at risk locations may prove to be subject to planning conditions preventing all-year-round occupancy. Data were not available to assess planning conditions that might be in place on properties but, given that coastal properties may be used as holiday homes (or holiday lets) there is the potential that planning conditions associated with use of the property for holiday accommodation only could affect the property value; and
- the Shoreline Management Plans themselves, which are the source of the data on which assumptions have to be made as to the life expectancy of properties and the degree of their vulnerability, are largely under review so that the nature of the proposed policy and its likely impact is not fully known either to the valuation team or to the market at large. The only SMP envisaging the abandonment of defences with any degree of certainty attaching to it is the Kelling to Lowestoft Ness SMP and even that is the subject of disagreement between its sponsoring bodies such that the average property purchaser may be alerted to a risk, but is probably unable to make an informed assessment of the degree of that risk.

Despite these various reservations, we are cautiously confident that the conclusions set out here will be confirmed rather than invalidated by any further investigation which is undertaken and we make certain recommendations as to further investigation which might be most cost effective.

It may be possible to obtain data on property that has been lost through erosion. However, such data have not been collected for this study since obtaining this information would require very detailed and time-consuming effort. This has not been possible within the timescales for this study.

2.3 Literature review

2.3.1 Overview of the Literature Review

The aims of the literature review were to (i) identify the impact of risks on asset values and (ii) assess the nature of the case study areas and to compare and contrast these areas.

2.3.2 Hedonic Pricing Literature

There is a wealth of academic research that assesses the impact of many different factors on property values (mainly residential property values). However, there are few articles that focus specifically on the impact of coastal erosion risk. Those articles that do take specific account of coastal erosion risk have been almost exclusively undertaken in the USA. To provide a context for the property value reductions seen in the US studies and to assess the impact of risk more widely, we extended the literature review to cover other types of risk. These included:

- fire risk: since this also results in loss of a property, although in this case the land would be available for redevelopment;
- earthquake risk: since this again could result in loss of a property and could also make the ground unsuitable for redevelopment (e.g. due to landslips or a change in ground conditions);
- flood risk: since this can result in loss or significant damage to properties, but in most cases, redevelopment can occur after the flood has retreated;
- man-made risks (such as explosions or pollution): these risks can affect the desirability of a property;
- noise: since this risk tends to be frequently reinforced (e.g. by subsequent movement along flight paths, railway lines and roads); and
- views (including sea views): since this can be a benefit that can add a premium to a property. Other factors such as access for recreation, and air quality can also be benefits and are included where covered by the literature. Consideration is also given to potential negative impacts associated with views, loss of access for recreation and poor air/environmental quality.

A review of articles covering all these risks provides an opportunity to assess the consistency of the findings and analyse if and how risks are understood and accounted for in property markets. Almost 70 articles have been reviewed. The full analysis of the articles is provided in Appendix 1 (results of the literature review).

2.4 Case Study Areas

The study focuses on the impact of coastal erosion in three case study areas:

- North Suffolk and North-east Norfolk;
- East Riding and North Yorkshire; and
- Isle of Wight.

Consideration has also been given to the South of England (specifically Dorset and Weymouth) during the literature review. However, no site visits were made to this area and no questionnaires were received from organisations or individuals from this area.

The characteristics of the case study areas have been drawn from Census data (neighbourhood statistics) for the wards at risk from coastal erosion to enable differences between the communities at risk to be identified. To allow comparisons to be drawn between at risk and not at risk areas, the case study literature review also includes analysis of data in wards where there is no risk from coastal erosion (i.e. inland wards) and where the policy at present is to hold the line. Discussion on differences between the communities (including development type) is given in Section 5 and on ownership of properties in Section 6.

A review has also been made of the coastal erosion issues, including history and nature of erosion.

2.5 Questionnaires and workshops

Both the literature review and collection of data on property values and sales data provide quantitative information. It is important also to have an understanding of how and why coastal erosion may impact on property values in order that both the study questions and related questions can be fully addressed. This can only be achieved through the collection of qualitative data. Thus, we supplemented the collection of quantitative information with the use of questionnaires and workshops to gather views and opinions on the effects of coastal erosion. Four questionnaires were developed to capture the views of four interest groups:

- *local people through questionnaires to councillors* (specifically parish councillors but extended to district councillors due to interest in the study). The overall objective of the councillors' questionnaire was to identify whether there are concerns that property prices or interest in properties decrease as a result of erosion risk;
- *estate agents* through questionnaires to estate agents' offices in areas where there is an awareness of coastal erosion risk. The overall objective of the estate agents' questionnaire was to identify whether there is evidence prior to property sales (i.e. in interest in properties and during completion of sales) that the property market is being affected by erosion risk;

- *those interested in properties at risk of coastal erosion* through questionnaires to local authorities. The overall objective of the local authorities' questionnaire was to identify whether there are concerns from property buyers in the form of requests for information made to local authorities; and
- *organisations that may influence potential property buyers* through questionnaires to mortgage lenders and insurance companies. The overall objective of the questionnaire for mortgage lenders and insurers was to identify whether there is evidence that erosion risk may affect the ability of a property buyer to obtain a mortgage and/or insurance cover.

The questionnaires were designed using an Internet-based survey company (ZapSurvey). This has the advantage of allowing respondents to follow different paths through the survey according to their responses. As a result, the surveys are tailored to each respondent making the questionnaires easier to complete and less onerous for consultees. Drafts of the questionnaires were circulated to Defra for comments and suggestions. Following revisions to the questionnaires in line with comments received, invitation emails were sent to the relevant interest groups:

- Parish Councillors: 41 responses to the invitation (44% of invitations sent), of which 27 (29% of invitations sent) completed the questionnaire (some may have viewed the questionnaire and decided it was not relevant to them, or may not have completed their response). The deadline for responses from councillors was 12 December 2008 (extended to allow parish councils meeting after the initial response date to provide a collective response);
- Local Authorities: 6 responses to the invitation (75%), of which 4 (50%) completed the questionnaire. The deadline for responses from local authorities was 5 December 2008;
- Estate Agents: 7 responses to the invitation (10%), of which 5 (7%) completed the questionnaire. A further two companies contacted us to say they did not operate in areas of coastal erosion risk. This is a very low response rate. The deadline for responses from estate agents was 12 December 2008. We sent reminders, which resulted in a very slight increase in responses and contacted the National Association of Estate Agents to request their assistance. Watsons held face-to-face discussions with three estate agents during their site visits; and
- Mortgage Lenders and Insurance Companies: 16 responses to the invitation, 10 of whom completed the questionnaire. It is not possible to give a response rate for this group of consultees due to the method used to circulate awareness of the survey. The deadline for responses from mortgage lenders and insurers was 12 December 2008.

Due to the low response rate, detailed analysis of the estate agents' questionnaires has not taken place. However, comments and information from the estate agents who responded have been used as anecdotal evidence to reinforce (or question) points made by the other interest groups. The responses received have also been supplemented by interviews with estate agents

undertaken during the site visits (one per site visit) and from questionnaires circulated to estate agents in North Norfolk as part of the work undertaken by RPA *et al* (2008) for North Norfolk District Council.

Full details of the questions asked can be found in Appendix 2 (detailed analysis of questionnaires).

The questionnaires included opportunities for councillors and local authority representatives to indicate their interest in attending workshops. Estate agents, mortgage lenders and insurance companies were asked if they would like to discuss the issues in more detail through interviews. Workshops were held in East Yorkshire (Skipsea) on 1 December 2008 and North-east Norfolk (Bacton) on 2 December 2008. Full details of the discussions can be found in Appendix 3 (workshops report).

3. Setting the null hypotheses

3.1 Introduction

This section sets out the null hypotheses for each study question (and related questions where appropriate), where the null hypothesis is defined as the assumption that there is no impact of coastal erosion risk on property values. The null hypotheses are tested through the four main strands of this research (depreciation theory, collection and analysis of valuation data for at risk properties, results of the literature review, and collection of qualitative information).

3.2 Study questions

1. How do asset values respond to coastal erosion risk? *Null hypothesis:* asset values do not respond to coastal erosion risk such that there is no difference in values of properties at risk of coastal erosion and values of properties not at risk of coastal erosion.
2. How do asset values in England respond to coastal erosion risk and in particular to a decision to withdraw investment in publicly funded coast protection works? *Null hypothesis:* asset values do not respond to coastal erosion risk where a decision has been made to withdraw investment such that there is no difference in values of properties at risk of coastal erosion and values of properties where investment has been withdrawn.

3.3 Related questions

- Are there regional variations in how property prices respond to erosion risk throughout England? *Null hypothesis:* asset values do not respond to coastal erosion risk such that there is no regional variation in the value of properties at risk of coastal erosion.
- When (i.e. how soon before loss) do property prices start to change as a result of erosion risk? *Null hypothesis:* asset values do not respond to coastal erosion risk such that property prices do not change up to the point that the property is lost.
- Is there an initial 'shock' effect of a decision to withdraw public investment in coastal defences? If so, how large (in terms of both value and duration) is it and do property prices recover? If so by how much? *Null hypothesis:* asset values do not respond to coastal erosion risk such that there is no initial 'shock' effect seen when the decision is made to withdraw public investment.
- To what extent has the property market in England fully understood and adjusted to erosion risk?

There are two elements to this question: (i) the extent to which erosion risk is understood and (ii) the extent to which this understanding leads to an

adjustment in the property market. As a result, it is appropriate to use two null hypotheses for this question to allow both elements to be explored.

Null hypothesis 1: erosion risk is not understood hence there is no impact on the property market.

Null hypothesis 2: erosion risk is understood but there is no adjustment in the property market as a result.

- Is there any regional variation in the extent to which the property market has understood and adjusted to erosion risk?

As above, there are again two elements to this question, here, concerned with whether there are regional variations. Two null hypotheses are again proposed.

Null hypothesis 1: erosion risk is not understood differently across regions hence there are no differences between regional property markets.

Null hypothesis 2: erosion risk is understood but there is no adjustment in the regional property markets as a result.

- How long is the average period of property ownership on an eroding coast? Although this related question requires a description of data collection for properties on an eroding coast versus properties elsewhere, the *null hypothesis* assumes that the period of ownership is the same across all properties (i.e. there are no differences between the period of ownership on the inland or on the coast, or the coast subject to erosion). The term 'eroding coast' is open to interpretation and defined here as a coastline where erosion is predicted to result in loss of properties over the next 100 years.
- Does the period of ownership change as a property becomes closer to the cliff top? *Null hypothesis:* there is no change in period of ownership as properties become closer to the cliff top compared with properties that are not at risk of coastal erosion.

3.4 Testing the Null Hypotheses

Sections 4, 5, 6 and 7 of this report set out the evidence collected during the study. Section 8 uses this evidence to set alternative hypotheses and assess whether the weight and reliability of the evidence are sufficient to reject the null hypotheses.

4. Depreciation theory

4.1 Introduction

Basic depreciation theory allows us to develop alternative hypotheses based on the assumption that differences in property values will arise as a result of adjustment being made to reflect both risk and the life expectancy of the property.

4.2 Basic depreciation theory

4.2.1 Principles

The capital value of any interest in property derives from a financial measure of the usefulness of that property over time (rent is one such measure), multiplied by a second figure which reflects the period over which that usefulness is likely to continue.

The first figure will be referred to in this section as 'annual worth' recognising that whilst an investment property can normally be expected to produce a monetary income (typically rent), an owner-occupied property may have a 'usefulness' to its owner perceived in other ways.

The second figure is known as Years Purchase² (or YP) and reflects three considerations:

1. The underlying rate of return (yield) that someone making an investment in an asset of the type under consideration would want on his/her money;
2. The risk of the flow of annual worth not continuing for some reason (abnormal risk is likely to be reflected in a requirement for a higher rate of return); and
3. The number of years for which the flow of annual worth is expected to continue.

The higher the underlying yield required by an investor, the lower will be the YP figure. The greater the risk associated with receiving the flow of annual worth, the lower will be the YP figure. The shorter the period over which the flow of annual worth is to be anticipated, the lower will be the YP figure. The figures used below are taken directly from Parry's Valuation tables and are illustrative of principle only; different rates of return could have been used.

Example, where the property's annual worth is in the form of income

Assuming a purchaser seeking a 6% return on his capital:

² Years Purchase is the amount that is yielded by the annual income of property. It is used to express the value of an item in the number of years required for its income to yield its purchase price (from Webster's Revised Unabridged Dictionary).

A YP of 7.36 might be applied to an annual income of £10,000 receivable over ten years producing a capital value of £73,600. If the annual income is receivable over thirty years, the YP would rise to 13.76 and the value to £137,600.

If the flow of income was considered more risky such that a purchaser may require an 8% return, the corresponding YP figures would reduce to 6.71 (producing a capital value of £67,100) and 11.26 (producing a capital value of £112,600).

In practise, there is a further complication discussed in the next section; but what has to be understood here is that the factors bearing on capital value centre on:

- annual worth;
- the life of the asset; and
- the risk associated with extracting the annual worth from the property.

The other point to be understood at this stage is that the value of a pound receivable in, say, fifty years' time is less than the current value of a pound receivable. So the person who can invest his money at 6% per annum may be happy to pay one pound for a pound to be received today; but only 5.5 pence for a pound to be received in fifty years' time.

Most freehold property is valued on the assumption that it will have an indefinite life and is therefore valued "in perpetuity". However, the value of a pound receivable in a hundred years' time is so small a fraction of a single penny that, to all intents and purposes, it is the next one hundred years life of a property asset which dictates its current capital value. A property with a life expectation greater than one hundred years will probably have no greater value as a result; that of one with a shorter life expectation can be expected to be lower.

4.2.2 Standard depreciation theory

The broad expectation is that, for a property with a given level of annual worth, its capital value will be less the shorter the period of years over which that annual worth will be available to a purchaser.

This set of circumstances is most commonly encountered with leasehold properties where, after a period of time, the lease will expire.

However, as well as reflecting the shortened period over which annual worth is to be received, the price paid must also allow for the investor to recoup his/her capital over the life of the asset – recognising that there will be no sale value in the asset at the end of its life.

It is normally assumed that provision for recovering the capital investment (i.e. the price paid plus costs directly associated with purchase such as legal fees and stamp duty) will be made by setting aside, out of the property's annual worth, a sum of money into a sinking fund sufficient, when interest is rolled up, to accumulate to the sum which was invested.. The shorter the life expectancy of the asset, the shorter is the period over which its capital cost must be

accumulated in the sinking fund and the larger will be the portion of annual worth which therefore has to be set aside for that purpose.

Example

To recover £100,000 invested (purchase price plus purchase costs) by means of a sinking fund accumulating for only ten years at, say, 5% per annum, £7,950 per annum needs to be set aside out of the property's annual value. But if thirty years is available to recover the same capital sum, only £1,505 per annum needs to be set aside.

Source: Parry's Valuation Tables

The figures given should be taken as indicative of the principle only; they ignore liability to tax on the fund accumulated. The point to be understood is that, the shorter the life of the asset being purchased, the greater the proportion of its annual worth which needs to be set aside to provide for the replacement of the initial capital investment when the property has been extinguished.

In effect, therefore, it is only what remains of the annual worth of the property, after the deduction necessary to create an adequate sinking fund, which remains to be capitalised by the application of a year's purchase figure.

The broad result is that, all other things being equal, the shorter the life of an asset, the lower will be its capital value with the reduction in value becoming greater each year as the life expectancy shortens.

Figure 4.1 provides a depreciation curve based on Parry's Valuation tables. Figures 4.2 and 4.3 below represent Leasehold Valuation Tribunal determinations between 1994 and 2007 as a proportion of full market value for comparison with the purely mathematical figure at 4.1. The figures show depreciation of some 12% at 60 years, 20% at 50 years, 30% at 40 years, 38% at 30 years, 48% at 20 years and 63% at 10 years. The graphs shown in Figures 4.2 and 4.3 differ from that given in Figure 4.1 because the Parry Valuation tables are based on a theoretical example, while the Leasehold Valuation Tribunal graphs are based on real data over a 13 year period (1994-2007).

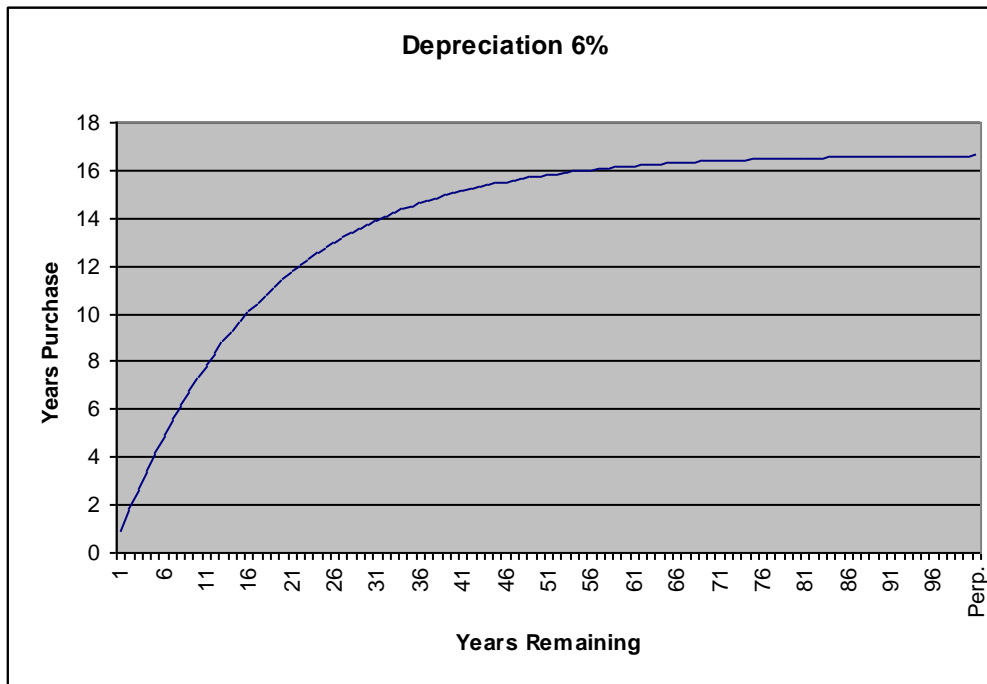


Figure 4.1 The mathematical relationship between the capitalisation factor (YP) and the property’s remaining life at a given rate of interest (prepared from Parry’s Valuation Tables) (note: A life expectancy greater than 100 years is regarded as being ‘In perpetuity’)

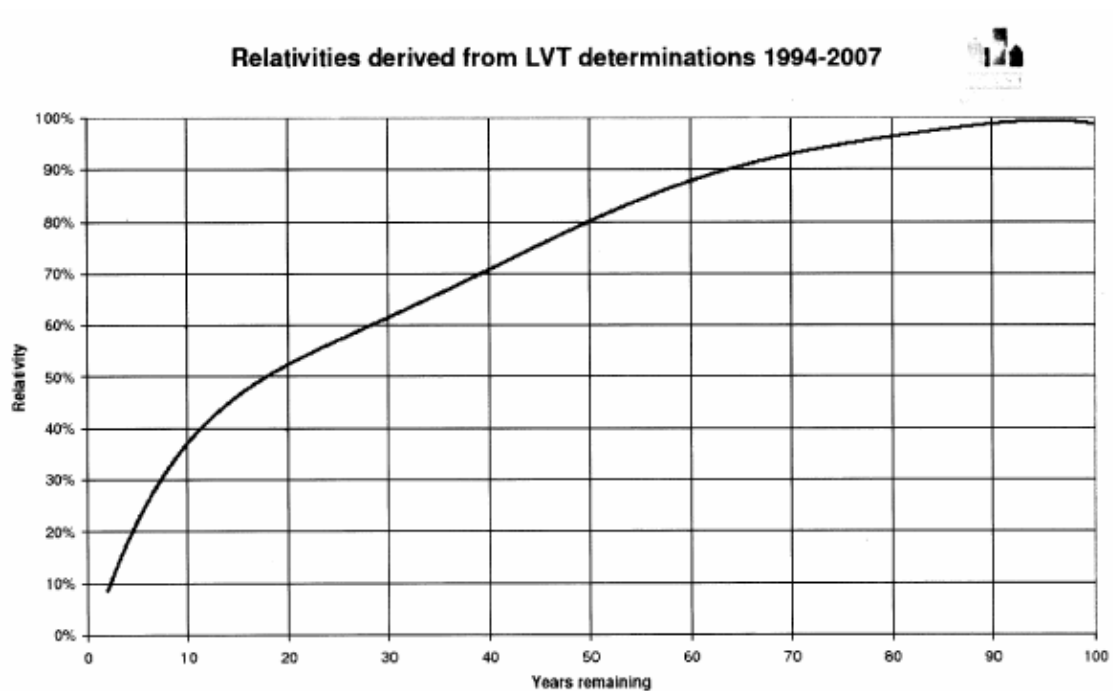


Figure 4.2 Leasehold Valuation Tribunal Determinations 1 (draft) (source: www.lease-advice.org)

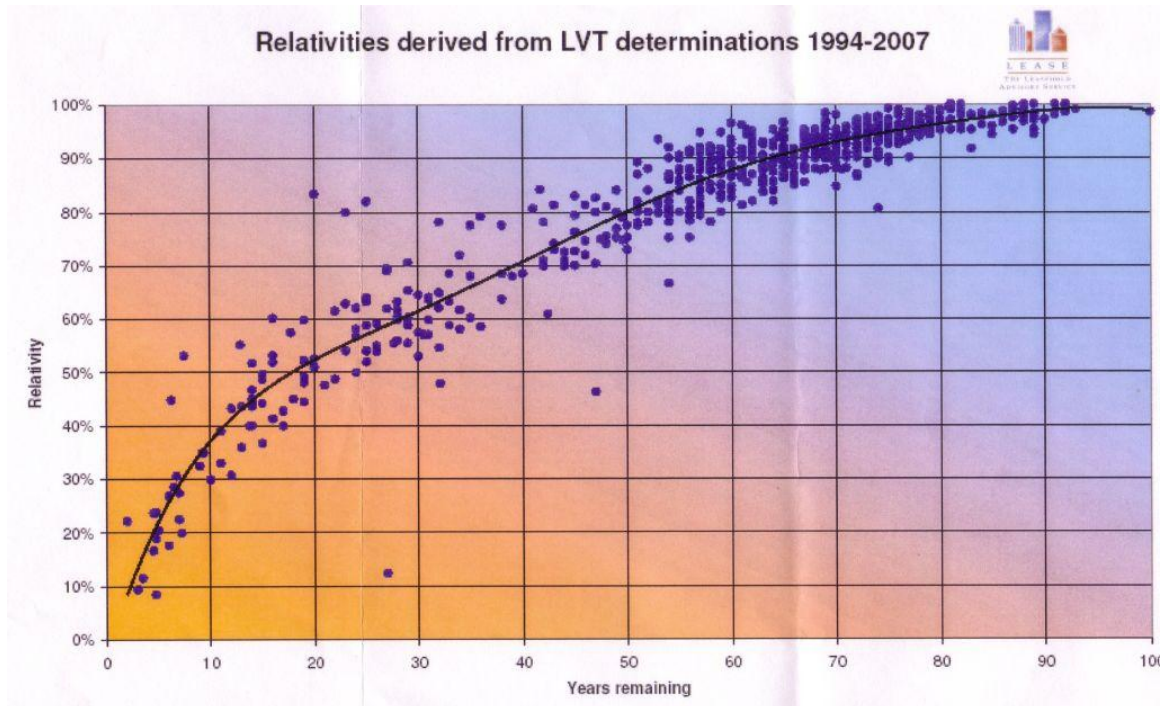


Figure 4.3 Leasehold Valuation Tribunal Determinations 2 (draft) (source: www.lease-advice.org)

4.2.3 Depreciation as applied to coastal erosion

As well as a static market, the standard approach assumes a number of things:

- certainty as to the life of the asset;
- the absence of any extraneous factors impacting on value such as a parallel deterioration in other nearby property;
- that the environment is one in which there are no factors which would offset adverse considerations of a reduced life expectancy;
- that the type of property is not one for which there would simply be no demand in the case of a short life expectancy; and
- that the property asset is separately assessable in its own right, rather than forming an integral part of some larger holding.

There are various reasons why variations on this standard pattern of depreciation might be expected in the case of coastal erosion.

However, one fundamental reason relates to imperfect information as to the life expectancy of the property, coupled with variations in buyer perception of impacts over time. A lease with sixty years to run is a lease with sixty years to run in any buyer's eyes. A property thought to have a life expectancy of sixty years before erosion by the sea may be seen, in the eyes of one buyer, as a property with no certain future after, say, thirty years and in the eyes of another buyer as a property with an indefinite life expectancy on the basis that some change in circumstances may protect it.

5. Collection of valuation data

5.1 Introduction

Valuation data has been collected through site visits to each of the case study areas (North Suffolk/North-east Norfolk, East/North Yorkshire and Isle of Wight). This Section summarises the findings from the data, including implications for understanding the risk from coastal erosion and how this varies between areas, and implications in terms of exposure to risk. A number of case study examples are also included.

5.2 Valuation data

5.2.1 Findings concerning exposure to risk

Perhaps the most important conclusion is that “coastal erosion” cannot be considered as a single phenomenon.

In places, notably parts of the Yorkshire coast, the process involves a gradual degradation of soft cliff faces, largely by the action of wind, rain and surface water discharge which results, over long periods, in a series of relatively small scale but continuing cliff collapses, the deposits from which are then washed away by the sea. The cliff collapses are also of a much larger scale following storms resulting in rapid erosion, rather than even erosion rates.



Photographs 1 & 2: Erosion at Mill Lane, Skipsea, Holderness Coast

In other locations, Norfolk amongst them, taller cliffs lead to more sudden and substantial collapses, often with long intervening periods without significant loss.

In parts of Cornwall, erosion affects localised areas of shale but has negligible impact on immediately adjoining areas of granite; it can be locally expedited by past mining activity.

In locations such as Black Gang on the Isle of Wight, the problem is one of large-scale land slips over many millennia such that a single large slip may destroy buildings some distance inland, even though the land on which the property stood may not be taken by the sea for many further years. A similar effect would be achieved in a land slip area in a wholly inland location.

In other areas of the Isle of Wight (for example the Bembridge peninsula), erosion is altogether more gradual such that there is little practical and unavoidable threat to property of value.



Photographs 3 & 4: Old and more recent landslips on the Isle of Wight

Finally, particularly in built-up settlements, the existence of formal hard defences established over many years (typically from the 19th century onwards) has created areas in which there is no recent experience of loss even though there will be a history of loss prior to the defences being constructed. Were

those defences now to be removed, it is probable that, for a period at least, loss now would be more dramatic and faster because the defences have, in many instances, resulted in these settlements forming small promontories into the sea. So here, not only may the loss be unexpected but it may also be of a more catastrophic nature because additional vulnerability has developed. This could mean not only that an individual property experienced a sudden major drop in value rather than a gradual depreciation, but also that whole areas of a previously defended settlement may simultaneously be affected by the loss of roads, services or other facilities.

A further complication is that, just as there is no standard process for 'erosion', there is no single standard method of defence. It is not as simple as envisaging a concrete wall today and none tomorrow. Coasts are protected by a wide range of defences including concrete walls, revetments, groynes (steel, timber or rock) beach recharge (using sand and shingle), breakwaters (on and off shore) and 'softer' options such as sand dunes and salt marsh. Although not their primary purpose, harbours, water fronts and promenades can also provide coastal defence.

Cliff stabilisation can also include ground water reducing works either as stand alone or in combination with works to provide erosion protection at the toe (such as rock revetment).

A decision to withdraw funding for maintenance of defences may not result in visible signs in respect to the defences concerned for some time. There may be a residual life to the defences which delays the onset of erosion, there may be a period with an absence of storms which prolongs the life of the defence or, as in the case of Happisburgh, when the defence disappeared, local people have provided a limited form of defence to try and reduce the erosion.

Therefore it is the public perception of the risk resulting from a policy to withdraw funding (now or in the future) that affects the value not just the condition or lack of defences.

There is also the situation where the withdrawal of funding for defences leading to increased erosion can have a beneficial effect to adjacent coasts as more material builds up the beach so providing an 'improved' defence. This then alters the degree of risk to which coastal property is exposed although, if the adjacent coast is close, the divide between abandonment and improve may not be obvious to the public perception of risk.

5.2.2 Findings relating to coastal property

The financial value of coastal land is related to its use or its potential use. Real issues of financial loss arise where land has been improved for more intensive use or developed with structures – enhancing its potential to afford a flow of annual usefulness/income.

In the three coastal areas considered in detail, a clear distinction was found (if only in broad in terms) between the way that land is used in areas with a long-term known history of loss (whether due to direct erosion by the sea or breakdown of cliffs for other reasons) on the one hand, and other areas where

loss is either unpredictable (for example the Black Gang area of the Isle of Wight) or where sea defences mean that it is no longer anticipated by the market.

In the first areas (i.e. those of regular known loss), we found large areas of wholly undeveloped scrub, significant areas of farmland and quantities of low intensity and temporary development uses such as golf courses and playing fields. We also found developments specifically related to their proximity to the sea, mostly holiday related – for example caravan and chalet parks although some with quite substantial “core” service buildings. There were also a number of individual commercial properties again related to their seaside location, such as cafés, restaurants and public houses. And we found individual residential development ranging from what amounts essentially to wooden changing huts through a range of wooden, asbestos and similar seaside holiday homes (although some lived in permanently) to more traditionally constructed permanent homes, the latter apparently often replacing earlier lower quality structures. Some of these more recent and permanent buildings may prove to have been constructed subject to planning occupancy restrictions.



Photograph 5: Overstrand, Norfolk

Photograph 6: Caravan site at Vale Road, Mundesley, Norfolk



Photograph 7: Corton, Suffolk

The overall conclusion is that, in these areas of long-term known loss, development (most of it since the end of the First World War) has always taken account of erosion risk or at the very least has had every opportunity to do so, with most buildings either being of a lower quality than the norm and designed for a shorter life expectancy or representing a relatively low intensity of use, in many instances relatively suited to removal of all but the infrastructure – caravan sites being the most obvious example of this.

Generally the development of land use and purchase decisions for a hundred years or more in these locations have all reflected the ongoing issue of erosion such that the relatively low value of land itself, by virtue of its short period of use, is reflected not only in what buyers can be expected to have paid, but also in the nature of the development placed on that land. Where development is, nonetheless, still of a relatively high standard in vulnerable locations, this is likely to be because, in the eyes of the owner, the short-term advantages of coastal proximity and sea views outweigh the long-term disadvantages of a likely shortened life expectancy.

An entirely different picture is found in locations where there has been no recent history of loss. In the locations we visited, this was due to coastal defences. But similar issues may arise where a community sufficiently remote from the sea starts to become perceived as having the potential to be affected for the first time.

In these locations, predominantly small towns and large villages, we find development typical of any such inland town or village – with permanent places of work, permanent homes and all the associated permanent infrastructure – shops, pubs, schools, surgeries, etc. There are often coast related developments as well – hotels, restaurants, caravan parks on the fringes, amusement arcades, etc. but all forming part of a cohesive economic and social unit in a way which tends not to be the case along the areas of coast known to be at risk.

So in these defended locations, as well as the potential for a sudden change in perceived risk, and the possibility of loss being on a more abrupt and large scale, the property which will be lost is of a different nature and with different economic and social inter-relationships than that located in the long-term erosion areas.



Photographs 8 & 9: Robin Hood's Bay and Corton, Suffolk



Photograph 10: Modern shops at Mundesley

5.2.3 Background to interpretation of prices in affected areas

The price for which a property can be expected to sell depends on many factors. Location is generally described as the primary factor and it is difficult to consider a more fundamental locational issue than whether or not the site of the property can be expected to exist at all. But there are other factors relating to location than that of coastal erosion – the most obvious being the proximity to the sea for those properties utilised for leisure and commercial properties; and sea views and coastal amenity generally for residential and second home properties. It will always be difficult to disentangle the potential negative impact of a short life span on price/value from the positive impact of proximity to the sea.

But there are many other factors which affect property prices also. All properties are affected by changes in the property market as a whole, but not all are affected to the same degree and we will return to the likelihood of properties threatened by erosion being more susceptible to market changes (in both directions) than the average property.

Specific factors affecting residential type properties include:

- the design and style of a given property;
- the form of its construction;
- the standard of appointment internally;
- the exact extent and arrangement of its accommodation;

- features such as conservatories, workshops, greenhouses etc;
- the size and nature of gardens and grounds;
- the nature of planning consents (particularly conditions restricting occupancy);
- legal restrictions on title – for example covenants;
- legal disputes with neighbours (and troublesome neighbours);
- the condition of the property; and
- the interests of special purchasers (for example someone wishing to house an elderly relative adjacent to their property next door).

Many more factors affect commercial properties, particularly those where trading potential is taken into account (such as restaurants, public houses etc).

All such issues make it dangerous to interpret individual sale prices and to ascribe variations in them from a norm as inevitably resulting solely from coastal erosion. The larger the sample and the more detailed the inspection of individual properties, the more other such factors can be eliminated but, in reading this present analysis, their potential impact should not be overlooked.

It is particularly important to understand that some of the “other” factors may be disproportionately represented in properties in coastal locations, notably:

- in a positive sense: sea views and beach proximity;
- in a negative sense:
 - lower standards of construction, maintenance and appointment; and
 - planning restrictions; and
- in both a positive and a negative sense: the state of the property market as a whole.

5.2.4 Findings relating to the reaction to exposure

We have already set out the theoretical mechanism for an anticipated reduction in the value of property in the context of a shortened life expectancy. The following section discusses how reality differs from the theoretical situation, illustrated by examples from the site visits to the case study areas. This includes consideration of the benefits of living in property that is near to the coast, the impact of erosion of services and access to properties and the issue of loss of ‘critical mass’ ,e.g. in terms of number of caravan pitches eroded. All of these issues are subject to the unpredictability of erosion and, thus, the difficulty of estimating the residual lives of properties and businesses. All of these factors affect how a potential purchaser may view a property and, as such, can affect the value of that property should the owners wish to sell.

It is immediately apparent that, for a variety of reasons, the actuality is significantly different in a coastal context. Only the start and finish points remain unassailable: if the property is sufficiently far from the coast for the coast to have no relevance to it, it may be expected to have “full” value; at the point it is about to go over the edge, it will have a nil value.

But in between those points there is every indication that prices and values may follow anything but an entirely predictable path. There is also little evidence that the driving consideration in the mind of buyers (with a few possible exceptions

in the commercial sector) is the theoretical one of providing for a sinking fund to replace the asset.

The beneficial impact of proximity to the coast is a significant factor. With regard to residential properties, the primary consideration is again sea views but with a degree of association, for example on the Isle of Wight and some parts of the North-east Norfolk coast, with upmarket retirement and second home areas more broadly benefiting from coastal proximity. Access to sailing facilities can also be a significant driver.

For commercial properties, their very viability depends, in many instances, on proximity to the coast and indeed in many instances the likelihood is that planning consent would never have been available for the development at all were it not to be for this proximity. Caravan and holiday parks are prime examples of this aspect.

So it may well be that the value of a property may actually increase as the coast comes nearer before dropping steeply away as erosion risk becomes an immediate one. Changes in the use of a property, possibly facilitated by its coastal proximity, may sometimes play a part in mitigating or delaying the adverse impact on value which would otherwise flow from erosion. We saw the remains of a private garden on the Yorkshire coast being used for storage of caravans and other properties converted for partial commercial use (guesthouses etc.).

A second consideration (and this is likely particularly to impact in denser areas of development such as currently defended coastal towns and villages) is that it may not be the threat of the loss of the property itself which is the most important consideration at any one time, but the threat (or actuality) of the loss of items such as infrastructure – and particularly road access. At Skipsea, we found the coast road eroded away such that some properties are no longer accessible with a vehicle and will shortly no longer be accessible on foot.

In the Black Gang area of the Isle of Wight we found a large section of coastal road completely destroyed such that there is now only one access to an area which may, itself, not be lost for some years yet.

In Flat Cliffs, Filey we found a group of coastal retirement homes approached over a private road now only two or three metres from the cliff edge. The homes themselves will probably be safe for several decades but the road may be lost very much sooner, at which point there will no longer be any means of access unless one is purchased (inevitably at considerable cost, in turn bearing upon value) from adjoining private landowners.

In some of the long-term erosion locations, the downward movement in prices is more predictable. Where a road such as Seaside Road, Aldborough in Yorkshire is roughly at right angles to the coast with ribbon development on either side, the unit closest to the beach is worth less than that next to it which is worth less than that next again and so on, once extraneous factors such as design differences are factored out.



Photograph 11: Mill Lane, Skipsea



Photograph 12: Flat Cliffs, Filey

However, even here there can be a different situation for commercial properties. For example the beach café at Mill Lane, Skipsea currently on the market, remains unsold and unoccupied and it is quite possible that the average potential occupier will see its likely ten-fifteen year life expectancy as being too short to allow a viable business to be built up. So whilst one type of property may still attract a degree of value with only, say, five years to go, another with a different use may have no value at all.

There are then properties which are reduced in value as they are reduced in physical size. This will inevitably apply to farmland. If half an acre goes over the edge from a 40 acre field, that is half an acre for which purchasers will no longer wish to pay but the remainder clearly still has a value leaving aside an issue such as loss of any means of access (marginal areas will also be unavailable for farming due to the erosion risk some time before their actual loss). This process also applies to caravan parks where a site for, say, 200 vans one year may be reduced to one for 195 a year later as individual pitches come too close to the edge. However, this diminution in value will likely reach a point at which certain such commercial enterprises are no longer viable. Sticking with that example and particularly if it depended on a central club house, it is easy to envisage a time arising when there are insufficient pitches (even though some survive) for the property to be marketable at all.



Photograph 13: Vacated pitches at a caravan park at Skipsea, now too close to the cliff edge for occupation

With holiday-related developments, the loss of a usable pedestrian access onto the beach can also have a disproportionate effect.

These are all factors relating to property.

It is then necessary to consider the reaction of buyers and sellers, who make up the market.

Some form of predictable adjustment in the light of a threat depends on good and reliable information as to the nature of that threat and on that information being widely available to prospective purchasers. This seems not to be the case with many aspects of coastal erosion.

In practice, we have found no definitive and adopted Shoreline Management Plans making clear any significant change in risk, the nearest exception being that for Norfolk and Suffolk. In the absence of such information, buyers have little upon which to base their decisions other than surmise or outdated information.

There is then the unpredictability of the erosion itself. The landslide at Black Gang has resulted in properties some distance inland no longer being occupiable or marketable and it is possible to suppose that before the slide (in 1995), this outcome would not have been anticipated (or known) by many purchasers and may not, therefore, have been fully reflected in prices paid³.

There appears to be a tendency for prices to react (indeed often over-react) to particular circumstances and then to recover when it has been possible to assess, more accurately, the actual risks associated with those circumstances.

Examples of this last are:

- the Scarborough slippage in 1993 after which properties in that general vicinity were described by a local valuer as “unsaleable” but which have since recovered quite considerably; and
- areas of the Norfolk Broads where it was again almost impossible to achieve sales for a period after the recently reported possibility of the coastline being abandoned and inland villages being lost but again with signs, now, of recovery.

It is then the case that different purchasers may see the risks differently. A North-east Norfolk valuer described to us the difference between the attitudes of local purchasers and those from further away. Local buyers found it difficult to believe that there was a significant risk where they had never seen any loss of land (because of defences). Buyers from further away were much more inclined to make formal enquiries as to policy and to reject properties on the basis of it. They may also associate the whole of the parish (this is certainly the case for the village of Happisburgh in Norfolk and to a lesser extent with the parish of Mundesley) with a vulnerability to erosion even though the individual property under consideration may be a mile inland and not threatened directly at all. This last is quite distinct from a more rational concern over a loss of

³ However, there is evidence (e.g. from www.risknat.org) that minor land movements occur almost annually with major events every 15-20 years, largely dependent on antecedent rainfall and associated changes in groundwater levels.

facilities or services, impacting instead on the perceived 'desirability' of a particular address. But that can soon turn into more practical objections: if numbers at a local school drop as a result leading to the school's closure, the adverse impact on the locality may be reinforced.

Example

The lead valuer Mr Morgan advised an out-of-area buyer on the purchase of a house well inland of the projected 100 year loss line in a North-east Norfolk coastal village in 2006, soon after the 2004 Shoreline Management Plan for the area was published for consultation. Mr Morgan advised that on balance:

"this house is sufficiently individual, as well as being sufficiently far away from the coast, for this not to be a major consideration."

The buyer decided not to proceed, stating:

"The primary reason for our decision to opt out was that we had serious concerns about our ability to sell this property [in 10 – 12 years' time] within a reasonable time frame (or promptly if medically necessary to sell it sooner) and without [the village] falling behind the (any) increase in house prices within the North-east Norfolk area. During our last visit to [the area], we mentioned to a few business people that we were intending to purchase property in [the village] and they all thought that we were barking mad to varying degrees!" She expressed concern that: "The draft SMP for [the village] could concern a mortgage company, particularly if it is adopted, erosion rates increase or there is a general perception that properties [in the village] are not a good investment. (Obviously, the reverse could be equally true ten years hence but it (sic) another imponderable)."

It is notable that this reaction, in what was then a strong residential property market, both preceded any actual evidence of renewed erosion in what is currently a defended settlement, and related to a property well inland of the area at risk in 100 years. But there does not seem to be a universal pattern. A new development of holiday homes on the Yorkshire coast appears to be selling well even though located directly on the coast, with buyers accepting that all of the new dwellings are at or behind the 300 year loss line.

Finally, we must look at changes in the market as a whole.

The housing market, in particular, tends to be subject to extremely uneven fluctuations in value and price from property to property as the market as a whole strengthens and weakens, depending on perceived drawbacks associated with that property. In a weak market, when there is more property available than there are buyers to take it up, buyers tend to concentrate on properties with no perceived drawbacks and those which do have drawbacks are left on the shelf altogether – or are sold only at much reduced prices. In a strong market when there is insufficient property to go round, there is a tendency for buyers to make do with whatever is available within their price range. So, quite apart from coastal erosion, it is well recognised that properties

in a poor location tend to rise by a greater percentage in value when the market strengthens than properties in a good location and to fall more rapidly when the market weakens. We found evidence that properties threatened by coastal erosion may, in a strong market sell relatively well (compared with other property at the same date) in a strong market, whilst selling only at a disproportionately large discount in a weak market.

Two new housing developments by the same developer currently available for sale within a mile of one another in the same village on the North-east Norfolk coast are instructive. One falls within the projected 100 year loss line; the other well outside it. Even in the current difficult market conditions, four out of the eight houses on the development not at risk have sold; none of the thirteen on the 'at risk' site have found a buyer, with coastal erosion reported by the agents as the primary consideration.

It is therefore fundamentally important to understand that the effect of coastal erosion upon the value of an individual property may be greatly magnified in a weak market (to the extent of the property being near to unsaleable) but relatively slight in a strong market. Section 5.2.6 considers statistical evidence to test this expectation but this is not based on the ideal approach which requires a more detailed consideration of individual transactions (to eliminate extraneous factors) and over a longer timescale – (to reflect clear variations in market conditions).

5.2.5 Findings relating to prices achieved

In considering evidence of the impact of coastal erosion upon value by reference to actual performance in the market we have looked in particular at two aspects:

1. Whether trends in price movement for properties in vulnerable locations are different, over time, to those for properties not at risk; and
2. Whether prices achieved in respect of individual properties inspected externally by the valuers demonstrate any clear variation from those which would be expected in a non-coastal/non-risk location.

Dealing first with movements in property prices, comparison has been made by means of Hometrack data, itself derived from Land Registry figures, between sale prices achieved in areas at risk, a roughly comparable area immediately inland and the larger region of which (normally) the two smaller areas form part. In each instance, reference has been made to movements in overall residential property prices over four years; and to movements in the price of semi-detached properties over two years.

It is very important to emphasise that the data sectors available from Hometrack were not designed to analyse erosion risk issues. The areas referred to here as 'at risk' include parts well outside the 100 year lines and it is very possible that the transactions contained in the figures include few or even none directly affected by erosion risk. Were more detailed bespoke analysis to be carried out restricted only to the 100 year line, the conclusions given here would be expected to be strengthened very considerably.

These classes of property for comparison have been chosen for the following reasons:

1. For any initial conclusions to be intelligible, it is necessary to narrow down the comparison classes. We recognise that it may be desirable to test some of the conclusions set out here against other classes of property;
2. In considering trends over as long a period as four years, the percentage movement in prices is likely to be sufficiently large that deviations from the norm reflecting individual property transactions should be “smoothed” to an acceptable degree. Even so, in the small areas (both the coastal location and the inland comparison area) numbers of transactions are low enough that a single highly unusual transaction – for example the sale of a small country estate which would still register simply as a detached house – may skew the figures. And in some instances, the numbers are so small that Hometrack do not provide data;
3. When considering the short two year scenario, only the prices of semi-detached properties have been considered to reduce the risk of skewing by unusual transactions. Even then, a semi-detached property may be unusually large or small and where there are few transactions, this could lead to some distortion of results.

Overall, however, we have found sufficient consistency in the various locations to allow broad conclusions to be drawn with a degree of confidence.

Properties exposed to coastal risk might reasonably be expected to benefit more in percentage terms in a strong market than the average (because potential buyers might be expected to take less account of the degree of risk in a market where few other opportunities presented themselves). This is referred to below as the ‘strong market premise’. In a weak market, however, where supply exceeds demand, precisely the opposite would be expected – namely that properties exposed to risk might only attract a buyer at all if very substantially discounted – referred to below as the ‘weak market premise’.

The two timescales considered reflect different stages in the market. Over a four year period (i.e. from 2004 to 2008) an appreciable increase in values is to be expected to have taken place in what was predominantly a strong and rising market. So in the absence of the suggested premise, an even percentage rise in property prices across the compared areas would be expected. Over the last two years alone, however, the market has weakened, such that values have fallen back, often to levels lower than those at the commencement of the period. So in the absence of the suggested premise, a consistently small increase or net decrease might be expected across the compared areas.

The actual figures from which the following conclusions are drawn are at Appendix 6.

5.2.6 Case study - trends in price movement

We distinguish, in each location, between price movements in the ‘at risk’ area (albeit including property not actually at risk), in an inland ‘comparison’ area or

areas where no property would be at risk and in a larger area which (normally) contains both of the smaller areas. If data were available (which on present information it is not) solely for properties directly at risk, the findings below would be expected to be very much more explicit. Table 5.1 summarises the data for the four year comparisons (2004 to 2008), while Table 5.2 summarises the data for the comparisons over the past two years.

Table 5.1 Summary of trends in price movement from case study areas

Case Study Area	4 year trends		Conclusions
	At risk area	Wider area	
Skipsea, Ulrome, East Riding	No data (too few transactions)	-	-
Aldborough, East Riding	36% rise	28.5% rise inland 30.2% rise larger area	Consistent with strong market premise
Scalby, North Yorkshire	11.1% rise	28.4% rise larger area 19% rise adjoining inland area	Data do not support strong market premise
Flat Cliffs, North Yorkshire	53% rise (slightly larger area)	51.2% rise inland area 28.8% rise region	Consistent with strong market premise
Robin Hood's Bay, North Yorkshire	36.5% rise	1.6% rise immediately inland/up coast 7.5% rise adjoining inland area 25.6% rise region	Generally consistent with strong market premise
Black Gang, Isle of Wight	47% rise	34.6% rise adjoining inland area 24.3% rise region 25.9% IoW as a whole	Consistent with strong market premise
Luccombe, Isle of Wight	20.3% rise	15.8% rise adjoining inland area 18.1% region 25.9% IoW as a whole	Consistent with strong market premise
Bembridge, Isle of Wight	47.5% rise 21.6% rise (adjoining at risk areas)	26.9% rise adjoining inland area 30.4% region 25.9% IoW as a whole	No clear conclusions can be drawn

Table 5.1 Summary of trends in price movement from case study areas

Case Study Area	4 year trends		Conclusions
	At risk area	Wider area	
Mundesley, Norfolk	18.1% rise (at risk but no change in policy) 5.4% reduction (at risk, change in policy)	39.1% rise inland area 22.9% rise region	This is the first example of a location where prices can be expected to have been affected by a changed perception in defence policy with a very clear distinction between the two parts of the village where the greatest change in expectation is to be anticipated and that part where erosion had always been a recognised consideration for buyers
Happisburgh, Norfolk	42% rise	28.6% rise adjacent market town of North Walsham 23.2% rise region	Consistent with strong market premise
Corton, Suffolk	61% rise	53.6% rise inland area 44.3% rise region 29.5% rise Waveney	Consistent with strong market premise

Table 5.2 Summary of trends in price movement from case study areas

Case Study Area	2 year trends		Conclusions
	At risk area	Wider area	
Skipsea, Ulrome, East Riding	3% rise	8.5% rise overall area 1.6% reduction inland area	Consistent with the weak market premise (but loss in inland area is potentially counter-intuitive)
Aldbrough, East Riding	15.2% rise	46.3% rise inland area (11.3% other inland area used as check) 18.8% larger area	Inconclusive but not inconsistent with the weak market premise
Scalby, North Yorkshire	1.8% rise	3.5% rise comparable inland area/larger area	Weakly supportive of weak market premise
Flat Cliffs, North Yorkshire ¹	68.7% rise	10.2% rise comparable inland area 9.4% rise region	Inconsistent with weak market premise (but based on just four transactions)
Robin Hood's Bay, North Yorkshire	4.2% reduction	14.8% reduction adjacent section of coast 10.2% reduction comparable inland 5% rise region	Although the at risk reduction varies between the two coastal areas and is not dissimilar from that a little inland, it nonetheless shows a more adverse market reaction than for the region as a whole such that the broad declining market premise is sustained
Black Gang, Isle of Wight	9.2% rise	7.9% rise inland area 8.2% rise region	Not possible to draw any significant conclusions

Table 5.2 Summary of trends in price movement from case study areas

Case Study Area	2 year trends		Conclusions
	At risk area	Wider area	
Luccombe, Isle of Wight	10.3% reduction	6% rise adjoining inland area 3.6% rise region	Consistent with the weak market premise
Bembridge, Isle of Wight	25.5% rise 7.4% rise (adjoining at risk areas)	7.3% reduction inland area 7.9% rise region	Inconsistent with the weak market premise
Mundesley, Norfolk	No data for at risk but no change in policy area 2.5% reduction (change in policy)	1.8% rise inland area 8% rise region	Consistent with the weak market premise
Happisburgh, Norfolk	9.7% reduction	17.3% rise in North Walsham 9.8% rise region	Consistent with the weak market premise
Corton, Suffolk	7.2% reduction	3.5% reduction inland area 15% rise region 12.8% rise Waveney	Consistent with the weak market premise

Notes:

¹ Figures derived from just four transactions such that one unusual transaction could produce an unpredictable outcome

At the very least, Tables 5.1 and 5.2 show that all property prices do not move similarly in the face of changed market conditions. The data available represents a blunt and imperfect tool for testing the hypothesis put forward. However, if the likelihood that a property may be seriously adversely affected in one market but much less affected in another is considered a relevant issue, we recommend that more specific data assessment is carried out to verify or disprove the proposition.

In the meantime, whilst to be treated with caution and with some individual figures at variance, we are satisfied that the evidence set out in Tables 5.1 and 5.2 broadly supports the premise that coastal erosion risk has a proportionally greater effect upon prices in a weak market than in a strong market. The evidence is much more consistent for the strong market premise, where all of the case study areas (except Bembridge, Isle of Wight) appear to support the premise. There is greater variability in terms of the weak market premise, although in many of the case study areas, property values in the at risk areas appear to have declined while inland and over larger areas, there has been a continued rise. It is important to note, though, that these data apply to a short period of time and in some cases to a small number of properties such that there is considerable uncertainty.

5.2.7 Case study areas – price comparisons

A similar exercise has been carried out with regard actual price levels on the basis of current market evidence – to establish whether there is any fundamental difference between the value of properties in ‘at risk’ areas and those nearby. However – the very blunt nature of the comparison tool is

emphasised: the at risk areas include large numbers of properties not at risk; and the Hometrack data is not collated in a way which makes it possible to identify whether the individual transactions included have abnormalities, or do or do not have sea views.

Comparison has been made on a price per square metre basis between, as with price trends, the area including a section of at risk coast, an adjoining inland area, and the larger area of which both form part. The results are summarised in Table 5.3.

Table 5.3 Summary of trends based on actual price levels (per square metre)

Case Study Area	Actual price levels in at risk area compared with	
	Adjoining inland area	Larger area
Skipsea, Ulrome, East Riding	15% higher	Marginally higher
Aldbrough, East Riding	16% lower	17% lower
Scalby, North Yorkshire	17% higher	17% higher
Flat Cliffs, North Yorkshire	11% higher	Marginally higher
Robin Hood's Bay, North Yorkshire	At risk area divided into two: First, 6% lower Second, 21% lower	Virtually identical
Black Gang, Isle of Wight	17% higher	Marginally higher
Luccombe, Isle of Wight	13% lower	11% lower
Bembridge, Isle of Wight	At risk area divided into two: First, 30% higher Second, 33% higher	Marginally higher
Mundesley, Norfolk	At risk area divided into two: First, 5% lower Second, virtually identical	5% lower
Happisburgh, Norfolk	2% lower	Virtually identical
Corton, Suffolk	26% higher	21% higher
Notes: ¹ Very few properties are directly threatened here so the 'uplift' may be indicative of a pure 'proximity to coast' premium		

Few conclusions can be drawn from the figures presented in Table 5.3 with respect to individual properties threatened with erosion because the data are not collated on that basis. The figures show some evidence, as would be expected, for a coastal premium, varying from one location to another. They do not, however, suggest a fundamentally different level of values per square metre of residential accommodation between coastal areas affected by erosion and the larger residential property market.

Our expectation is that a more detailed analysis of the figures would demonstrate a price premium attaching to properties close to the coast but **not** directly affected by erosion, which will probably be masking the price *discount* attaching to properties in the same data area which **are** directly threatened.

5.2.8 Comparison of individual properties

From the individual properties inspected externally, we have isolated those of a sufficiently standard nature (for example three bedroom semi-detached houses) to enable meaningful comparison between one and another. We have made those comparisons both between individual properties in the same village but at greater or lesser distances from the area of risk, and between essentially similar properties in nearby adjoining settlements where there may be a different perception of the degree of risk.

It is not practicable to set out, in a public document, our assessment of individual transactions because there is every likelihood that they will include transactions with unusual factors bearing on value that would, taken individually, invalidate the conclusions seemingly to be drawn from that transaction. The observations set out here are all ones which are, however, supported by a number of comparable transactions such that we are satisfied that they can be validly drawn by reference to those transactions, when taken together as a group.

Transactional evidence points to the following:

1. Many coastal locations (whether threatened by erosion or not) attract a recognisable price premium – examples from within the sample areas include Robin Hood's Bay but there are many other locations providing similar evidence, for example Blakeney in Norfolk;
2. Over and above the premium attaching to coastal locations, there is evidence for a significant additional premium attaching to sea views (as well as to this premium potentially outweighing any discount attaching to coastal erosion in certain locations);
3. Properties as a whole are often constructed to a lower standard (by reference to size or type of construction, or both) within a lower range of prices in areas where there is a long history of continuing erosion;
4. General property prices appear recognisably lower than would otherwise be expected to be the case in areas which have come to have a degree of *notoriety* associated with coastal erosion – for example Skipsea in Yorkshire, Happisburgh in Norfolk and Black Gang on the Isle of Wight;
5. This general impact on property values in “notorious” locations may extend some distance beyond the area at foreseeable risk of loss – notably to the extent of the parish or other postal address with which the area of notoriety is identified;
6. Even when properties have only a short life expectancy they appear to retain a significant degree of value with over £80,000 being paid in 2004 for a wooden bungalow at Skipsea to which, four years later, the vehicular access has been lost and, anecdotally, £12,000 being paid for a similar bungalow at Happisburgh with only a three year life expectancy by a purchaser who regarded that payment as an inexpensive equivalent to three years rent;

7. Reductions in value have the potential (although we found no specific evidence to support this) to be brought about by the loss of facilities such as an access road or services, rather than the loss of the property itself;
8. For commercial properties there is some evidence that the sharpness of the decline in the later period when a property has less than 50 years' life expectancy (and certainly where it has less than 15), would be steeper than for residential property although this may apply less to commercial properties with low elements of capital improvement – for example caravan sites; and
9. Agricultural land appears to be least affected of all although there is very little transactional evidence at all within the areas we have considered. Only very small parcels likely to be lost in their entirety within a limited period of time are likely to show clearly measurable reductions in value on a transactional basis.

5.3 Econometric analysis

The variation in property types, construction and between the different case study areas has meant that there are too many variations for econometric analysis to be undertaken. The sample size (some 350 properties) is large but the lack of comparable properties combined with the short-time period over which transaction data were available has meant that any econometric analysis would not be robust.

6. Literature review

6.1 Introduction

A detailed literature review has been undertaken covering research into the impacts of risks and nuisances on house prices generally and the characteristics of the case study areas, specifically. The results of the literature review allow us to develop alternative hypotheses based on the assumption that there is a difference in property values because an adjustment is made to reflect the risk. This section also looks at the assumptions behind the adjustments found in the literature (to the extent that these are reported in the relevant articles).

6.2 Results of the literature review

6.2.1 Hedonic Pricing Literature

This Section summarises the findings of the literature review and assesses the implications for properties at risk of coastal erosion. Full details of the literature review are provided in Appendix 1. Only limited research has been undertaken on the impact of coastal erosion risk on property values, and much of this uses hedonic pricing to assess the impact of erosion risks on property values.

Hedonic pricing is based on regression analysis and is used to assess the impact of particular characteristics of a property or its neighbourhood on the market value of that property. Hedonic pricing has been used to investigate the impacts of a wide range of different hazards and events. These include fire risk, earthquake risk, flood risk, noise, explosions, road, railway, etc. It is useful to examine the findings of studies in these other areas as there may be parallels in terms of impact on property values associated with erosion risk. The findings of the research also give ranges of property price impacts; these can then be compared with the impacts from coastal erosion found during our study. Table 6.1 summarises the findings of the literature review in terms of the percent discount associated with erosion risk. The table also puts the impacts identified as a result of coastal erosion into context with property price discounts caused by other risks. Premiums associated with views (including sea views) are provided in Table 6.2.

The studies reviewed generally included large sample sizes. For example, Kriesel *et al* (2000) based their assessment on 3,612 returned questionnaires. After removing atypical properties and those that were more than 200 feet from the coast, the sample available was 1,344. The use of questionnaires allowed properties purchased over a longer time period to be included (the average purchase time was 1986). Other studies reviewed used sample sizes of 1,075 (Bin *et al*, 2008); 8,375 (Bin & Polasky, 2004); 3,081 (Kriesel *et al*, 2000a) and 2,000 (Samarasinghe & Sharp, 2008). The studies used regression analysis to investigate if there were differences in property values that could be attributed to exposure to risk. The results are reported in terms of whether they are statistically significant (or not) and with a measure of confidence at the 90% or 95% level. All the results given here are significant to at least the 90% level.

Table 6.1 Comparison of Property Discounts by Risk

Discount	Risk Type			
	Erosion of property	Flood	Fire/Earthquake	Other
-37%	10 years until erosion in Great Lakes region ¹			
-29%	20 years Great Lakes region ¹			
-28%	10 years Pacific region ¹			
-23%	30 years Great Lakes region ¹ 10 years Atlantic region ¹		After second forest fire ²	Houses located within 100m of flight path ³
-21%				Houses located near to airport ³
-20%	40 years Great Lakes region ¹			Pollution from wastewater treatment plant ⁴
-18%	20 years Atlantic/Pacific regions ¹			After an explosion at industrial plant ⁵
-17%	50 years Great Lakes region ¹			
-15%	30 years Atlantic region ¹ Net effect of coastal erosion ⁶		After forest fire 2 miles from town ⁷	
-14%	60 years Great Lakes region ¹			
-13%	30 years Pacific region ¹			Due to no maintenance on 40 year old property ⁸
-12%	40 years Atlantic region ¹ 10 years Gulf of Mexico region ¹			On boundary of landfill ⁹
-11%		Location in 1% flood zone ⁶ After flooding from Meuse (upper) ¹⁰	Exposure to earthquake and volcano risks (upper) ¹¹	
-10%	50 years Atlantic region ¹ 40 years Pacific region ¹	After flood event ¹²	After first forest fire ²	
-9%	60 years Atlantic region ¹ 50 years Pacific region ¹ 20 years Gulf of Mexico region ¹			
-8%	100 years Great Lakes region ¹	After flooding from Meuse (lower) ¹⁰ Location in 1% flood zone ¹³ After flooding caused by Hurricane Floyd ¹⁴	Exposure to earthquake and volcano risks (lower) ¹¹	

Table 6.1 Comparison of Property Discounts by Risk

Discount	Risk Type			
	Erosion of property	Flood	Fire/Earthquake	Other
-6%	100 years Atlantic region ¹ 60 years Pacific region ¹ 30 years Gulf of Mexico region ¹	Location in 0.2% flood zone (1:500) ¹³ Location in floodplain ¹⁵		Location near to landfill ¹⁶ After rupture of pipeline (in town 2 miles away) ¹⁷
-5%	50 years Gulf of Mexico region ¹			
-4%	100 years Pacific region ¹ 60 years Gulf of Mexico region ¹	Location in flood prone area ¹⁸	Before earthquake occurred ¹⁹	
-3%	100 years Gulf of Mexico region ¹		After earthquake occurred ¹⁹	
-2%				Location near to railway (noise level >55 dB) ²⁰
-1%				Location near to railway (noise level >50 dB) ²⁰ Due to one additional year of age ¹⁴ Location within 6.5 miles of power plant ²¹ Reduction in lot size by 10% ²²
-0.3%				Depreciation rate of properties ¹
0%				After explosion of nuclear reactor ²³

Sources:

- ¹ Kriesel *et al* (2000); study from USA
- ² Mueller *et al* (2007); study from USA
- ³ Rahmatian & Cockerill (2004); study from USA
- ⁴ Zabel & Kiel (2000) in Boyle & Kiel (2001); study from USA
- ⁵ Carroll *et al* (1996) in Boyle & Kiel (2001); study from USA
- ⁶ Bin *et al* (2008); study from USA
- ⁷ Loomis (2004); study from USA
- ⁸ Wilhelmsson (2008); study from Sweden
- ⁹ Nelson *et al* (1992) in Boyle & Kiel (2001); study from USA
- ¹⁰ Daniel *et al* (2005); study from the Netherlands
- ¹¹ Bernknopf *et al* (1990) in Smith *et al* (2002); study from USA
- ¹² Schultz & Fridgen (2002) in Loomis (2004); study from USA
- ¹³ Okmyung *et al* (2008); study from USA
- ¹⁴ Bin & Polasky (2004); study from USA
- ¹⁵ Speyrer & Ragas (1991) in Smith *et al* (2002); study from USA
- ¹⁶ Reichert *et al* (1992) in Boyle & Kiel (2001); study from USA
- ¹⁷ Simons (1999) in Boyle & Kiel (2001); study from USA
- ¹⁸ Samarasinghe & Sharp (2008); study from New Zealand
- ¹⁹ Beron *et al* (1997) in Daniel *et al* (2005); study from USA
- ²⁰ Andersson *et al* (2008); study from Sweden
- ²¹ Blomquist (1974) in Boyle & Kiel (2001); study from USA
- ²² Kopits *et al* (2007); study from USA
- ²³ Gamble & Downing (1982) in Boyle & Kiel (2001); Nelson (1981) in Boyle & Kiel (2001); studies from USA

Table 6.2 Comparison of Property Premiums

Premium	Risk Type	
	Erosion Risk Management	Views
+0.05%	1% reduction in erosion risk (Atlantic coast) ¹	For locations 100 feet closer to open space or natural areas ¹
+0.3%	1% reduction in erosion risk (Great Lakes region) ¹	
+0.4%	1% reduction in erosion risk (Pacific coast) ¹	
+2%		Due to average water views ³
+3%		Due to good water views ³ Waterfront location (lower) ⁴
+4%		Located within 500m of River Meuse ⁵
+5%	Premium associated with sand nourishment (potentially capitalisation of benefit of works undertaken by federal or state government) (upper) ¹	Waterfront location (higher) ⁴ Due to view of forests ⁶
+6%		Home with a seaview ⁷ Seaview (lower) ⁸
+9%		Home with a view (type not specified) ⁹
+10%		Seaview (upper) ⁸ Partial ocean views ¹⁰
+12%	Premium associated with sand nourishment (potentially capitalisation of benefit of works undertaken by federal or state government) (upper) ¹	
+13%		Seaviews ¹¹
+23%	Premium associated with protection by seawall (potentially capitalisation of benefit of works undertaken by federal or state government) ¹	
+25%		Sea views (less fashionable areas) ¹²
+28%		River views ¹³
+32%		Full ocean views ¹⁰
+33%		Medium water views ¹⁴
+50%		Sea views (more fashionable areas) ¹²
+59%		Wide water views ¹⁴

Sources:

¹ Kriesel *et al* (2000); study from USA

² Lake & Easter (2002); study from USA

³ Abelson (1979) in Bourassa *et al* (2003); study from Australia

⁴ Garrod & Willis (1994) in Boyle & Kiel (2001); study from UK

⁵ Daniel *et al* (2007); study from the Netherlands

⁶ Tyrvaïnen & Miettinen (1999) in Boyle & Kiel (2001); study from Finland

⁷ Rahmatian & Cockerill (2004); study from USA

⁸ Tse (2002) in Bourassa *et al* (2003); study from Hong Kong

⁹ Gillard (1981) in Boyle & Kiel (2001); study from USA

¹⁰ Benson *et al* (1997) in Bourassa *et al* (2003) ; study from USA

¹¹ Graves *et al* (1988) in Bourassa *et al* (2003); study from USA

¹² Norwood (2005); article from UK

¹³ McLeod (1984) in Bourassa *et al* (2003); study from Australia

¹⁴ Bourassa *et al* (2003) ; study from Australia

Reductions in the value of properties exposed to risks

Table 6.1 shows that exposure to a variety of different risks affects property values. The maximum reduction seen (37%) is associated with erosion and relates to the estimated property price reduction in the Great Lakes region when the property has 10 years of life remaining. The maximum reduction associated with alternative risks is 23% (reduction following a second forest fire, and for houses located within 10m of a flight path). The same property value reduction is associated with houses at risk of erosion with 30 years of life remaining in the Great Lakes region, or with 10 years of life remaining in the Atlantic region. Other regions of the USA show variable property value reductions: -28% in the Pacific region and -12% in the Gulf of Mexico region.

Flooding is found to reduce property values by between 4% and 11%, similar to earthquake risk. The maximum level of reduction associated with flooding can be seen, from Table 6.1, as being similar to reductions as a result of erosion risk when the properties have around 40 to 60 years remaining (Atlantic and Pacific regions). At the low end of the reductions associated with flooding, the discounts as a result of erosion apply to properties with 60 to 100 years of life remaining (Pacific and Gulf of Mexico regions). All regions affected by erosion in the US research have greater value reductions, even with 100 years of life remaining, than discounts caused by road or rail noise.

Regional variations

The regional variation in discounts caused by erosion are worthy of further consideration. Kriesel *et al* (2000) highlights some of the differences between the regions, including exposure to flood risk. In this case, the Great Lakes region, where most properties are located on cliffs, has little or no exposure to flood risk. The other regions do include exposure to flood risk. It is important to note that the USA has a system of insurance available to homeowners whose properties are at risk of flooding. It is unclear whether erosion not associated with flooding is covered but responses to questions on the National Flood Insurance Program (NFIP) by the Federal Emergency Management Agency (FEMA) suggests this may not be the case⁴. Thus differences between the four regions and the discounts seen could be interpreted as reflecting the variable availability of insurance. However, this is likely to be an over-simplification. Other factors such as recreational opportunities are also likely to be important.

Properties at risk of erosion in the Great Lakes region are highly prized because of the recreational (boating) opportunities they provide. The other three regions tend to be more associated with beach recreation. Erosion can be more problematic in the Great Lakes region as it can reduce opportunities for mooring boats close to properties. Thus, some of the discounts seen may reflect the loss of moorings, on top of the risk to the property itself.

⁴ The Federal Emergency Management Agency (FEMA) answers to questions about the NFIP state that 'Subsidence of land along a lake shore or similar body of water which results from the erosion or undermining of the shoreline caused by waves or currents of water exceeding cyclical levels that result in a flood is covered. All other land subsidence is excluded' FEMA (2007).

Property value premiums associated with sea views and recreation

The importance of recreation and sea views is shown in Table 6.2. Here it can be seen that waterfront locations and good sea views can be associated with significant price premiums. The actual premiums are highly variable; sea views alone range from +6% to +50%. Only one study (Bin *et al*, 2008) attempted to net out the negative effect of erosion and the positive effects of sea views and recreation. Bin *et al* (2008) found a net reduction in value of 14.7% for properties at risk of coastal erosion. The study also found that the net effect depends on the variability in erosion rates, where the study area had constant rates of erosion. Bin *et al* (2008) conclude that the net effect of reductions from erosion and premiums associated with sea views and recreation were likely to be location specific.

Kriesel *et al* (2000) focused on the potential community impacts of degraded beaches, where a reduced beach can result in tourism-related properties becoming concentrated very close to the shore. Ongoing degradation of the beach is likely to result in the coastal community reflecting the structure of an ordinary residential community. The premium for sea views, though, is not lost.

Impacts of increasing awareness of risk

Kriesel *et al* (2000) found that there was a 0.24% increase in uptake of insurance for each year of Geotime lost (the amount of time that a coastal property has before the distance between it and the coast is reduced to zero due to erosion). Furthermore, property owners in areas where there was an ongoing programme of beach nourishment are more likely to purchase erosion insurance, perhaps reflecting their greater awareness of the risk. The (potential) availability of insurance in the USA means that property owners would receive some financial assistance if their house is eroded. However, the literature also notes that there is still a price premium even where insurance is available, potentially reflecting the additional capital loss identified with flooding/erosion.

In considering how property values adjust to risks it is useful to consider the change in discounts before and after events (particularly where these events highlight the risks to which a property is exposed).

Bin & Polasky (2004) found that property values in the floodplain decreased by almost 6% after flooding caused by Hurricane Floyd. This may reflect the adjustment for risk made after the event, since before it many people were unaware that they were living in a floodplain.

Mueller *et al* (2007) reported that a second forest fire in the USA caused property values to decrease by 23%, where the first had reduced property values by 10%. The additional decrease occurred even though the two fires were several years apart.

Price reductions also increased after a flood event on the Meuse, Netherlands (Daniel *et al*, 2007). Prior to the flood, property values in the floodplain were 8% to 14% higher than after the flood. The additional price reductions were

reduced only slightly even eight years after the flood (8% to 12%), suggesting that the readjustment was not a short-term reaction.

The results from these three studies which all show an increased adjustment after exposure to risks can be compared with the results of a study on the Loma Prieta earthquake, USA (Beron *et al*, 1997, in Daniel *et al*, 2005; Bin & Polasky, 2004). These studies showed that property values in the earthquake zone were reduced by 4% before the earthquake occurred, and by 3.4% after. This is interpreted as showing that the residents were fully aware of the risks (due to education and preparedness campaigns associated with earthquake risks over previous decades) and that property values were adjusted accordingly such that no readjustment was necessary.

Lower awareness of risks can also result in smaller property value reductions. Samarasinghe & Sharp (2008) explain the (relatively) low discount of 4.3% of properties in a floodplain in New Zealand as being (at least partly) due to a lack of recent flood experience. Thus, it would be expected that properties that are at risk of coastal erosion but where this is not well known or publicised would show little or no reduction in value. In fact, the influence of positive factors (sea view, access to recreation) may result in those properties attracting higher values than properties further inland.

Coastal erosion is a constant risk where there are no defences or where defences are no longer maintained. Thus, it could be expected that property values would continue to fall over time, not just because the risk of erosion is increasing but because potential property buyers are constantly reminded of the risk and so may be constantly adjusting their perception of the risk. This is supported by Kriesel *et al* (2000) who found that the impact of Geotime doubled following media interest showing properties falling into the sea. Samarasinghe & Sharp (2008) noted that people find it more difficult to adjust for risk where the risk is low likelihood and high consequence. In such cases, subjective perceptions of risk tend to dominate. The impact of differences between types of erosion (e.g. gradual on-going erosion versus sudden cliff failures or landslips) could have a significant effect on the extent to which the risk of erosion is appreciated, understood and, consequently, any adjustments made.

The issues may be slightly different where a decision has been made to maintain defences for a set period, after which maintenance would be withdrawn. Publicity is likely to initially result in a significant reduction in property value, similar to that seen where erosion is progressing. This occurs because the risk is constantly being reinforced, raising awareness and 'encouraging' the readjustment of property values. The reduction in value may be even greater as the capitalised value associated with the defences (as noted by Kriesel *et al*, 2000) is lost. Once publicity reduces though and no evidence of erosion is seen, it could be expected that there would be some recovery in property prices (at least in the short-term until the risk is again publicised). Should a decision be made to reverse the policy at some later date, there could be a significant price rebound. This was seen in the USA when property prices increased by 38% after the decision was made to relocate an industrial plant that had previously had an explosion (Carroll *et al*, 1996, in Boyle & Kiel, 2001). This compares with property price reductions before the decision to relocate of around 18%. The study does not mention if property prices fell back over time.

Acceptance of risk

There is also a perception element to acceptance of risk that can result in impacts being seen on property prices even outside the area of (apparent) risk. Loomis (2004) found that property values decreased by 15% in a town located two miles from a wildfire. The town itself was unaffected, but the wildfire resulted in people adjusting their perception of the risk. The same could be expected in towns and villages where part of the settlement is at risk. In such cases, reductions in property values may extend to the whole town/village due to the perception that it is the area that is at risk, not specific locations. People also view risk differently. Some people will not accept any risk, as seen in Zhai (2006) where 50% of respondents to a survey stated that they accepted no flood risk at all. Others will take a more optimistic view of risk, potentially under-estimating the consequences and so may be disproportionately attracted to properties with lower values. If the findings of Zhai (2006) were applicable in England, properties at risk of erosion would be of no interest to at least 50% of the population. This would reduce interest in the properties, making it potentially more difficult or take more time to sell the property with the likelihood of a price reduction. The price reduction itself may then attract those with an optimistic perception of the risk. As a result, these impacts would be seen to a greater extent in a weak market, where there are fewer buyers or more properties available. This is supported by the research undertaken by Kriesel *et al* (2000) who found that only 3,000 out of 21,000 coastal communities joined the National Flood Insurance Program (NFIP) in the first four years. This was explained as being due to people with optimistic perceptions of risk or unaware of risk being attracted by the lower priced houses. It could also be explained by the strong market premise, where buyers would consider 'problem' properties due to greater competition within the market.

Incomplete understanding of the risks can result in the impacts being much greater than would be expected (e.g. extending over a much wider area or reflecting media interest showing properties falling into the sea). Such impacts can result in very significant effects on property prices. Although no directly comparable figures for property price reductions in England are available from the literature, reductions exceeding 10% or 20% could be expected (even where properties still have significant residual lives). Given the lack of financial assistance once a property has eroded, it is likely that the reductions could be even higher.

Incomplete understanding can also result in the impacts being significantly lower than might be expected. Optimistic perceptions of the risks may result in properties maintaining price premiums associated with sea views and access to beaches for recreation. Such situations are unlikely to last, however. Publicity of an erosion event is likely to force people to adjust their perceptions and could result in property prices reducing (as seen following repeated forest fires and flooding). This may be countered where property buyers hold an optimistic perception of risk because they value the sea view much higher than a future erosion risk. This situation may best fit those locations where defences are being maintained at present, but may be withdrawn in 50 years. If interest in the at risk properties can be maintained then property values may not decline until much closer to the time that the funding of maintenance is withdrawn. This may depend on property market conditions, where fluctuations in the market

could have greater impacts on properties at risk of coastal erosion than might be expected on properties that are not at risk.

Ownership of coastal properties

CLG (2008) found that the average (median) period of property ownership is 11.6 years. This increases to 22.4 years for those who own their property outright, compared with 7.1 years for those buying with a mortgage. These figures relate to the time spent in the home at the time of the survey (not the complete length of time that residents will spend in their property). Clearly, older people are more likely to be those without a mortgage so it could be expected that ownership of coastal properties may be longer than the median.

Census data (www.neighbourhood.statistics.gov.uk) suggest that there is a concentration of older residents in at risk wards in North Suffolk, North-east Norfolk, East Riding, North Yorkshire and the Isle of Wight (compared with the areas as a whole). Table 6.3 summarises these data for the case study areas.

Table 6.3 Summary of Census data

Case Study Area	Ward	45-64 year old (%)	45-64 year old (%) in LA area	65+ year old (%)	65+ year old in LA area
North Suffolk	Gunton and Corton	31.4%	25.5%	26.0%	21.6%
North-East Norfolk	Poppyland	31.1%	28.3%	27.1%	25.4%
	Happisburgh	33.1%		21.7%	
	Mundesley	28.2%		28.3%	
East Riding	East Wolds and Coastal	30.1%	27.5%	18.2%	18.4%
	North Holderness	28.0%		23.2%	
Isle of Wight	Bembridge North	30.6%	27.2%	34.1%	22.4%
	Bembridge South	29.6%		31.9%	
	Shanklin North	25.7%		25.6%	
North Yorkshire	Filey	26.2%	27.2%	31.4%	21.4%
	North Bay	26.7%		15.3%	
	Fylingdales	32.4%		22.2%	

Source:
www.neighbourhood.statistics.gov.uk

The non-standard construction of some coastal properties (particularly in East Riding) also means that they are more difficult to mortgage. Differences in the age of buyers as well as the type of properties both suggest that home ownership in these areas may be closer to the 22.4 years than the 7.1 years.

Other factors that may affect property values

Maintenance of the property and properties around it can also affect property values. While Bin & Polasky (2004) found that house prices decreased by 1.1%

for each additional year of age, Wilhelmsson (2008) identified a 13% difference in the value of a 40 year old house that had been maintained versus one that had not. Vanderford *et al* (2005) found that vacancy rate had a negative influence on property prices, although the authors did not quantify the impact. These results show that lack of maintenance of a property that is expected to erode (because there is no incentive to pay to maintain a property that will be lost) could exacerbate the reductions in property values. Where a number of houses in a block or along a road are not maintained, then the impacts would be expected to extend to neighbouring properties.

7. Collection of qualitative information

7.1 Introduction

Collection of qualitative information provides the evidence that can help to explain some of the findings from the valuation data, econometric analysis and, to a lesser extent, the literature review. Although the qualitative information may not allow quantified alternative hypotheses to be developed, it will provide information to support the decision to reject (or otherwise) the null hypothesis.

The following discussion summarises the findings from the questionnaires and workshops. It is important to note that these findings are based on responses from a relatively small number of respondents (27 parish councillors, four local authorities, ten mortgage lenders, 15 estate agents and 16 attendees to the workshops). The small number of responses reflects, in part, the limited number of potential respondents (given the nature of the case study areas). As a result, the responses may not be representative of all those living and working in the at risk areas.

7.2 Questionnaires

7.2.1 Awareness of risk

Responses to the parish councillors' questionnaire identified that 18 of the 27 respondents (67%) are in parishes that are at risk from coastal erosion. With the exception of one respondent who was uncertain, the remainder (30%, 8 respondents) did not consider their parish to be at risk, although 5 (19%) stated that they were close to parishes that were at risk. A higher response rate from those at risk would be expected since councillors for these areas are more likely to be interested in the subject area and to feel that they want to contribute.

Three out of the four respondents to the local authorities' questionnaire stated that they received requests from potential buyers for information regarding coastal erosion. This fits with the responses of all three estate agents who fully completed the questionnaire. They disagreed with the statement that 'buyers show no obvious awareness of coastal erosion in my area' and that 'sufficient buyers disregard coastal erosion for there to be no noticeable impact on prices'. Similarly, two respondents disagreed that 'buyers are only sensitive to coastal erosion if they can see an immediate threat to the property', while one respondent agreed with this statement.

Although only one of the ten respondents to the questionnaire for mortgage lenders and insurance companies claimed to have a policy for dealing with coastal erosion, five others took specific circumstances into account. Therefore, in practice, 60% of the respondents are aware of coastal erosion risk to the extent that they take it into consideration in their everyday business.

These responses generally suggest that there is an awareness of the risks from those living in the at risk areas, potential property buyers and those who could fund purchase of properties. However, this does not mean that the risks are

well, or accurately, understood. The degree to which the risks are understood was considered in the workshops (see Section 7.3).

There are concerns from parish councillors that coastal risk in neighbouring parishes could affect property values in their parish. However, only four respondents (33%) who live close to parishes at risk feel that outsiders think properties within their parish are at risk. This suggests that the impacts tend to be associated with areas that *are* at risk. Indeed, two of the three estate agents providing responses disagreed with the statement that '*buyers are put off over a larger area than that actually at risk - for example a whole parish*'. In parishes at risk though, 8 respondents (44%) believed that the whole parish was associated negatively with coastal erosion, even though only part of it was actually at risk. Considering local authorities, two of the three respondents had been asked whether a village/area was at risk of erosion, suggesting the impacts went beyond those buildings at immediate risk. Yet comments from mortgage lenders indicate that being in a coastal parish does not automatically mean mortgages are refused. Instead of plain refusal, there appears to be a heavy reliance on the information provided in the valuer's report, which implies that each property is assessed individually.

Overall, the results suggest that impacts may extend beyond those properties directly at risk, but that the additional area affected may not be large and may be limited to local settlements/parishes.

Questionnaires were circulated to estate agents in North Norfolk as part of the work undertaken by RPA *et al* (2008) for North Norfolk District Council. Of the eleven responses received, 73% (8) had experienced purchasers expressing concern over coastal erosion in the previous twelve months. The three who had not all operate are outside the (main) at risk areas. Of the eight agents that had indicated that purchasers had expressed concerns, five believed this had impacted prices.

In terms of the extent of the impacts, 82% (9) of the respondents believed that coastal parishes as a whole were seen as having a problem with coastal erosion. No respondents considered that the problem extended to parishes without a shoreline frontage (RPA *et al*, 2008).

7.2.2 Reductions in the value of properties exposed to risk

Over two-thirds (72%, 13 respondents) of councillors representing parishes at risk from coastal erosion believe property prices are lower. Eight respondents (44%) thought that interest in properties was lower. Four respondents (22%) did not believe that there was any impact on the property market as a result of coastal erosion. Two of these parishes were in Yorkshire (one in Scarborough, one in East Riding) and one on the Isle of Wight.

In terms of the response of property prices, 39% (7) thought property prices fell once people became aware of the erosion risk and have not recovered. Four respondents (22%) felt prices had fallen more and more over time, yet another four respondents felt that prices had varied. One respondent felt prices fell and then recovered a little, one that prices had stayed more or less the same, and one that prices had increased. The general opinion that property prices fell

(whether or not there had been any recovery) is reinforced by the responses of the four estate agents who answered this particular question. They all believed that property prices were affected by the risk of coastal erosion, with two respondents indicating that the impacts were just related to properties at risk of erosion and two that impacts occurred to other properties as well.

As mentioned above, 60% of the respondents to the questionnaire for mortgage lenders and insurance companies take coastal erosion risk into account either through having a policy or in specific circumstances. The key factors taken into consideration include:

- time until property is predicted to erode: 100% of respondents (5);
- advice from surveyor: 100%;
- length (time period) of mortgage required: 60%;
- level of insurance cover required: 60%;
- whether there are other risks associated with the property: 80%;
- advice from engineer (e.g. landslips): 80%; and
- value of property: 60%.

Although these responses are based on a small number of responses, all of the mortgage lenders who responded would take the residual life of the property and advice from a surveyor into account but only 60% (3) would take the value of the property into account.

Two (of three) mortgage lenders expected their company's policy or approach to negatively affect both property sales and property values. The other respondent did not expect there to be any significant effect. Considering local authorities and the impact of their replies to requests for information on coastal erosion risk, two (of three) felt that 'responses varied considerably from one person to the next, no common response', whilst one believed 'interest in properties at risk of coastal erosion tended to decrease'.

Responses from estate agents to the questionnaire in RPA *et al* (2008) suggested that price reductions in at risk areas (or perceived at risk areas) ranged from 3% to 15% (based on four responses), with a mean reduction of 11%. Three of the 11 respondents (27%) believed that there was also a price reduction for properties outside the areas shown in the SMP as being at risk. All three respondents indicated that this reduction was 10%.

7.2.3 Impact of increasing awareness of risk

A significant proportion (six respondents, 43%) of parish councillors felt that the impacts of coastal erosion on property prices first began when erosion lines were published. 'Following media coverage' had three responses (21%). Two respondents were unable to say as coastal erosion 'has been going on for a long time'. These responses suggest that actions that highlight the risk of erosion can change perceptions of risk such that adjustments are made for the risk. Whether these adjustments accurately reflect the risk is more uncertain, however. The potential for some recovery in property values over time (as discussed above) indicates that there may be some overestimation of the risks (at least in the short-term).

Four out of eleven (45%) estate agents responding to the questionnaire in RPA *et al* (2008) considered that residential properties shown within the area likely to be lost in the next 100 years in the Shoreline Management Plan have sold for less than would have otherwise have been the case during the past twelve months. Only three of the respondents had dealt with non-residential property in the past twelve months. Of those, two had experienced no negative reaction to the Shoreline Management Plan in the context of non-residential properties but the third spoke of this issue being “a significant factor in property at Mundesley being discounted in order to achieve sale”.

Overall, it could be expected that adjustments to risk should be seen in property prices, although some locations may not fully reflect the risk of erosion in the property values. The impacts may extend beyond those properties at immediate risk of erosion. This could be interpreted as indicating an incomplete or inaccurate understanding of the risks, but it could also reflect people’s uncertainty about future risks and what could happen. For example, buyers may be unwilling to purchase property inland of the at risk erosion zones because they expect impacts on the community, loss of services, schools, etc. However, the extent to which buyers take account of future changes in a community is difficult to separate from the uncertainties that surround the risk and the potential overestimation of risks. The overestimation of risks may be driven by media coverage which tends to publicise dramatic events (e.g. houses falling over cliffs), emphasising negative messages and often reporting assumptions as fact, neglecting any uncertainties.

7.2.4 Acceptance of risk

Three of the four respondents from local authorities received requests for information about coastal erosion. The information requested includes:

- whether a village/area is at risk of coastal erosion: 2 respondents;
- whether a specific property (business or house) is at risk of coastal erosion: 3;
- how long before a property is expected to erode (property at erosion risk): 2;
- how long before a property is expected to erode (property not at erosion risk for at least 100 years): 2; and
- whether a property is likely to erode within a specified time period: 3.

The most common requests, though, are to ask whether a specific property (business or house) is at risk of coastal erosion and whether it is likely to erode within a specified time. Two local authorities received several requests per month; the other one received 10 to 12 per year. The requests were evenly spread over time but bunched geographically, either to those areas at greatest risk of erosion (2 respondents) or to one or more areas even though others are at similar risk. One respondent suggested that the person requesting the information reduced their interest in the property once they become aware of the risk, but the other two respondents stated that it was not possible to tell if the level of interest changes. This mixed pattern of responses is reinforced by the information from the estate agents. Three (of four) respondents stated that concerns about erosion risk were raised by both buyers and sellers, yet one respondent thought erosion only raised concerns amongst buyers. These

concerns are perhaps driven by publicity, with one estate agent respondent commenting '*I feel that it is mainly when the media gets hold of new statistics; [that] is when buyers then start to have itchy feet and withdraw*'. Should the media be selectively reporting on the more dramatic erosion events, it is perhaps not surprising that buyers then overestimate the risks.

Overall, it appears that some buyers are not willing to accept the risks and this may affect whether they pursue an interest in a property.

7.2.5 Other factors that may affect property values

One parish councillor (7%) agreed that interest in coastal properties was higher, along with property prices (because of sea views), with this perhaps counteracting some of the negative impacts. The same respondent considered that house prices had increased even though the risk of coastal erosion was known.

However, mortgage lenders highlighted how they relied on the reports produced by valuers when deciding whether to lend money. This implies that if the valuer in question has a good understanding and awareness of coastal erosion, potential buyers of at risk properties may find it difficult to obtain a mortgage. Therefore, although the issue of sea views and recreation may mask the impact of coastal erosion, this effect may be limited to specific locations, in particular those which are not at immediate risk.

7.3 Workshops and interviews

The results of discussions at the workshops and through interviews with mortgage lenders are summarised below. Full details of the workshops can be found in Appendix 3, with a summary of the interviews set out in Appendix 4. The results produced below use responses from the workshops to assess the extent to which the risk of coastal erosion is known and understood and, thus, the confidence that can be placed on anecdotal evidence surrounding perceived reductions in property values. Information given in *italics* reflects the views of attendees to the workshops or opinions raised during the interviews.

7.3.1 Awareness of risk

Workshop attendees highlighted a number of key points that illustrate the variable nature of understanding of risk:

- *there is a perception that all coastal erosion is the same even where rates of erosion are highly variable. This can result in a perception of risk that is greater than the actual risk;*
- *people are unable to adjust for time when considering risks. They are unable to appreciate that a risk in 20 or so years' time will affect them and then complain when the effects become apparent;*
- *people find it difficult to assess where the risks are, tending to assume that the risks extend much further inland than they actually do (e.g. in Happisburgh where the whole parish is considered to be at risk even though much of it is significantly inland);*

- *there is misunderstanding of what the risk really is. Loss of assets can mean that a property would be 'effectively' lost much earlier since it could not be accessed or has no sewerage service; and*
- *information about risk is not always provided or well understood. Estate agents are perceived as not telling buyers about the risk of property [nor are they obliged to do so]. Local authorities can only give information based on historic erosion rates and advice for those buying properties can be poor quality.*

These responses indicate that local people are themselves concerned about awareness of risk of property buyers and those who advise them. It is not surprising that awareness is variable given the nature of coastal erosion risks and the uncertainties surrounding it:

- erosion rates where future predictions of what will erode and when can themselves be highly variable. Thus, it may be difficult to determine whether any one property is at risk or not;
- type of erosion and availability of evidence showing the risks (e.g. areas of on-going erosion compared with areas that have been defended). Again, this may affect whether a property is seen to be at risk or not;
- issues of time and future effects versus impacts now. This is important when considering if a property is likely to become at risk in the future;
- potential impacts on other services and assets beyond just the property itself. Again, this will affect whether the property and/or quality of life would be affected in the future; and
- the extent to which information on the risks is provided to potential buyers and, importantly, the extent to which they take that information into account when deciding whether to proceed (or not) with a purchase. Good information may help a buyer understand whether the property is at risk or could become at risk in the future.

Overall, therefore, the extent to which any one potential buyer is aware of the risks of coastal erosion is likely to vary according to the information with which they have been provided (or have found for themselves) and the confidence they have in that information. All of these factors will also affect how well a buyer understands the risks.

7.3.2 Understanding of risk

Attendees at the workshops raised issues over the different levels of understanding of risks amongst different groups of people:

- those living in erosion risk areas:
 - *those living in the East Riding of Yorkshire are aware of the risks but do not want to publicise these risks to avoid blight,*
 - *people living in the area may underestimate the risks as they cannot believe that erosion will be allowed to occur; they cannot picture their home being allowed to erode and only half the village remaining; and*
 - *the prediction of erosion rates is difficult. This can affect how people adjust for risk, encouraging them to be pessimistic, especially if recent rates appear to show acceleration in erosion over recent years. For example, a bungalow in East Riding was purchased with advice that it*

would not be affected by erosion for 50 years, but it is now expected to erode within eight years.

- people looking to buy properties and move into the area:
 - *those moving into North-east Norfolk do consider the risk when looking at properties on crumbling cliffs (i.e. where the risk is difficult to overlook); and*
 - *people moving into North-east Norfolk are more likely to overestimate the risks, associating the whole parish with erosion risk.*
- mortgage lenders and insurers:
 - *people are being refused mortgages even though they are inland;*
 - *people cannot get insurance even though they are half a mile or more inland;*
 - *coastal erosion is generally a very low profile issue with lenders relying on the expertise of valuers to decline properties that are unlikely to maintain their value over a full mortgage term; and*
 - *properties at risk of coastal erosion are excluded from use of automated valuation models so are subject to consideration of a valuer.*

The results of the workshops show that understanding of risk is variable. Again, this is understandable given the number and type of uncertainties that affect it and how coastal risk can be fully understood:

- the accuracy of information provided from professional people (estate agents, mortgage lenders, solicitors, valuers, insurance companies) as well as local people. Local people may not want to acknowledge or publicise the risks to avoid blight or may be in denial of the risks. Professional people will try to take account of the uncertainties where they can, but this will depend on the extent to which they are fully informed and experienced with coastal erosion in the local area. Mortgage lenders tend to rely on valuers when considering properties at risk of coastal erosion. This can mean that decisions relating to re-mortgages or advances on properties that might be at risk of erosion would take longer, potentially disadvantaging those living in at risk areas in terms of their ability to benefit from mortgage deals;
- the influence of uncertainties on the extent to which any predictions are questioned. The purchase of properties is often driven by emotional choices rather than logic. Thus, even high quality advice may be under-represented when a buyer makes a choice about a property. The uncertainties themselves, though, will mean that understanding of risk is almost always subjective to some degree; and
- differences between erosion type, rates and evidence of erosion in different locations will either reinforce or detract from perceptions of risk. Thus, the 'reality' of erosion risk may be easier to overlook in defended areas than in areas where erosion is ongoing. At the same time, erosion lines can result in the perception of the loss of significant parts of a settlement, raising concerns for buyers over the quality of life and the potential to sell the property should they wish to move in the future.

7.3.3 Acceptance of risk

Acceptance of risk by potential buyers will affect whether they will choose to proceed with a purchase or not. This choice will depend on their awareness and adjustment for risk (e.g. they may choose to put in a low offer that reflects

their understanding of the risk). The workshop attendees highlighted a number of key issues in relation to anecdotal evidence on the extent to which people are willing (or not) to accept risk:

- *anything that affects confidence in the market is likely to affect property prices. Once lines are drawn on a map there is a clear message indicating what the risks are and where. The 100-year line was considered to represent an area that was blighted;*
- *the housing market relies on mortgages. Lenders typically follow general rules that a mortgage offer will only be made if there is 25 years (length of the mortgage) plus 30 years, i.e. 55 years of residual life (Nationwide, Northern Rock, Abbey, while Halifax require 65 years and Bristol & West and Ipswich Building Society require 70 years). Houses with less than this number of years may become difficult to mortgage;*
- *mortgage lenders rely on valuers to decline properties that are unlikely to maintain their value over a full mortgage term;*
- *mortgage lenders do not attempt to assess the life expectancy of properties at risk as there are too many uncertainties and the consequences of a flawed assessment are too great to make this an acceptable proposition;*
- *even properties with a lot of equity cannot get advances, e.g. to build extensions (even though the North-east Norfolk SMP has not yet been accepted);*
- *properties can only [easily] be mortgaged if they can get insurance;*
- *people often buy their homes to pass onto their children; erosion can result in the loss of investment value;*
- *some buyers are only concerned that the property has enough time left to 'see them out'; and*
- *some people have pushed for a change of occupancy from holiday accommodation to 11-month occupancy to full-time occupancy. Once this is agreed they complain about the risk of erosion and the impacts this has on them and request protection.*

The comments of workshop attendees suggest that acceptance of risk can change over time, depending upon the level of confidence in the property market, availability of mortgages and insurance, and use of the property (for themselves and as inheritance). Acceptance of risk may also depend on others, not just the buyers, where a buyer needs a mortgage, for example. Those purchasers who do not require a mortgage (e.g. those retiring to the coast or buying properties of non-standard construction) can base their decisions on their own willingness to accept risk. Even this may vary over time though, with questions as to whether difficulties of assessing risk over time (including uncertainties associated with erosion rates), potentially affect people's views as their property becomes increasingly threatened.

External factors such as the strength of the property market can also influence acceptance of risk. Buyers may be more willing to accept some risk when the market is strong and there is competition for properties. This may change though when confidence is low. Publication of erosion lines can reduce confidence in local property markets and may drive buyers who are unwilling to accept risks elsewhere, even when the overall market is strong. Adjustment to risk may follow a pattern where an unwillingness to accept the risk results in a drop in confidence. There may then be some recovery due to people

reassessing the risks and/or buyers being more willing to accept risks (either as confidence recovers or due to new types of buyers entering the market).

7.3.4 Ownership of coastal properties

Workshop attendees noted that *'there are also people living in the at risk properties that consider themselves trapped. It is very difficult to sell the property to move elsewhere. As a result, they cannot downsize or move for work easily, if at all'*. This suggests that properties at risk of erosion can be difficult to sell. This is likely to result in ownership of the at risk properties being extended over longer time periods.

7.3.5 Other factors that may affect property values

As well as the awareness, understanding and acceptance of erosion risk, there are other factors that can affect property values:

- factors linked to erosion but which extend beyond individual properties:
 - *erosion can have significant impacts on communities One of the community impacts relates to a loss of sense of belonging;*
 - *coastal erosion risks cause people to start to worry. In general, people do not like to have to move. Most like to put down roots and pass them onto their children; and*
 - *the house itself is an asset, but there is also an additional issue related to the gradual loss of communities.*
- factors associated with coastal properties such as sea views and recreational opportunities:
 - *it is the sea view, clean air and reminiscence value (visiting the area since they were children) that tends to dominate when people are buying a property;*
 - *purchase of a property tends to be an emotional (heart-driven rather than head-driven) choice which means that properties at risk along the Holderness coast still sell and are considered likely to continue to sell;*
 - *property that comes onto the market is bought as holiday chalets. Any new dwellings that are built in Skipsea tend to be bought by people moving into (and retiring to) the area;*
 - *even after the North-east Norfolk SMP has been made public, properties are continuing to sell because of their sea views. The benefit of a sea view may be increased ability to sell as well as any added value;*
 - *not everyone is willing to pay for a sea view though, bearing in mind the risks; and*
 - *buyers tend to be limited to those that only need the property for a reasonably short time or those who adjust their price to reflect the residual life of the property versus rent payments they would have to make on another property elsewhere.*

These responses suggest that sea views can be (and still are) overriding factors that can attract buyers even in the knowledge of the erosion risks. The wider community effects, though, could result in impacts extending beyond the areas directly at risk of erosion, encouraging short-term occupants over families. This could change the nature of the community and, consequently, the services it provides and supports.

8. Answers to the study questions

8.1 Introduction

This section brings together all the results of the study to provide answers to the study questions. These questions were set out in the project specification and are designed to provide Defra with the depth of understanding required to meet the project objective⁵. There are seven 'related' questions and two study questions. Each sub-section identifies the null hypothesis for each question (from Section 3) and then discusses if the findings of Sections 4 to 7 of this report support one (or more) alternative hypotheses, such that the null hypothesis can be rejected. Some of the related/study questions include more than one alternative hypotheses; these are not always mutually exclusive, i.e. both alternative hypotheses could occur. Analysis of the case for and against each hypothesis (null as well as alternative hypotheses) is based on the evidence collected.

8.2 Overall study questions

8.2.1 How do asset values respond to coastal erosion risk?

The *null hypothesis* is set as: asset values do not respond to coastal erosion risk such that there is no difference in values of properties at risk of coastal erosion and values of properties not at risk of coastal erosion.

Depreciation theory suggests that a buyer will not pay the same amount for the right to occupy a property for one year as he/she would for the right to occupy for 50 or 100 years. The theory points to a smoothly accelerating downward curve in value starting at a life expectancy of 100 years and ending (at a nil value) with the property's expiry. Thus, it would be expected that a property with a known or predictable finite life would have a lower value than a property assumed to have a life that extends 'in perpetuity'.

Thus it is possible to reject the null hypothesis based on depreciation theory alone and to suggest an *alternative hypothesis* that: the capital value of a property with a given level of annual worth will be less the shorter the period of years over which that annual worth will be available to a purchaser (*alternative hypothesis 1*).

This raises the question of how much less the value will be and whether the pattern of reduction in value follows a curve similar to that associated with leasehold valuation tribunals. This curve shows a reduction in value to reflect that the property has a finite life. As that comes to be less than 100 years the depreciation curve suggests a reduction in asset value of:

⁵ To provide information and analysis that will help in the understanding of how property prices respond to coastal erosion risk in two specific contexts of where there has never been a defence and where there has been a decision to withdraw public investment from publicly funded coast protection works.

- 3% at 60 years;
- 6% at 50 years;
- 10% at 40 years;
- 18% at 30 years;
- 32% at 20 years; and
- 56% at 10 years.

These results can be compared with the findings of the literature review and the anecdotal evidence from the valuation data, questionnaires and workshops, as shown in Table 8.1.

Table 8.1 Comparison of theoretical depreciation curve and the literature review findings on property value reductions due to erosion risk

Residual life	Depreciation curve	Literature review ¹	Valuation data/ questionnaires/ workshops ²
60 years	3%	4% to 14%	3% to 15% (mean 11%) 10% to 25% (notorious locations)
50 years	6%	5% to 17%	
40 years	10%	5% to 20%	
30 years	18%	6% to 23%	
20 years	32%	9% to 29%	
10 years	56%	12% to 37%	

Notes:

¹ based on Kriesel *et al* (2000)

² residual lives have been estimated based on the location at which an observation or suggested property value reduction was given and the likely residual life (e.g. from the relevant SMP)

Table 8.1 suggests that the literature review findings and depreciation curve are similar up to a residual life of 20 years. When residual life falls below 20 years, property values in at risk locations in the US appear to decline at a slower rate than suggested by the depreciation curve. This may reflect the premium associated with sea views and access to recreation. It may also reflect that the Kriesel *et al* (2000) study was undertaken at a time of a strong market, with property prices almost doubling over the ten years preceding the study. It is more difficult to directly compare the results from the valuation data, questionnaires and workshops as the residual life is not certain. The observations included in Table 8.1 may relate to properties with around 50-60 years of residual life (but this is highly uncertain). If the estimated residual lives are reasonable, the suggestion is that the property value reductions may be greater than suggested by the depreciation curve and similar to the US studies. However, the ranges tend to overlap such that no clear conclusions can be drawn.

The estimated reductions under the depreciation curve anticipate that buyers will make a logical provision for replacing their investments through a sinking fund which is seldom the case for residential property such that a quite wide deviation from this pattern is to be expected when considering individual coastal properties. Furthermore, there are many other factors that can affect property value, making it difficult to isolate erosion risk alone and leading to a complex pattern of reactions: what is true for one property in one location may not hold

true even for a similar property in another location. In addition, some properties actually *derive* their value from their coastal proximity.

To the extent that a relationship with erosion risk can be identified, the discount in property value is found to vary from the standard theory for a number of reasons (notably imperfect knowledge on erosion risk and the implication for residual life of a property), with the degree of variation differing between properties and between property types:

- in areas 'notorious' for an erosion problem (i.e. attracting media attention or similar): there is an initial adverse impact of the notoriety which can (but does not always) affect property values well inland of any measurable risk. Property values in these areas could be typically reduced by 10% to 25%. Effects on the wider communities (perceived or real) can also cause the impacts to extend beyond the area at direct risk of erosion (potentially extending to the whole parish due to parishes becoming associated with erosion and erosion risk);
- estate agents responding to a questionnaire in RPA *et al* (2008) suggested price reductions of 11% for properties shown to be at risk in the SMP, but also price reductions of 10% for properties not shown to be at risk, but in the same coastal parish;
- in other locations, and beyond the initial impact just referred to, the main decline in values appears to commence at around a 60 year life expectancy. This is supported by the requirements of mortgage lenders for properties to have a life that extends beyond the mortgage life (25 years) by 30 or so years (as a minimum) and the unwillingness of lenders to provide mortgages for properties whose value declines during the term of the mortgage. The literature review also shows discounts begin when properties have 100 years of life remaining (3% to 8%), increasing to 4% to 14% with 60 years of life remaining and to 12% to 37% when there are just 10 years of life remaining. Prices are likely to decline more steeply than would be expected under the standard depreciation model. This may be emphasised in certain types of commercial property and better quality houses but is less the case with low quality homes and farmland;
- some properties retain a degree of capital value until having a life expectancy of less than 5 years whilst others, particularly some commercial properties, may effectively be unsaleable at 10 or even 15 years. The opportunity to change the use of a property can help to retain value as the life expectancy reduces;
- the loss of access and services may deprive some properties of most or all of their value long before the properties themselves are lost. This means that the timing and extent of value reductions is likely to be specific to the locality in question;
- readjustment for risk (e.g. after a policy change) can result in a significant decline in property value as the capitalised value of the defences is lost along with the discount associated with revised estimate of the expected life expectancy of the property;
- benefits associated with sea views and access for recreation can mask (or even outweigh) the value reductions, especially with longer life expectancies, but this is likely to vary between different locations;
- emotional linkages with the area can also affect whether a buyer will underestimate the risks associated with properties on the coast;

- exposure to risks (including erosion risks, flooding risk, fire risks and earthquake risks) results in a reduction in property value. The literature highlights that the extent of the discount may be greater for erosion than with many other risks, with net effects of around 15%, but with the actual discount likely to vary according to the years remaining before the property is eroded; and
- the impact of erosion risk on sale prices varies with market conditions. At risk properties are disproportionately adversely affected in a weak market but the impact may be very slight (even non-existent) in a strong market. So at risk properties are subject to much sharper price movements than the market generally.

Thus, the alternative hypothesis can be amended to: the capital value of a property at risk of coastal erosion will begin to decline when the risk becomes known (e.g. following publicity and/or an erosion event) or (where there is good awareness and understanding of the risks) when it has around 60 years of life remaining. The extent of the decline will vary according to factors such as the location of the property, the type of erosion to which it is exposed, the type of property at risk, linkages with other assets at risk (particularly accesses and services), subjectivity associated with understanding of the risks (and associated uncertainties), and the market conditions. Property values are likely to continue to decrease as residual life declines further but, again, this will vary in accordance with the factors set out above (*alternative hypothesis 2*).

Table 8.2 Model illustrating the impacts on adjustment of property values for risk

Factor	Over-adjustment for risk	Accurate adjustment for risk	Under-adjustment for risk
Awareness and understanding of risk	Partial knowledge of erosion risks Considerable uncertainty over future predictions of erosion (e.g. erosion zones) Little understanding of erosion risks and what would be affected	Full knowledge of erosion risks Limited or negligible uncertainty Evidence (e.g. past records of erosion)	No knowledge of erosion risks Little understanding of erosion risks and what would be affected
Impact of other factors	More publicity of erosion events showing houses being lost		Beneficial effect of sea views, recreational opportunities Emotional attachment to the area Reduction or lack of publicity
Impact of market confidence	Weak property market		Strong property market
Information and advice from others	Poor quality or limited/no account taken of advice provided on risks from local authority, estate agents, solicitors, valuers, etc.	Accurate information based on best science and historic evidence	Poor quality or limited/no account taken of advice provided on risks from local authority, estate agents, solicitors, valuers, etc.

The variations caused by the factors described above mean it is difficult to provide overall estimates of how much property values may decline. Instead, a

model can be described that illustrates how the various factors could result in over-, under- or accurate adjustment for risk. The model is set out as Table 8.2.

Comparison of theoretical depreciation with that to be expected in the context of coastal erosion

Theory, given certainty over a shortening residual life allowing an owner to plan both for full occupation and for replacement, would not necessarily point to a buyer requiring a higher yield as the life expectancy of the property shortens. The result is likely to be a smoothly accelerating downward curve in the percentage of market value. There are two expected variations in the context of coastal erosion:

- First, the actual reduction in property values may be greater than that suggested by the depreciation curve due to uncertainties associated with estimating the residual life that are not present when considering depreciation associated with the number of years remaining on a lease; and
- Second, as life expectancy shortens, buyers are expected (all other things being equal) to seek a higher yield, reflecting greater risk and uncertainty such that the decline is likely to be quicker than in a ‘predictable’ theoretical situation.

As a result, the erosion curve may lie somewhat beneath the theoretical depreciation curve. The uncertainties over the estimation of residual life will affect where the erosion curve lies in relation to the theoretical curve. Other factors, such as premiums payable for sea views may mask the effect of property value reductions such that the erosion curve could lie above the depreciation curve. This is more likely in a strong market. In a weak market, the erosion curve could lie significantly below the depreciation curve.

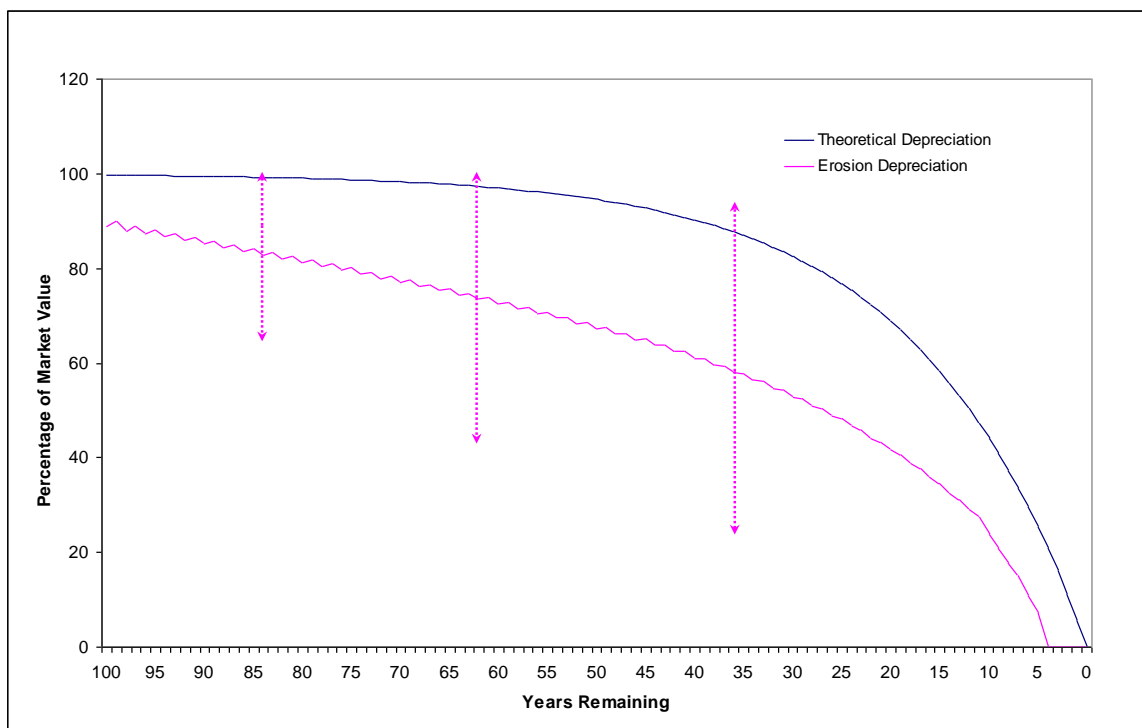


Figure 8.1 Erosion depreciation compared with theoretical depreciation (the arrows highlight the direction of uncertainty, not the magnitude)

8.2.2 How do asset values in England respond to coastal erosion risk and in particular to a decision to withdraw investment in publicly funded coast protection works?

The *null hypothesis* for this study question is set as: asset values do not respond to coastal erosion risk where a decision has been made to withdraw investment such that there is no difference in values of properties at risk of coastal erosion and values of properties where investment has been withdrawn.

Depreciation theory suggests that moving from a (perceived) life expectancy that continues in perpetuity to one that is finite will mean that the null hypothesis would not be expected to hold. The decision to withdraw funding for defences could be expected to result in a rapid readjustment such that property values reduce to the point that reflects their new life expectancy.

Thus an alternative hypothesis can be suggested where: a decision to withdraw investment for defences will result in a rapid readjustment in property values to the point that the value better reflects the life expectancy of the property (*alternative hypothesis 1*).

The evidence collected during this study is insufficient to allow for robust or final conclusions to be drawn as there are so few areas where the decision to withdraw funding has been taken (even in Happisburgh, a degree of private defence provision has been made) but:

- the available evidence points to an immediate adjustment to reflect a perception of risk where there was none before. This has been seen in property values following exposure to fire and flood risks, where the risks were not fully understood before exposure to the risk occurred. The readjustment is likely to include loss of any premiums associated with capitalisation of the benefits associated with defences. Research from the US (Kriesel *et al*, 2000) shows that these benefits may be between 12% and 23%;
- the immediate adjustment may be excessive and be followed by a degree of recovery in values until a new equilibrium is established;
- suggestions from estate agents in North Norfolk are that property prices have declined by 11% for properties shown to be at risk in the SMP, plus 10% reductions for properties in the coastal parishes at risk. This may reflect the extent of the immediate adjustment, although this may be somewhat muted since the SMP has not yet been accepted while many policies of no active intervention will not be implemented for around 50 years;
- the adjustment may include a loss of any capitalised benefits associated with the provision of defences (similar to that seen in the US, where properties behind hard defences or where beach nourishment was undertaken showed an increase in property values interpreted as reflecting capitalisation of these benefits). It is unclear from the literature whether this loss in value would reflect values along undefended coasts; and
- in areas that have previously been defended, there is likely to be a greater complexity of interdependence with other properties and with, for example, the risk to facilities, roads and services. As a result, the complexities over which properties are at risk and when may make it difficult for buyers to fully

appreciate the risks such that they may overestimate (especially buyers from further afield) the risks and, hence, result in a greater value reduction.

Defended areas will have been developed on the assumption of defence – with an intensity and quality of property which would not have been built (together with infrastructure) had the area been perceived to be at risk. So the impact upon property values in these locations can be expected to be magnified – not only does the property come to be exposed to risk, but it is not the type of property for which there would be most demand in an ‘at risk’ location (*alterative hypothesis 2*).

The decision to withdraw funding for defences can, therefore, add one additional factor to the model set out in Table 8.2, above. The revised model is summarised in Table 8.3. It is important to note that the other factors described in Table 8.1 are still relevant here as they will affect the extent to which the readjustment occurs.

Table 8.3 Model illustrating the impacts on adjustment of property values for risk when a decision has been made to withdraw funding for coast protection works

Factor	Over-adjustment for risk	Accurate adjustment for risk	Under-adjustment for risk
Awareness and understanding of risk	Partial knowledge of erosion risks Considerable uncertainty over future predictions of erosion (e.g. erosion zones) Little understanding of erosion risks and what would be affected	Full knowledge of erosion risks Limited or negligible uncertainty Evidence (e.g. past records of erosion)	No knowledge of erosion risks Little understanding of erosion risks and what would be affected
Impact of other factors	More publicity of erosion events showing houses being lost		Beneficial effect of sea views, recreational opportunities Emotional attachment to the area Reduction or lack of publicity
Impact of market confidence	Weak property market		Strong property market
Information and advice from others	Poor quality or limited/no account taken of advice provided on risks from local authority, estate agents, solicitors, valuers, etc.	Accurate information based on best science and historic evidence	Poor quality or limited/no account taken of advice provided on risks from local authority, estate agents, solicitors, valuers, etc.
Future changes	Sudden policy change resulting in fear and uncertainty over future Readjustment for risks that were underestimated before the decision to withdraw funding was made (including loss of any benefits of defences that were capitalised into property values)		Belief that defences will continue to be provided (perception before policy changes are made, i.e. lack of awareness of risk) Denial that erosion will be allowed to happen

Figure 8.2, overleaf, shows that the value of a property before a decision is made to withdraw funding (X_1) is equivalent to the assumption that the property has a residual life of 'in perpetuity' giving it 100% of its not at risk property value⁶. It is unlikely that any discount would be attributed to the property because there would be no assumption that the property is at coastal erosion risk (due to the presence of defences).

If a decision is then made to withdraw funding for defences, the residual life of the property would have to be reassessed. In Figure 8.2, the residual life is shown to be 60 years (X_2). In reality, there would be uncertainty over the residual life and this lack of information and knowledge of the risk could mean that the residual life is overestimated (i.e. assumed to be longer) such that any property price reduction is lower. Conversely, the residual life of the property could be underestimated (i.e. assumed to be shorter) such that any property price reduction would be greater. Thus, the location of point X_2 could be much closer to the price reduction suggested by the theoretical depreciation curve; similarly, the location of point X_2 could be further from the theoretical depreciation curve. As well as uncertainty over the erosion rates, there is also subjective interpretation of information; this can both increase and decrease the property value.

Ability to estimate the residual life of the property is further complicated by other factors that also impact on the value of an at risk property. A key factor is associated with the requirement of mortgage lenders. Since many require a residual life of at least 60 years; the impact of a residual life of (around 60 years) could be to reduce the number of available buyers (since those requiring a mortgage may not be able to obtain funding to purchase the property). This reduces demand for the property and is likely to result in a reduced price. The condition of the market is also an over-riding factor. A strong market is one defined by a surplus of buyers, hence, the impact of erosion risk may be masked due to a lack of available properties. Conversely, a weak market (with a surplus of sellers) may exacerbate the property value reduction as buyers look elsewhere, avoiding risky or problem properties.

Coastal properties can also attract a premium associated with sea views (even where they are at risk of erosion). This can help increase demand for properties such that the property value is increased; again masking any reductions in value associated with the erosion risk.

Overall, the combined (and potentially conflicting) result of these factors is that the property value following a decision to withdraw funding could (where the negative factors predominate) result in a significant property price reduction. The report identifies reductions of between 10% to 15% where decisions have been taken to withdraw funding (e.g. North-East Norfolk). Given that the decision is included in a publicly available document (the Kelling to Lowestoft Ness SMP), information on the risks is readily available with maps showing potential residual lives of properties. Thus, it might be expected that reductions in property values would reflect the reduction in residual lives. However, the SMP has not yet been accepted such that the full implications of the risks may not have been realised to date.

⁶ This value could include a premium for sea views.

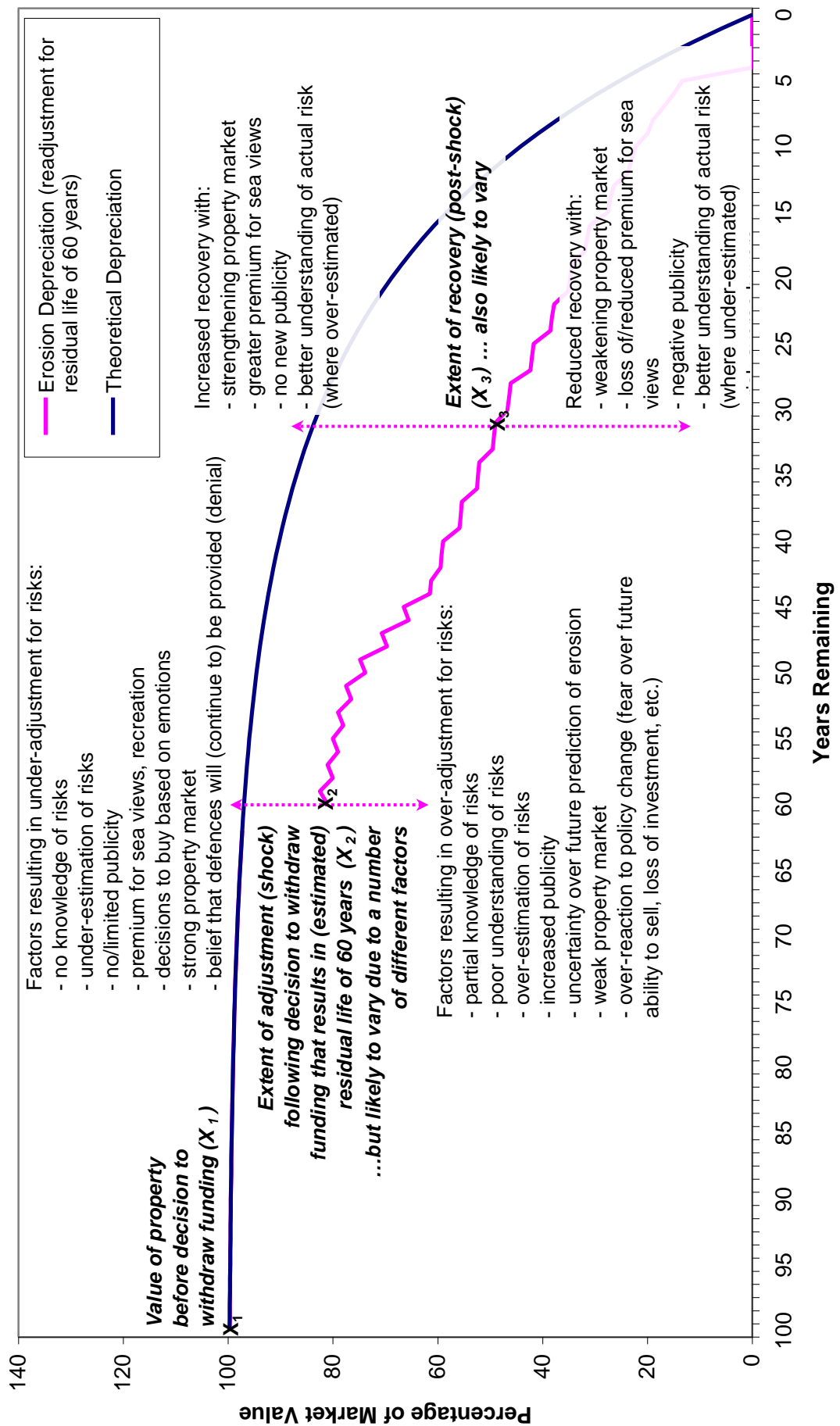


Figure 8.2 Impact of withdrawing funding for maintenance resulting in change in residual life of a property to 60 years (the arrows highlight the direction of uncertainty, not the magnitude)

Workshops with residents of affected villages show that there is a premium associated with sea views which could be masking the 'true' reduction in value. At the same time, there has been a lot of publicity surrounding erosion in North-East Norfolk which may be discouraging potential buyers (particularly those from outside the local area) such that reductions may be greater than might otherwise be the case. The estimated 10% to 15% reductions were suggested in a time before the property market crashed, although not necessarily at a time of a strong market. Thus, the impact of the market is unclear. It is not possible, therefore, to clearly identify whether the 10% to 15% suggested property value reduction is an over or underestimate.

The potential recovery of property values following the initial 'shock' associated with a decision to withdraw funding is similarly difficult to identify with a high degree of confidence. The same factors as applied to the initial reduction also affect the likely recovery. A lack of example sites (and sufficient time between decisions to withdraw funding and this study) mean that the extent of any 'shock' period is also uncertain. Figure 8.2 shows an indicative point X_3 which suggests that the recovery could be to a value greater than that suggested by the theoretical depreciation curve (e.g. in a strong property market with significant premiums attached to sea views). Conversely, the recovery could be limited (e.g. in a weak market where many buyers are risk averse or over-estimate the risks).

8.3 Related questions

8.3.1 Are there regional variations in how property prices respond to erosion risk throughout England?

The *null hypothesis* is: asset values do not respond to coastal erosion risk such that there is no regional variation in the value of properties at risk of coastal erosion.

Depreciation theory assumes that reductions in property value are driven by the life expectancy of the property (or lease) and, as such, does not predict variations due to region alone. Location factors (such as average property values) resulting from differences in the property market may result in differences but these result from differences in properties and the economic situation of the local area and are not a result of the region. Overall, therefore, depreciation theory does not provide an alternative hypothesis.

Market data showed that there are locational differences as a result of the type of development, types of properties, mechanism of erosion, varying opportunities to recreation and because of variations in perception and understanding of risk. However, although this could be interpreted as reflecting regional differences, it is more likely that two areas that have similar attributes would show similar response to erosion risk. Thus, an alternative hypothesis can be proposed that: locational differences are likely to result in variations in the response of property prices to coastal erosion risk (*alternative hypothesis 1*). It is more appropriate to test this alternative hypothesis than one considering regional effects since two villages within the same region could have different property types and erosion rates and, as such, show different

responses to erosion risk. At the same time, two villages in two different regions could have similar property types and erosion rates and, therefore, show similar responses to erosion risk.

Regional differences are reported in research from the USA, but the differences reflect exposure to different types of risk (e.g. flood, hurricane as well as erosion), different types of erosion (e.g. cliff erosion versus beach erosion, with defences and without defences) and different recreational opportunities (beach recreation versus boat-based recreation). The results are variations in property values of 25% (with 10 years of life remaining⁷) to 11% (with 60 years of life remaining⁸) (Kriesel *et al*, 2000).

Variability in awareness and understanding of risk is likely to exacerbate locational differences. At the same time, there is perceived to be a misconception that erosion is the same in all places. Even where erosion risk is highly variable (e.g. along the Holderness coast), many people cannot distinguish between different areas. They tend to assume that erosion risk is the same everywhere with their perception of risk often based on a worst-case scenario (e.g. from publicity showing houses being eroded). As a result, there is a tendency to overestimate the risks.

8.3.2 When (i.e. how soon before loss) do property prices start to change as a result of erosion risk?

The *null hypothesis* for this related question is: asset values do not respond to coastal erosion risk such that property prices do not change up to the point that the property is lost.

The null hypothesis can be rejected based on depreciation theory where leasehold valuation tribunal determinations between 1994 and 2007 show depreciation of some 12% at 60 years, 20% at 50 years, 30% at 40 years, 38% at 30 years, 48% at 20 years and 63% at 10 years.

Thus, an *alternative hypothesis* can be set that: property prices start to reduce when the residual life of the property is less than 100 years but with the main effect falling after 60 years.

This alternative hypothesis is supported by much of the data collected, including the literature review which shows that house prices in the USA begin to fall 100 years before erosion, but this only becomes marked when fewer than 60 years remain⁹. With 60 years of life remaining, property prices were found to be 4% to 14% lower than not-at risk values (lower value based on Gulf of Mexico; upper value on Great Lakes region) (Kriesel *et al*, 2000).

The requirements of mortgage lenders also suggests that property values are likely to be affected once life expectancies fall below 60 (or so) years. Many

⁷ -37% for Great Lakes region and -12% for Gulf of Mexico region (Kriesel *et al*, 2000).

⁸ -14% for Great Lakes region and -4% for Gulf of Mexico region (Kriesel *et al*, 2000).

⁹ Even with 100 years remaining, Kriesel *et al* (2000) shows reductions in value of between 3% (Gulf of Mexico) and 8% (Great Lakes).

mortgage lenders will require properties to have a life expectancy that extends beyond the 25 year life of the mortgage by around 30 years.

Events that publicise the risks to coastal properties can also result in a reduction in property values due to an over-reaction to the risk or readjustment to risks that had not previously been known (e.g. following a decision to withdraw investment in coast protection works).

The impacts on property values along the coast are complicated by the benefits associated with sea views and access to recreation. Properties with sea views are considered likely to continue to sell in both East Riding and North-east Norfolk. These tend to be limited to cash buyers where there is difficulty in getting a mortgage and insurance, and those retiring to the coast who may be more willing to accept shorter residual lives for their property. This means that the number of buyers available is reduced such that property values are also likely to be reduced and/or the time taken to sell a property may be increased.

Poor understanding of the full range of assets that could be affected by erosion may also mean that some properties appear to be outside the erosion risk zone. New information may become available that forces people to reassess the risks. This may result in the impacts suddenly increasing, usually due to a specific event or decision. For example, a bungalow in North-east Norfolk was refused planning permission because the access road would be lost in 60 years. This had not been publicised before such that all properties along that road were effectively shifted from loss in 100 years to loss in 60 years. A lack of information on the impact of losses of services and access could mean that the risks are not properly accounted for.

The implications of these complications mean that it can be difficult to determine the life expectancy of a property in a coastal location. A property that appears to be outside the risk zone can be brought into the at risk area if roads or other services (e.g. sewage treatment works) are affected. Meanwhile, properties with sea views may appear to hold their value for longer due to the premium associated with the view. Thus, the alternative hypothesis has to be adjusted to reflect these complications to: property prices start to reduce when the residual life of the property is less than 100 years but with the main effect falling after 60 years. The life expectancy of the property needs to take account of the services and roads that support it, while benefits such as sea views can (apparently) delay the onset or the decline for properties closest to the coast (*alternative hypothesis 2*).

8.3.3 Is there an initial 'shock' effect of a decision to withdraw public investment in coastal defences? If so, how large (in terms of both value and duration) is it and do property prices recover? If so, by how much?

The *null hypothesis* for this related question is set as: asset values do not respond to coastal erosion risk such that there is no initial 'shock' effect seen when the decision is made to withdraw public investment.

Depreciation theory suggests that property prices will reduce more or less instantly at the point that there is an increased perception of risk. It is likely that

prices will readjust to reflect the life expectancy once the risk of erosion is known. In this case, a 'shock' effect would occur were the life expectancy to be decreased to below 60 years (based on the evidence presented above that 60 years of life remaining appears to be the approximate time at which property values begin to decrease). As a result, it could be expected that property values would readjust even if funding would be provided for some years into the future (providing erosion is predicted to occur shortly after withdrawal of funding). Thus, an alternative hypothesis can be set that: there is a 'shock' effect with property prices reducing once a decision has been made to withdraw defences (even if this decision will not be implemented until sometime into the future) (*alternative hypothesis 1*).

Anecdotal evidence from Mundesley suggests that house prices¹⁰ declined by 10% to 15% following publication of the SMP even though defences would continue to be provided until 2055; giving properties in the at risk area a life expectancy of 50 years (minimum), i.e. having a long-term risk of erosion. Responses from estate agents in RPA *et al* (2008) suggest price reductions of around 11% for properties shown to be at risk in the SMP (based on four responses).

The literature review also supports the hypothesis that there is a 'shock' effect, where media interest in erosion prone areas in the US resulted in a readjustment in property values. The readjustment doubled the discount associated with house prices at risk of erosion, compared with before the media coverage (Kriesel *et al*, 2000). Similar effects have been seen after media coverage of the Scarborough slippage in 1993 after properties were described as 'unsaleable' by a local valuer, but which have recovered considerably since.

The magnitude of the 'shock' is likely to vary according to market conditions. Should the decision to withdraw public funding occur when the market is strong, there is the potential that the 'shock' effect could be masked due to increased demand helping to maintain property values. If, however, the decision is made during a weak market, the 'shock' could be magnified as the limited number of buyers are more likely to focus on properties outside risk zones. As property market conditions fluctuate, the 'shock' effect could be seen at a later date (when the market begins to weaken), or relative values could partially recover (when the market strengthens).

The degree to which the risk is known before the decision is made and is understood following the decision will also affect the magnitude of the 'shock'. Where the risks are initially overestimated, there is the potential that recovery of prices could occur. Even if risks are underestimated (and the effect of the 'shock' is somewhat reduced), prices could recover if other factors such as sea views, recreation and market conditions are favourable. Similarly, prices could continue to decline (even where risks have been overestimated) if the perception of risk continues to be publicised, uncertainty remains high and understanding of risk is low. Thus, the actual extent of the 'shock' and whether recovery is seen is likely to depend on a wide range of factors.

¹⁰ The price reduction relates to semi-detached properties rather than detached or terraced properties, which may be due to the availability of these type of properties, but there is uncertainty as to the actual reasons that the anecdotal information relates to semi-detached properties only.

Sudden awareness of risks that were not well understood or perceived before can result in a rapid decrease in confidence in an area. As a result, property values can be significantly reduced as a result of the initial perception of the risk. Over time, there can be a partial (or even full) recovery in property values as risks are reassessed. The workshops highlighted that most of the councillors' responses (61%) felt property values had fallen and had not recovered. It is important to remember though, that only four or so years have elapsed since publication of the North-east Norfolk SMP. This may suggest that the period for recovery could be longer than four years after the initial 'shock' occurs. Again, this is supported by the experiences in Scarborough where recovery has occurred over the 13 years since the highly publicised slippage. Whether there is a recovery or not and the timing of it needs to be explored further through continued data collection over a longer period of time.

8.3.4 To what extent has the property market in England fully understood and adjusted to erosion risk?

There are two elements to this question, such that two null hypotheses are proposed:

- *Null hypothesis 1:* erosion risk is not understood hence there is no impact on the property market; and
- *Null hypothesis 2:* erosion risk is understood but there is no adjustment in the property market as a result.

Understanding of erosion risk requires understanding of a wide range of factors:

- knowledge that there is a risk of erosion;
- type of erosion and the impact of the type of erosion on the likely life expectancy of a property; and
- some appreciation of the uncertainties associated with erosion and what these uncertainties mean.

This understanding needs to be held by both sellers and buyers and perceived in the same way if the erosion risk is to be reflected in property prices.

In fact, evidence collected during this project suggests that understanding is variable between different people. Thus, understanding is likely to be partial because:

- there is limited availability of reliable information;
- even where there is information, buyers may be unable to access it; and
- buyers may not consider the information that is available to be reliable or relevant.

Questionnaire responses suggest that buyers from outside areas at risk of coastal erosion are more likely to associate whole parishes with the risk (rather than just the coastal strip), even where erosion lines are drawn, e.g. in SMPs. These impacts can extend to organisations responsible for mortgage lending and insurance where postcodes are used as the basis for decisions. The result can be that the risks are overestimated.

Sellers may not always be willing to acknowledge the risks. The workshops and previous research (e.g. RPA *et al*, 2008) showed that people living in a village at risk of coastal erosion are less likely to accept that erosion will occur. They find it difficult to imagine the changes that will result due to erosion and that these changes will be allowed to happen. As a result, they tend to underestimate the risks.

In terms of understanding of the risk, therefore, an alternative hypothesis is proposed where: the property market in England has a partial understanding of the risk, where this understanding is often based on subjective information and perceptions of what the risk (and its impacts) might be.

Poor understanding of risk means it is unlikely that a bell-shaped curve exists (as suggested by Kriesel *et al* (2000) where properties right on the coast are worth very little, houses further back but with a sea view and access for recreation are worth a lot, and houses further inland are worth less since they lack a sea view and immediate access to recreation). It is likely to be the perception of risk that affects property values, which may not always reflect the actual risk. Samarasinghe & Sharp (2008) noted that people find it more difficult to adjust for risk where the risk is low likelihood and high consequence. This suggests that future risks (e.g. associated with policies that may be implemented in 20 or 50 years) may not be accurately reflected in property values.

However, properties prone to erosion may attract, disproportionately, a type of buyer predisposed to discount the impact of a reduced life expectancy upon value, particularly when taken together with positive features such as a sea view. For example, a retirement buyer with no need to provide for children may take the view that the advantage of living in a property overlooking the sea for twenty-five years outweighs the disadvantages of writing off the capital so invested. So properties with sea views or in particularly sought-after retirement locations might be expected to be less adversely affected than those in a more routine residential area.

Thus, two alternative hypotheses can be suggested:

- *Alternative hypothesis 1:* erosion risk is not well understood and it is this poor understanding that results in impacts on the property market which are different from those predicted by depreciation theory; and
- *Alternative hypothesis 2:* the poor understanding of risk means that adjustments seen in the property market depend on a wide variety of factors, some of which are subjective. As a result, it is difficult to predict what the adjustments may be.

The impact of these two alternatives is that it is difficult to define the shape of the curve that links remaining life expectancy with property value. Some factors, e.g. publicity, lack of appreciation of uncertainty, could result in over-estimation of the risks resulting in larger property value reductions. At the same time, other factors such as sea views, access to recreation and purchase decisions that are driven by the heart rather than the head, can result in an underestimation of the risks resulting in smaller property value discounts. Over-riding these factors is the strength of the property market. A strong property

market is likely to create demand even for those properties that are at risk. As the property market weakens, demand for at risk properties is likely to decline faster than general demand, such that adjustments may appear greater.

Furthermore, people's ability and willingness to understand and adjust for risk changes due to their particular circumstances. The workshops highlighted examples (particularly in East Riding) of people buying holiday accommodation knowing the erosion risks and potential lifespan of the property. Anecdotal evidence suggests that they have then applied for change of use to 11-month occupancy and then to full-time residential accommodation. Once the change of use has been agreed, the property owner is much less willing to accept the risks.

8.3.5 Is there any regional variation in the extent to which the property market has understood and adjusted to erosion risk?

Consideration of regional variations in the understanding and adjustment to erosion risk requires the above questions to be divided into two elements and, as a result, two null hypotheses:

- *Null hypothesis 1:* erosion risk is not understood differently across regions hence there are no differences between regional property markets; and
- *Null hypothesis 2:* erosion risk is understood but there is no adjustment in the regional property markets as a result.

Like the related question on regional variations in response to property values, it is not really regional factors that affect understanding and, consequently, adjustment to risk, but locational factors. Thus, two settlements in the same region may have very different locational factors (e.g. erosion type, property type) and, thus, have different levels of understanding of the specific risks. Conversely, two villages in different regions may have similar locational factors such that the impact on understanding and, thus, adjustment may be similar.

Locational factors seen to be important in terms of affecting understanding of risk include the presence of sea walls and beach nourishment schemes, as these can result in a reduced perception of risk. Indeed, Kriesel *et al* (2000) suggest that property prices in such areas may have capitalised the benefits of these schemes such that the property values do not reflect the risk. At the same time, sea walls can be seen as a disamenity, reducing recreation value when a beach is eroded. This can result in decreases in property values and changes to the community behind the defences (Kriesel *et al*, 2000).

Beach nourishment can make people buying property along coastlines more aware of the risks. Anecdotal evidence from the workshops suggests that people living in at risk areas in East Riding of Yorkshire do not want defences as they fear that could raise awareness of erosion and, potentially, cause blight to the area. In the USA, it was found that the likelihood that people bought insurance increased by 9% on nourished beaches, with this interpreted as people being more aware of the risks and acting to protect themselves from the potential consequences (Kriesel *et al*, 2000).

Many decisions to buy coastal properties are based on emotional choices linked to visiting the area as a child driving choices on where to purchase retirement homes. Regional differences can result from the historical nature of tourism in the area.

Both the Holderness and North-east Norfolk coasts have strong traditions in providing seaside holidays. This is likely to result in a strong bond between people who have visited the area as a child, encouraging them to seek properties when retiring (or looking for a holiday home). Decisions that are driven by emotions are much less likely to take proper account of risk such that variations may occur as a result of historical recreational opportunities.

Overall, it is difficult to reject the null hypothesis based on the evidence collected when considering the cause of variations between one location and the next. While it appears that regional variations do not occur because of regional differences, there are locational differences. Thus, the assessment of understanding and adjustment to risk needs to take account of the specific nature of an area (erosion type, property type, sea views, recreation, historical nature of development and land use, etc.). It is not considered that the level of understanding and adjustment can be described by consideration of the region (e.g. North-east Norfolk versus East Riding of Yorkshire versus North Yorkshire).

8.3.6 How long is the average period of property ownership on an eroding coast?

The *null hypothesis* for this related question assumes that the period of ownership is the same across all properties (i.e. there are no differences between the period of ownership on the inland or on the coast, or the coast subject to erosion).

CLG (2008) found that the average (median) period of property ownership is 11.6 years. This increases to 22.4 years for those who own their property outright, compared with 7.1 years for those buying with a mortgage. These figures relate to the time spent in the home at the time of the survey (not the complete length of time that residents will spend in their property). Clearly, older people are more likely to be those without a mortgage so it could be expected that ownership of coastal properties may be longer than the median. Census data suggest that there is a concentration of older residents in at risk wards in North-east Norfolk, East Riding and the Isle of Wight (compared with the areas as a whole) suggesting that home ownership in these areas may be closer to the 22.4 years than then 7.1 years. Properties of non-standard construction (which are commonly found in at risk areas, particularly in East Riding of Yorkshire) are not generally acceptable as mortgage security, so they would be associated with longer periods of home ownership, based on the data from CLG (2008).

Studies from the USA, found that owners of coastal property (in the USA) were older, richer, better educated and have more leisure time than the general US population (Kriesel *et al*, 2000).

Thus, an *alternative hypothesis* can be proposed that property owners on the coast tend to be older such that the period of ownership may reflect that of people without mortgages rather than people with mortgages. As a result, property ownership on the coast may be longer.

This alternative hypothesis may hold generally, but there may be specific instances when the length of property ownership is less. Instances where this may hold include where people are buying properties on the basis of predicted residual lives, only to find that erosion appears to be accelerating such that the residual life of their property is much shorter. As a result, the period of property ownership may be reduced. In addition, any buyers that are willing to purchase properties in the most at risk zones may be looking for short-term ownership where they can benefit from sea views while also benefiting from low property prices due to erosion risk.

Overall, therefore, there may be a general rule that property ownership on coastlines which are eroding may be longer, but there will be specific examples where property ownership could be reduced.

8.3.7 Does the period of ownership change as a property becomes closer to the cliff top?

For this question, the *null hypothesis* is that there is no change in period of ownership as properties become closer to the cliff top compared with properties that are not at risk of coastal erosion.

Valuation data, depreciation theory and qualitative information from the questionnaires and workshops provide evidence for longer periods of property ownership as the life expectancy of properties reduces. Difficulties of obtaining mortgages and insurance, along with the risks of loss of financial investment reduce the number of available buyers for properties as they approach the cliff top. As a result, properties close to the cliff top can become difficult to sell. This can result in those living in the properties feeling trapped. Such people are unable to sell, even when they need to move for work or to downsize because of health issues and they need to move into care. At the same time, the value of properties with short life expectancies can be significantly reduced such that there would be little or no financial benefit from trying to sell the property.

Results from RPA *et al* (2008) suggest that properties close to the edge can be abandoned, leaving unoccupied properties along the frontage. In such cases, ownership would remain the same even if the property has been abandoned.

This evidence supports an *alternative hypothesis* that the period of ownership becomes longer as properties become closer to the cliff top.

As with property ownership on eroding coasts more generally, there may also be instances where property ownership is shorter. For example, RPA *et al* (2008) suggests that properties with short residual lives may be bought by those looking for a short term investment, e.g. a holiday home. As a result, it could be expected that the period of ownership declines as properties approach the cliff edge. These instances will be limited to where there are opportunities for change of use and where this change of use is taken up by a new owner.

9. Conclusions and implications of uncertainty

9.1 Introduction

The previous sections of this report set out the null and alternative hypotheses for answering the study and related questions. This section summarises the findings, identifying the most appropriate hypotheses and why. The section also discusses the uncertainties surrounding the conclusions and provides recommendations as to how the implications of these uncertainties could be explored through further research.

9.2 Conclusions

9.2.1 Study Questions

How do asset values respond to coastal erosion risk?

The data and evidence collected suggest that the most appropriate hypothesis is that the capital value of a property at risk of coastal erosion will begin to decline when the risk becomes known (e.g. following publicity and/or an erosion event) or (where there is good awareness and understanding of the risks) when it has around 60 years of life remaining.

The reasons why this hypothesis is suggested are:

- Where risk was always known, development patterns over time have reflected that risk;
- Types of erosion vary;
- The above, coupled with poor information, leads to uncertainty;
- Generally, theory, practical UK evidence and research from overseas all point to property values declining as a proportion of full market value as life expectancy reduces;
- However, there are likely to be wide variations from the norm reflecting different property uses, other issues such as planning restrictions and balancing considerations such as proximity to coastal amenities;
- Properties at risk are likely to be disproportionately adversely affected in a weak overall property market and much less so in a strong market;
- Property values can be reduced to near zero before the property itself is lost as a result of the loss of a means of access or of services.

The evidence for quantitative estimates of the impacts based on data collected and analysed during this study is limited. As a result, it is not possible to draw definite conclusions or to draw a generic curve that could be used to identify likely reductions on property value based on remaining life expectancy alone. However, it is possible to identify a theoretical curve based on the experience of the valuers. It does not illustrate specific transactions although the valuers believe it is consistent with the evidence available. It could be tested by analysis of a sufficient number of actual transactions within identified 100 year risk zones but this would be a complex process and quite significant variations from the norm are to be anticipated.

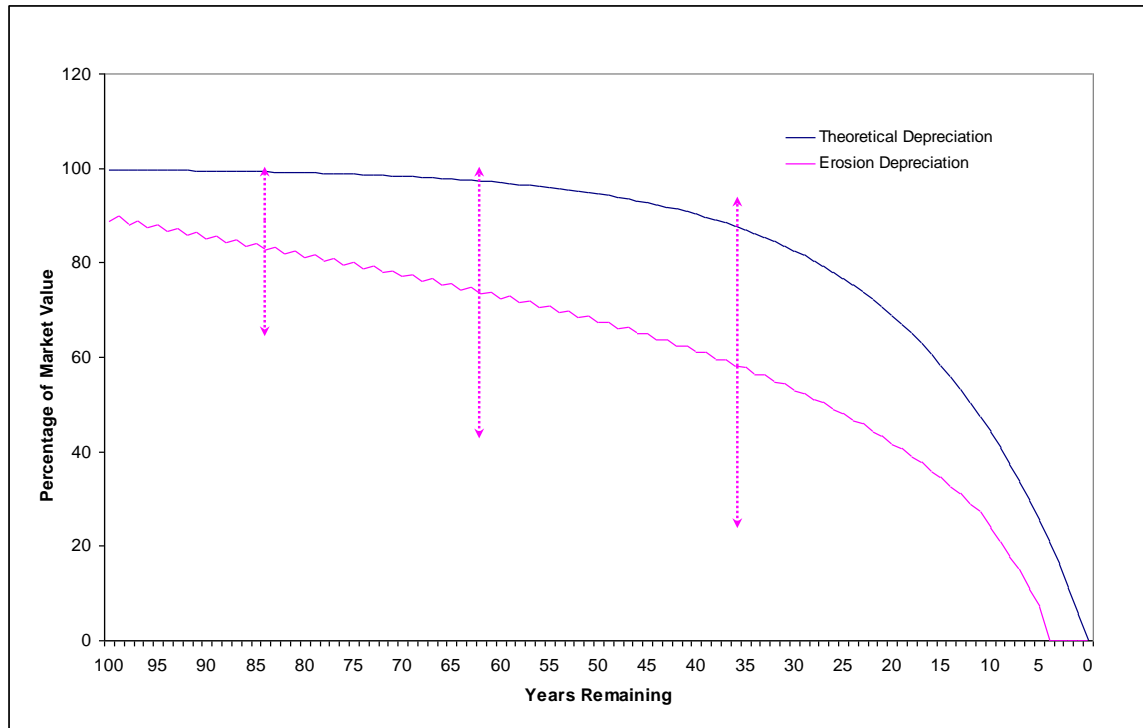


Figure 9.1 Erosion depreciation compared with theoretical depreciation

How do asset values in England respond to coastal erosion risk and in particular to a decision to withdraw investment in publicly funded coast protection works?

There has been insufficient passage of time since the first realistic threat of sea defences being removed to enable an historical analysis of resulting transactional evidence. However, initial evidence points to the potential for values to suffer an initial shock reaction at the point of a changed perception of risk but with the potential for some recovery until a new ‘norm’ becomes established.

Defended areas will have been developed on the assumption of defence – with an intensity and quality of property which would not have been built (together with infrastructure) had the area been perceived to be at risk. So the most appropriate hypothesis (given a high degree of uncertainty) is that impact upon property values in these locations can be expected to be magnified – not only does the property come to be exposed to risk, but it is not the type of property for which there would be most demand in an ‘at risk’ location.

Uncertainty surrounding this hypothesis arises because:

- Coastal protection works vary and ‘withdrawal of investment’ is not always the whole picture;
- There are no known locations in the UK where a clear policy of withdrawing funding has been followed by a sufficient subsequent period of certainty to allow a clear market response to be evaluated;
- The nature of development in protected areas is different from that in areas which have always been at risk. It does not reflect erosion risk and tends to

- be more cohesive such that the loss of one property may impact more heavily on the value of others; and
- Such evidence as there is points to a significant reduction in values at the point the perception of risk changes, possibly with some subsequent recovery before values settle at a lower plateau than in the 'defended' context.

Figure 9.2 presents an illustrative curve for withdrawal of funding for coast protection works that would result in a property having a residual life of 20 years (before the decision was taken to withdraw funding, the property is assumed to have a life of 'in perpetuity').

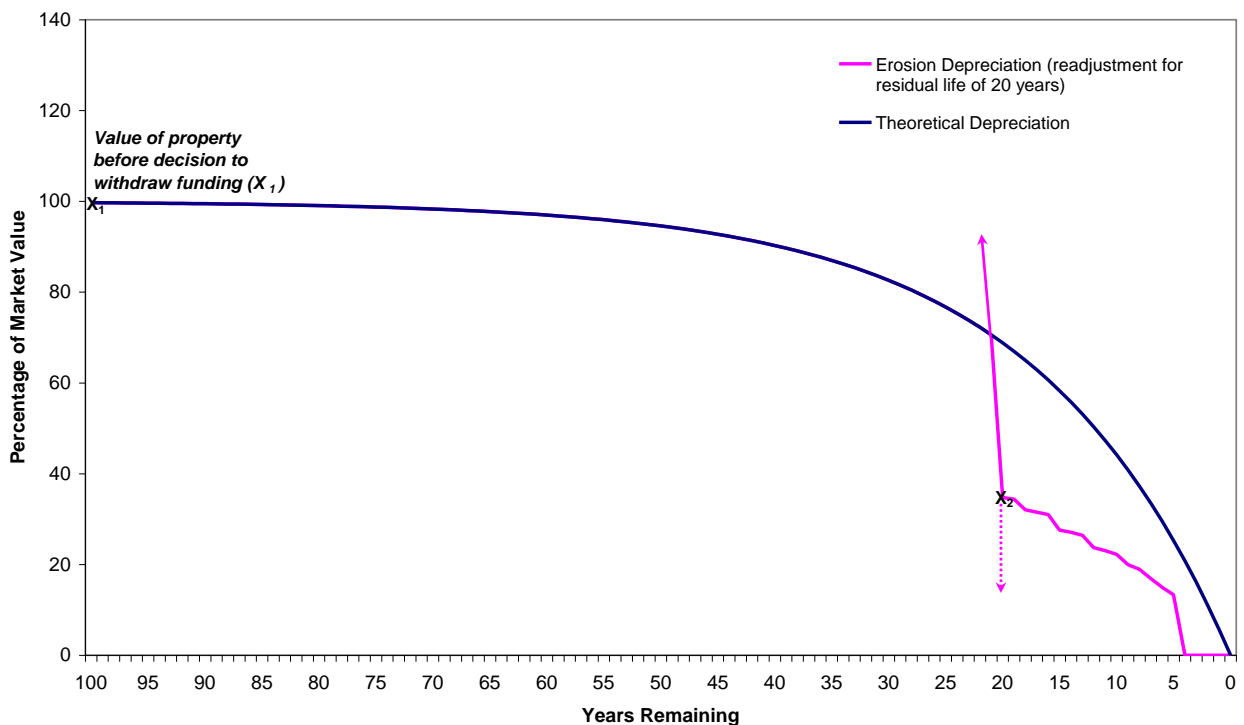


Figure 9.2 Erosion depreciation associated with a decision to withdraw funding for coast protection works that results in residual life of a property reducing to 20 years (illustrative example)

9.2.2 Related Questions

Are there regional variations in how property prices respond to erosion risk throughout England?

The proposed hypothesis is that it is locational differences that are likely to result in variations in the response of property prices to coastal erosion risk, *not* regional differences. The main supporting evidence is that the response of the market varies from location to location (as well as from property to property) but there is no evidence that this variation is of a regional nature.

When (i.e. how soon before loss) do property prices start to change as a result of erosion risk?

The most appropriate hypothesis given the evidence is that property prices start to reduce when the residual life of the property is less than 100 years but with the main effect falling after 60 years:

- There is some adjustment when a property is first perceived to be at risk – possibly by association with an area, rather than directly reflecting the risk to the property itself and typically between 10% and 25% compared with a no-risk value. This is supported by the findings of the US studies but may be masked in actual property values due to premiums paid for sea views and lack of adjustment for risk in a strong market. The impacts may be exacerbated in a weak market; and
- Beyond this, values are expected to continue to decrease as life expectancy reduces below 60 years, even more so where access to the property or services are threatened. This reflects the requirement of mortgage lenders for a residual life of (around 60 years) if they are to fund purchase of a property. Studies from the US also support a reduction in values from around 60 years.

However, there are complications which mean that it can be difficult to determine the life expectancy of a property in a coastal location:

- A property that appears to be outside the risk zone can be brought into the at risk area if roads or other services (e.g. sewage treatment works) are affected; and
- Properties with sea views may appear to hold their value for longer due to the premium associated with the view.

Is there an initial ‘shock’ effect of a decision to withdraw public investment in coastal defences? If so, how large (in terms of both value and duration) is it and do property prices recover? If so how much?

The limited evidence available suggests that there is a ‘shock’ effect with property prices reducing once a decision has been made to withdraw defences (even if this decision will not be implemented until sometime into the future). This is, however, based on limited data, where:

- Such evidence as there is suggests an initial shock extending almost to property becoming temporarily unsaleable, followed by a degree of recovery as the risk is more accurately assessed;
- The amount of ‘shock’ will depend on how immediate the threat now is; and
- The degree of recovery will depend on the certainty of information and on the underlying strength of the market in that area.

To what extent has the property market in England fully understood and adjusted to erosion risk?

Two hypotheses are suggested as best summarising the evidence for the answer to this question, reflecting the two elements within this question (understanding of erosion risk and adjustment to erosion risk):

- *Hypothesis 1:* erosion risk is not well understood and it is this poor understanding that results in impacts on the property market which are different from those predicted by depreciation theory. A variety of factors including widespread uncertainty as to where the risk lies means that in areas other than ones where erosion has been a long-term constant, there is inconsistent understanding of the risk; and
- *Hypothesis 2:* the poor understanding of risk means that adjustments seen in the property market depend on a wide variety of factors, some of which are subjective. As a result, it is difficult to predict what the adjustments may be. The evidence suggests that the market has not fully adjusted to any risk there may be, and certainly not in areas where no risk was perceived.

Is there any regional variation in the extent to which the property market has understood and adjusted to erosion risk?

There is no evidence of regional variation in the extent to which the property market has understood and adjusted to erosion risk. There may, however, be locational differences in understanding and adjustment to risk due to the influence of erosion type, property type, sea views, recreation, historical nature of development and land use).

How long is the average period of property ownership on an eroding coast?

The proposed hypothesis is that property owners on the coast tend to be older such that the period of ownership may reflect that of people without mortgages rather than people with mortgages. As a result, property ownership on the coast may be longer than the typical seven year average. However, there is little information available to fully support this conclusion.

Does the period of ownership change as a property becomes closer to the cliff top?

No clear data was found but, towards the later stages, the likelihood is that there will be no market for the property such that the final ownership may typically be extended as a matter of necessity.

9.3 Recommendations for further research

This report has approached the issue of potential impacts upon property values with an open mind. We have collected evidence in, for practical reasons, a strictly limited number of locations and tried to interpret that evidence.

There would be a strong case, now, for testing the specific conclusions we set out here both by more detailed analysis of some of the evidence we have already considered and by extending the analysis to other groups of properties and other locations specifically selected for their relevance to the conclusions we are suggesting.

It may in particular be useful to:

1. Identify locations where loss of access and/or loss of services may impact on the value of property in advance of the loss of the property itself and analyse sales evidence in those locations;
2. Identify locations where there has been an abrupt change in public perception of the level of risk and analyse the impact of that change over a longer period of time than has been possible in this study, for example, the area around Holbeck Hall Hotel in Scarborough, the village of Mundesley in Norfolk, the area around the Broadland village of Hickling in Norfolk following suggestions of managed realignment leading to loss and the Black Gang area of the Isle of Wight. Collection of data to create a larger sample size may also enable hedonic pricing through regression analysis to be undertaken. Such an approach would provide data that are more directly comparable with information collected during the literature review. A much larger number of transaction details would also, over time, allow a scatter graph to be constructed that could help to identify the modal or median reductions associated with a (reasonably) reliable estimate of the residual lives of the properties at the time of the transactions. Commentary would be required on each transaction to allow the effect of market conditions to be taken into account. This information could be used to better define the erosion curve;
3. Carry out more detailed analysis of property prices in unaffected parts of “notorious” villages to identify the point at which a recognisable impact upon value takes place. This could be informed by assessment of recently available data going back to 1995.

With regard to locations affected by the proposed removal of defences, there is too little firm evidence upon which to base definite long-term conclusions. Such evidence as there is can be derived mostly from the village of Mundesley in Norfolk where a fully defended settlement is clearly threatened with loss. Similar evidence may be derived from the nearby village of Overstrand, not considered by the valuers in this study. There is good evidence of an immediate and substantial resulting drop in values in Mundesley; what is less clear is how much of that loss will be sustained in the medium term; whether some of it will be recovered; or whether the initial loss will accelerate as an adverse perception becomes ingrained in the minds of buyers.

Turning to commercial properties there are at least three potential areas for further consideration:

1. Standard commercial properties in locations not hitherto at risk but which may now be threatened – pubs, shops, industrial units etc. We have not identified transactions relating to any such properties in the limited number of locations which we have been able to consider but the way in which their values will react to a shortened life expectancy may be significantly different to that for other types of property;
2. Detailed analysis of the impact of coastal erosion on coast-related businesses such as caravan sites and holiday parks, taking account not only

of gradual loss but also of factors such as loss of access to the beach and aiming to identifying the point at which such businesses may no longer be viable and may therefore suffer accelerated reduction in value even though some or all of the property may remain;

3. Interdependence in commercial property values close to the coast – for example any evidence that the loss of one major business may impact on the values of others not directly affected.

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Appendix 1: Findings of the Literature Review

1. Erosion Specific Literature

Much literature exists on the subject of coastal erosion, but this mainly seems to be related to types of coastal defences, disaster management or insurance, and is often very mixed up with inland flooding. The main literature available that discusses how coastal erosion affects house prices is a major study carried out in America (Heinz Center, 2000) which considers the matter in great and relevant detail. A key Annex to this study, from the University of Georgia, is carefully evaluated in Section 1.1, with the main report being reviewed in Section 1.2, then the remainder of the literature to be considered is discussed in Section 1.3.

1.1 Annex from the University of Georgia (Kriesel *et al*, 2000)

This study focuses on coastal areas of the United States, specifically the Pacific, Atlantic and Gulf of Mexico coasts, and the Great Lakes shorelines, and examines their coastal erosion risk and how this affects property prices using the concept of Geotime. Geotime is the amount of time that a coastal property has before the distance between it and the coast is reduced to zero due to erosion. The findings of the study show that even with 1000 years of Geotime remaining, house prices begin to fall a little, but this becomes marked when only 60 years remain. Kriesel *et al* (2000) suggest that if new construction was prohibited within the 60-year erosion zone, then house prices would benefit, less insurance would be required and coastal wildlife would be protected. Data were assessed over 15 years of property sales.

The study found that owners of coastal property were older, richer, better educated and have more leisure time than the general US population. In total, 32% of the properties were primary residences, 28% were holiday homes, 30% were part-time rental and part-time holiday homes and 10% were full-time rental. If insurance had now been available, 45% would not have bought the coastal properties. However, only 41% had insurance (32% for whom it was compulsory and 9% who had purchased it voluntarily). Information about erosion had been seen by just 34%, but 50% thought that they were likely or very likely to suffer an erosion-induced capital loss.

The Hedonic Price Analysis method was used to evaluate the prices of waterfront properties as a function of their environment, in this case propensity to be damaged by flooding or erosion, and the risks of suffering a capital loss due to erosion. This analysis includes Geotime to account for the risk of house collapse due to erosion as well as the risk of flooding due to erosion, and also Elevation, to account for flooding factors alone. The paper suggests that a bell-shaped graph of property prices would result from this analysis as houses right at the coast would be worth very little, then houses that are back slightly, out of the hazard zone, would be worth a lot due to sea views, proximity to beach

recreation and so on, but then houses further inland than this would return to lower property prices due to lacking these amenities.

The results of this study by Kriesel *et al* (2000) show that risk of flooding and coastal erosion are key determinants over property prices, though much of the report is given over to a discussion of flood insurance rather than property prices themselves. An interesting interplay between the two is that the demand for flood insurance remains high, even when the property price itself has dropped due to proximity to an erosion or flood hazard. The US National Flood Insurance Program (NFIP) does not at present include coastal erosion, but a regression analysis conducted by this study showed that many people would be willing to pay for this, depending on a selection of factors such as cost, income, distance from the water's edge etc.

The study's findings with respect to insurance and its effect on coastal property prices were that higher insurance premiums lead to lower property prices, but this was found not to be statistically significant. This was approximately as expected, as Kriesel *et al* (2000) predicted that the price of insurance would not affect property prices as the cost should be offset by the potential benefits of the insurance, and therefore not impact upon house prices. It was also expected that, rather than insurance correlating with house price, it should correlate with risk.

The effects of coastal defences on the prices of houses that are protected shows that rock armouring is likely to increase the value of nearby properties, while a lack of beach causes prices to fall dramatically. However, seawalls may be seen as a dis-amenity as they impact upon the natural beach, so depending on whether the buyer or seller takes this view, or takes the view that the seawall is valuable protection, will affect the prices of the houses it protects. The study predicted that a natural beach would be more desirable than a sand-nourished beach as, though sand nourishment could protect houses, it is easily compacted and will contain shell fragments etc. so may be of an undesirable quality for a prospective home-buyer. This was found to be an incorrect assumption in many of the study areas as sand nourished beaches are actually seen as effective and aesthetic protection.

There are some issues with the data that this study uses, as Ohio, for example, ignores the effects of coastal defences while Georgia, for example, has total faith in them, so there is no consistency in some aspects of the data.

The final section of the report discusses the benefits of a natural beach that would support recreation. These benefits include increased house prices, so beach conditions need to be maintained so as to avoid loss of assets. Wide beaches, as well as providing recreation and attractive views, are a coastal defence in themselves, protecting the cliffs and houses by dissipating wave action.

1.1.1 Atlantic Coast Results

The Atlantic coastline had the highest storm damage of the four regions studied by the Kriesel *et al* (2000) report, due to hurricanes and nor'easters. Analysis showed that prices have increased at around 7% per year for waterfront properties, compared to the 6.6% national average since 1965. The analysis also shows that a 1% decrease in erosion risk could increase the price of a coastal property by 0.05%. The average property sold for \$220,300 had 2,100 square feet and was purchased 13 years ago.

The five key variables that were evaluated in the models, and their effects on prices, are as follows:

- *Waterfront*: waterfront lots were shown to be worth 28-30% more than inland lots;
- *Depreciation*: the annual depreciation rate is 0.3%;
- *Beach width*: this gave a positive, significant coefficient (3.5%), so buyers prefer wider beaches;
- *Sand nourishment*: properties near nourished beaches are worth more than others, so buyers are not affected by the decreased beach quality but instead probably view this in the same way as the Beach Width variable (with a premium of 6.5%);
- *Armour*: this gave a positive coefficient, so buyers prefer the protection, even if it is something of an eyesore. The premium was 20.2%; and
- *Distance to Erosion Reference Feature (ERF)*: buyers prefer to be further from the water with a premium of 2.1%, but this is not statistically significant.

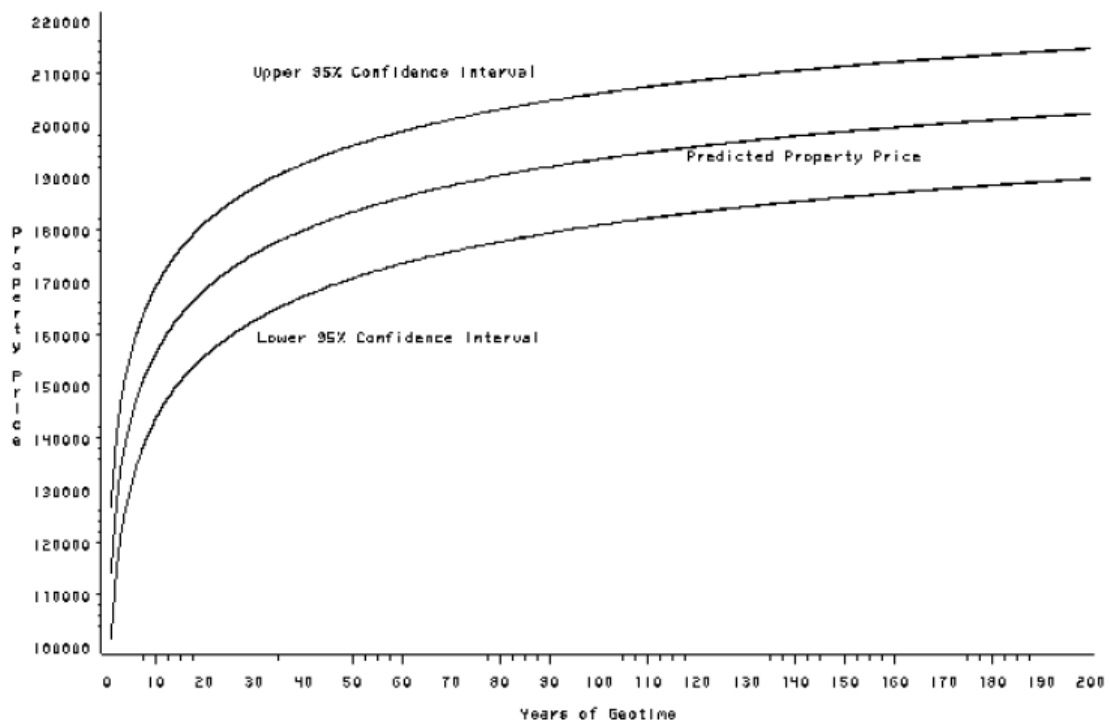


Figure 1.1: How property prices in the Atlantic region respond to Geotime, with upper and lower 95% confidence intervals. From Kriesel *et al* (2000).

Other non-statistically significant findings are that houses built according to FEMA's building codes are worth 3.6% more than average, and houses sold after the flood zone hazard has been officially notified are worth 3% less. Figure 1.1 shows the Atlantic Geotime results, demonstrating how property prices decrease as years of Geotime also decrease. The effect can be seen even at 200 years of Geotime remaining, but there is a dramatic decrease in house prices once the 50 year Geotime mark is passed.

1.1.2 Gulf of Mexico Results

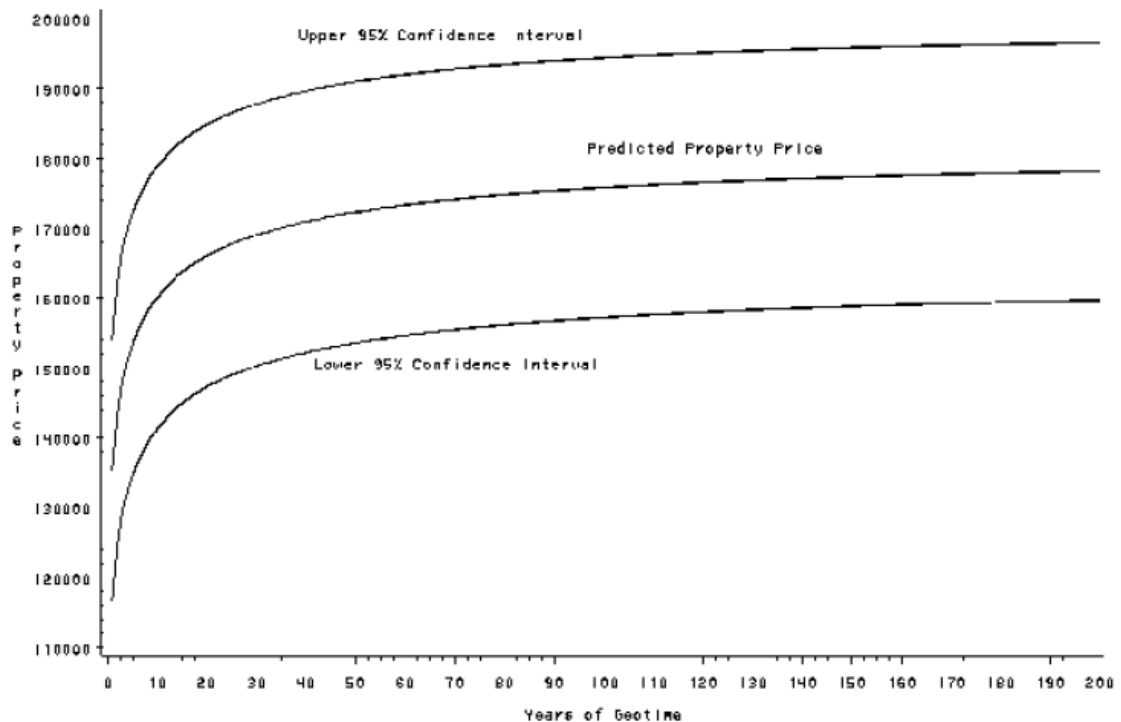


Figure 1.2: How property prices in the Gulf of Mexico respond to Geotime, with upper and lower 95% confidence intervals. From Kriesel et al (2000).

In the Gulf of Mexico, a waterfront lot is worth 9% more than a corresponding house inland, while price increases have been at about 5% per year for the last 41 years. This is less than the national average price increase, which is a different pattern from that seen on the Atlantic coast. The average property sold for \$175,000, has about 1,600 square feet and was purchased 9 years ago. None of the five main variables studied has a statistically significant impact in this region, however some of the results are reported below, along with details of some of the other variables looked at:

- *Waterfront:* waterfront lots were shown to be worth 8% more than inland lots;
- *Depreciation:* the annual depreciation rate is 0.7%;
- *Sand nourishment:* properties near nourished beaches are worth more than others (4.7%), so buyers are not affected by the decreased beach quality and are actively encouraged to buy by the increased protection offered;

- *Armour*: this gave a negative coefficient (-9%), so buyers prefer a natural beach in this region;
- *Building codes*: a house built according to the building codes is worth 15% more than those which are not (this could be high due to the high hurricane damage that this area often sustains); and
- *Flood insurance availability*: in areas where flood insurance can be bought, houses cost 31% more than other properties.

Figure 1.2 shows the Gulf of Mexico Geotime results, demonstrating how property prices decrease as years of Geotime also decrease. Approximately the same pattern is seen as in the Atlantic region, but the dramatic price decline begins later, when only about 25 years of Geotime remain, and before this time house prices are fairly stable.

1.1.3 Great Lakes Results

The Great Lakes' shorelines are not like the Gulf of Mexico or Atlantic as most of the houses are built on glacial till bluffs high above the water, so flooding will never be a problem and therefore flood insurance will not be purchased.

In this region, a waterfront lot is worth a massive 50% more than an inland lot, but annual house price increases have been of the order of 5%, lower than the national average. The average property sells for \$168,000, has about 2,250 square feet and was purchased 12 years ago. Kriesel *et al's* (2000) Geotime calculations show that a 1% decrease in erosion risk would lead to property price increases of around 0.29%.

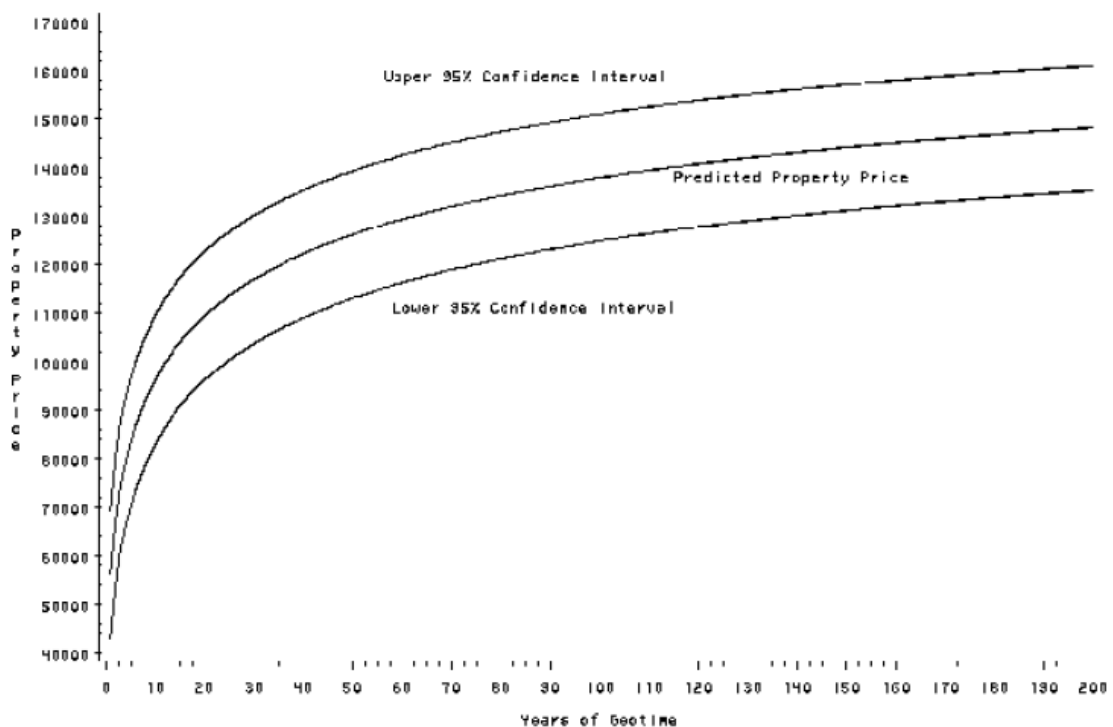


Figure 1.3: How property prices in the Great Lakes region respond to Geotime, with upper and lower 95% confidence intervals. From Kriesel *et al* (2000).

In the Great Lakes region, while waterfront properties are 45% worth more than properties far inland, within the waterfront area property prices increase as setback distance from the water increases. This is more significant than the pattern seen on the ocean costs, and could be related to a lower value of water proximity in the Great Lakes region. Depreciation due to increasing house age is 0.2%.

The Armour variable was statistically significant, with buyers preferring the visible protection of a seawall, so protected house prices are worth 23% more than unprotected ones. Beach width has a premium of -0.8%, which may reflect the absence of recreational amenities for those beaches. Here, a wide beach may be seen as not being suitable for docking a boat.

Figure 1.3 shows the Great Lakes' Geotime results, demonstrating how property prices decrease as years of Geotime also decrease. As with the Atlantic, large decrease in property prices begin when about 50 years of Geotime remain.

1.1.4 Pacific Coast Results

Most houses in the Pacific area sampled are high above the water on cliffs, so owners will never buy flood insurance, therefore Insurance Price could not be used as a variable in the Pacific model. However, a new variable, Cliff, was included to account for any differences between properties on cliffs and those closer to the sea.

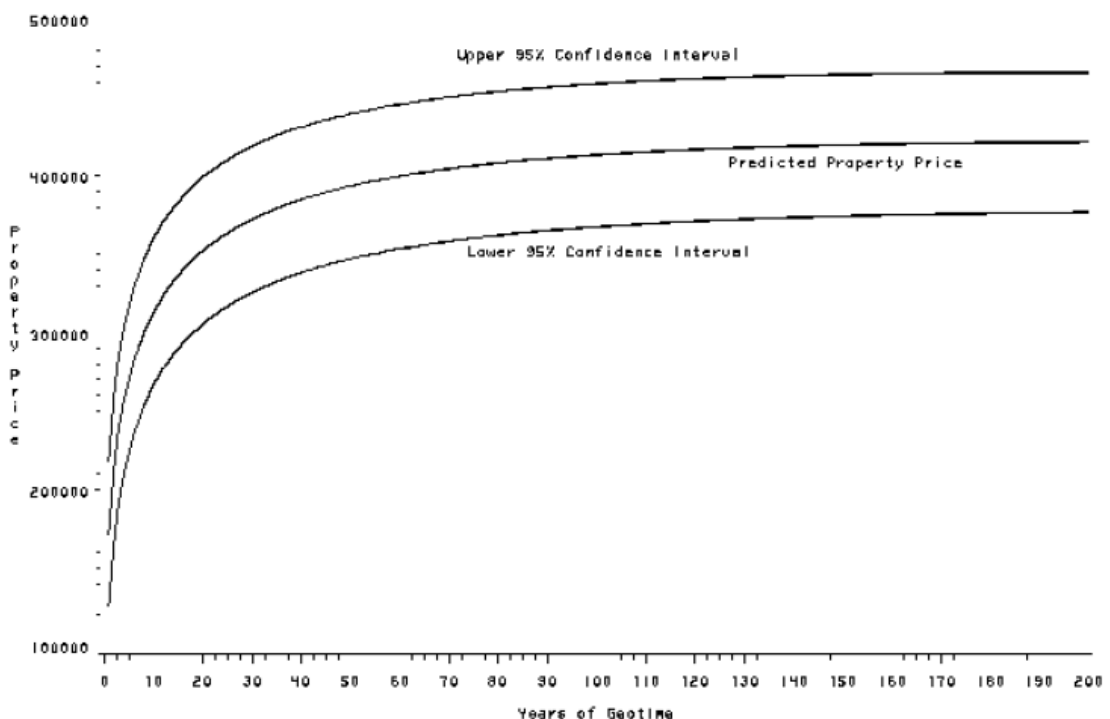


Figure 1.4: How property prices on the Pacific coast respond to Geotime, with upper and lower 95% confidence intervals. From Kriesel *et al* (2000).

Average house prices in the region are much more than the other three regions sampled, with waterfront lots worth 40% more than those inland and house prices increasing by 9% over the last 55 years, compared to the national average of 6.6%. The average property sold for \$324,300, had about 2,140 square feet and was purchased 15 years ago. These values show that the Pacific coast is a highly sought-after location. A 1% decrease in erosion risk is shown to potentially increase property prices by 0.36%. Buyers in this area were shown to prefer visible sea wall protection.

Waterfront properties are worth about 40% more than non-waterfront lots. The depreciation rate is 0.3%. Beach width has a premium of 4.9%. Sand nourishment results in a premium of 12.3%, while armouring is estimated at 17%.

Figure 1.4 shows the Pacific Geotime results, demonstrating how property prices decrease as years of Geotime also decrease. Similar to the Gulf of Mexico, the Pacific house prices remain fairly steady until Geotime becomes too low to be ignored – when about 30 years remain.

1.1.5 Comparing the Four Regions

In the four regions, the following factors were used in the models, and the results are detailed below. Some are related significantly to house price:

- *Age of Transaction*: in all areas, house prices have been increasing over time, ranging from 5% in the Great Lakes to 9% in the Pacific;
- *Age of House*: there is an average annual depreciation rate of 0.03%;
- *House Size*: larger houses are more expensive;
- *Parcel Size*: houses with more land are worth more;
- *Distance to CBD*: this is significant in the Gulf and Great Lakes regions, but not in the Atlantic or Pacific, possibly due to differences in the numbers of holiday homes compared to permanent dwellings;
- *Geotime*: buyers prefer houses that are not at risk of erosion, though this is not significant in the Gulf, and the effect of this levels off at around 200 years (Figures 1.5 and 1.6);
- *Elevation* (level of the house's first floor above base flood level, measured in feet): this is only a factor in the Atlantic and Gulf regions but was found to have a weakly significant effect, showing that insurance is no substitute for elevation, possibly because full coverage is not offered, or elevation is in addition to insurance as an extra measure. This is probably not significant in the Great Lakes and Pacific regions because many of the houses are built on bluffs above the water;
- *Distance to ERF*: this showed that houses that are located back from the water are worth more. However, Distance to ERF is not strongly significant;
- *Waterfront*: houses near the waterfront are worth more than those inland. This is strongly significant and could explain the weak pattern shown by Distance to ERF – the waterfront variable indicates the value of water proximity and what remains was picked up by Distance to ERF;

- *Beach Width*: wide beaches were valued in the Atlantic but not in other regions, possibly because a wide beach prevents boat moorings;
- *Armour*: this was generally a positive significant effect, with beachfront houses increasing in price if hard defences are present, though it can reduce inland property values due to loss of local beach attractiveness;
- *CBRA*: in the Atlantic region this lack of insurance availability was shown to decrease house prices by 2.3%, but as well as lack of insurance, this area tends to lack other amenities so this effect may not be significantly related to insurance alone and is in fact not statistically significant. Therefore, 2.3% is the upper bound of potential house price reductions if flood insurance were denied;
- *Sand Nourishment*: generally this increased property prices, but this was only significant in the Atlantic. An explanation of why there is a positive effect may be that buyers realise that somebody else, i.e. the federal or state government pays for the majority of a nourishment project and the buyers capitalise the expected value of this free good into their bid price; and
- *Built and Sold Post-FIRM*: this is an effect in the Atlantic and Gulf, and relates to storm damage. Building after the FEMA building codes came in increases the price of houses by up to 15.6% because they are more likely to be resistant to storm damage. However, selling after the FEMA building codes came in reduced house prices by 3.2% (Atlantic) or 8.9% (Gulf) as the introduction of building codes had brought attention to the fact that the coastline was eroding and there is a high risk associated with living in the area.

In general, property characteristics that mean the house has reduced erosion- and flood-hazard lead to higher property prices. Homeowners prefer houses that are elevated above potential flood waters even if insurance is available, so these homeowners are averse to unnecessary risks and consider insurance to be a poor substitute to being out of harm's way. Kriesel *et al* (2000) suggest that because of this finding, it can be assumed that even if insurance companies offered special erosion insurance, then Geotime, Sand Nourishment and Armour would not lose their importance to house buyers, and even if flood insurance were cheaper, elevation would still be an attraction. In addition, the evidence shows that the typical coastal property buyer thinks that flood insurance will not compensate him for losses. The results also indicate that there is no gain in value from having the building very close to the water. This suggests that waterfront properties should be placed away from the water, contributing to greater Geotime, which enhances property value.

In communities with recreational beaches, the restaurants, rental cottages, etc. extend inland so the beach amenity is displaced. In communities with degraded beaches, the amenity value is restricted to properties very close to the shore and at worst the beach degradation causes them to become ordinary residential communities.

Figures 1.5 and 1.6 show the results across all four regions so they can be easily compared. Figure 1.5 shows total house prices, hence why the Pacific is

so high, but Figure 1.6 adjusts for this by demonstrating percentage decreases in property prices over time.

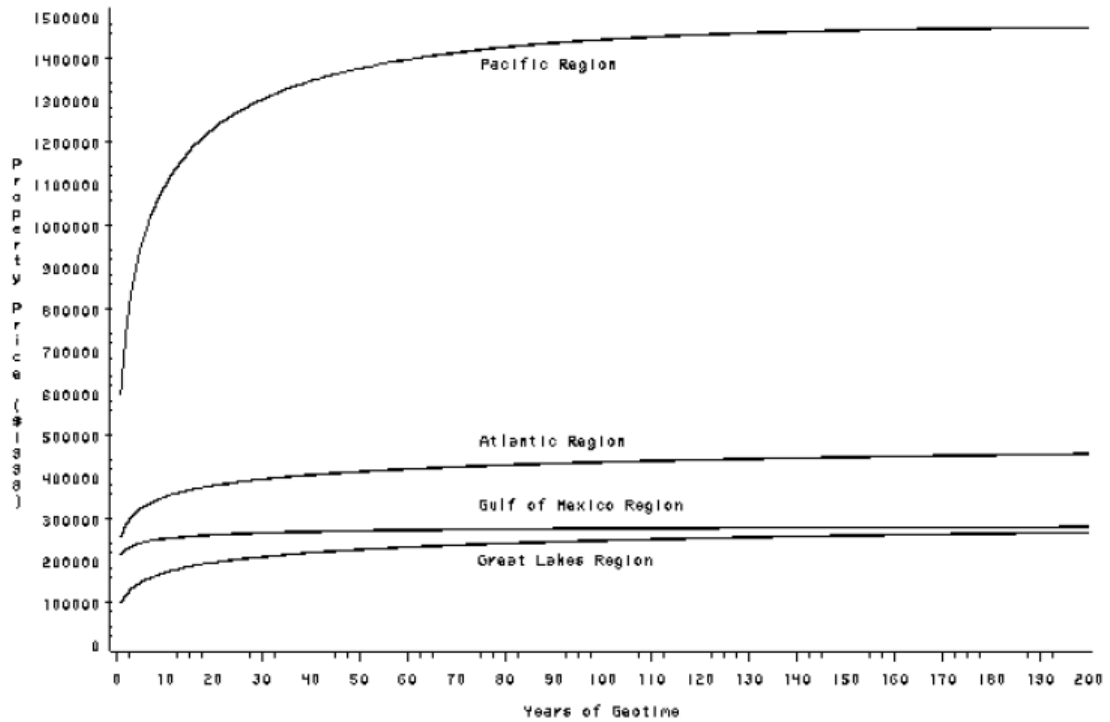


Figure 1.5: Response of property price to changes in Geotime across the four regions. From Kriesel *et al* (2000).

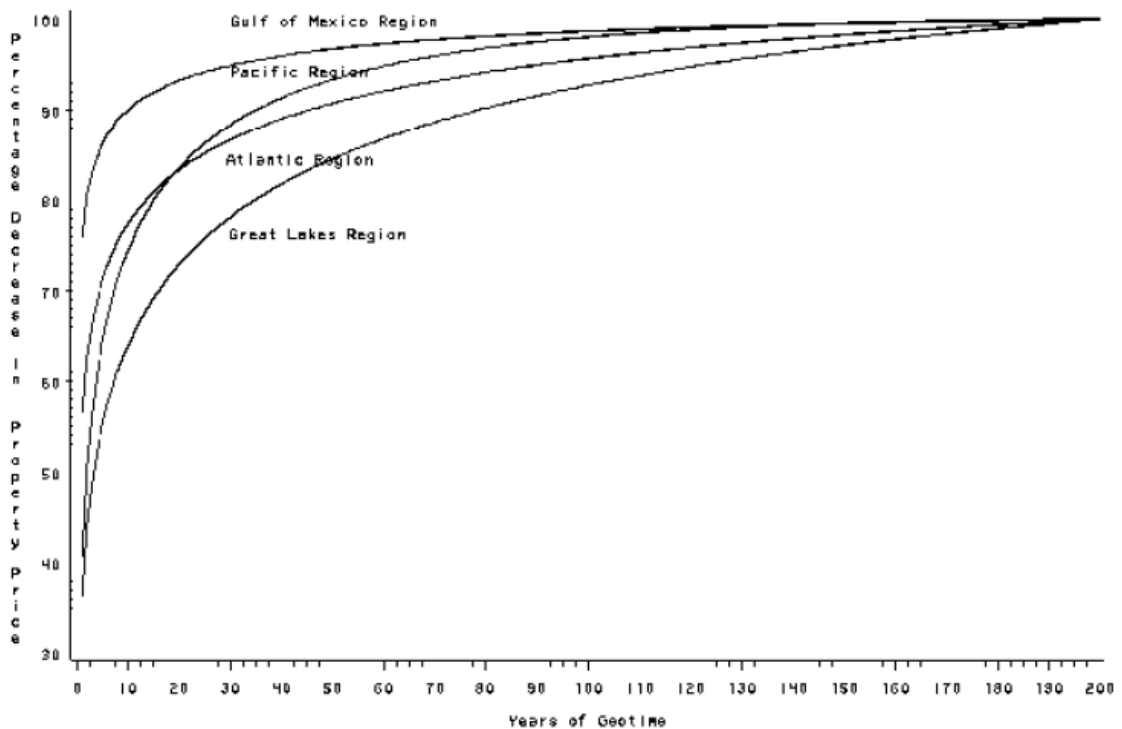


Figure 1.6: Response of percentage property price to changes in Geotime across the four regions. From Kriesel *et al* (2000).

Figure 1.6 can be used to estimate the impact of residual life on the value of the property across the four regions. The results are summarised in Table 1.1.

Region	Percent Reduction in Property Prices by Time until Erosion (Geotime)						
	100	60	50	40	30	20	10
Gulf of Mexico Region	-3%	-4%	-5%	-5%	-6%	-9%	-12%
Pacific Region	-4%	-6%	-9%	-10%	-13%	-18%	-28%
Atlantic Region	-6%	-9%	-10%	-12%	-15%	-18%	-23%
Great Lakes Region	-8%	-14%	-17%	-20%	-23%	-29%	-37%

Source: based on Kriesel *et al* (2000)

Table 1.1 shows considerable variation between the four regions, with the decrease in property values being much greater for the Great Lakes Region than for the Gulf of Mexico Region. The authors do not explain why there are such significant differences between the regions, but this could be due to a range of factors including availability of recreation (e.g. beach quality), local scarcity of waterfront properties and the impact of other risks (e.g. hurricanes).

1.1.6 Erosion, Geotime and Insurance

To calculate the effects of erosion on property prices, the following method was used by Kriesel *et al*. Property values were established for an average property with 60 years of Geotime remaining, and an average property with a Geotime of one. The difference between these latter two values is the “decline in value suffered by the average property that is located at the most precarious position in the hazard zone, compared with its value if it were located just outside the hazard zone.” This value was found to be \$162,250 for the Atlantic coast, using 1998-99 prices. The effect of notifying the public of erosion risk was also calculated, based on what occurred when public notification of flood risks was carried out. The property price decline is only statistically significant for the Atlantic, where prices decreased by \$16,200 on average.

Enforcing setback of properties was found to be a potential way to increase house values significantly in all areas other than the Gulf, because setback means an increased Geotime, which has been shown to be statistically significant in raising house prices in coastal areas (apart from the Gulf). The only problems would arise if the parcel of land was not deep enough to allow for setback, so the property owner would probably have to move in order to avoid coastal erosion problems, therefore losing the value of their home.

An interesting, but not unexpected, finding is that Geotime is now a more important factor in determining house prices than it used to be. Houses that were bought in the last 12 years were compared to those purchased before this, and it was found that the effects of Geotime have doubled. This has probably resulted mainly from the increased media activity surrounding houses that are

falling into the sea, so public awareness has increased. This leads to property buyers' willingness to pay for an endangered house falling.

Overall, it is concluded that it can be said with some confidence that buyers discount properties that are more prone to erosion damage. Assessment of the impact of elevation and availability of insurance showed that elevation is a poor substitute for insurance implying that there may be high-risk aversion and less-than-full-coverage.

The National Flood Insurance Program (NFIP) was created to look into the feasibility of flood insurance and provide it for people at risk, as before this program flood insurance was not available in the US. Now, it is being proposed that coastal erosion is included under NFIP. Currently, if the erosion occurs during a flood-causing storm, then the insurance is likely to pay out, but if not, properties are not covered against erosion and 'sunny day losses'. A benefit of providing this insurance would be that it might prevent homeowners from building their own groynes and seawalls to protect their properties, which can lead to beach erosion and adversely affect the natural beach system. This would depend on whether insurance or sea walls are seen to offer more effective protection.

From a survey of home owners, the relationship between Geotime and insurance was shown to be a 0.24% increase in purchasing insurance for each year of Geotime lost. All else being equal, waterfront property owners have a 9.94% higher probability of opting to buy erosion insurance. Interestingly, property owners living on a shoreline that is undergoing a beach nourishment program are 8.6% more likely to purchase erosion insurance, possibly because they are more conscientious, having bought a house where soft engineering is taking place rather than an unprotected coast, or because there is a recognised problem in these areas so they want to be prepared. This factor was statistically insignificant where the Armour variable was concerned.

Overall results from this study relating to insurance show that the cost of insurance, and whether it is available or not, do not impact greatly upon the housing market. None of the insurance-related variables showed any significant results. NFIP participants are mainly those homeowners who are forced to purchase flood insurance as a requirement of their mortgage (only 8% of eligible home owners have flood insurance but were not forced to buy it), so other residents presumably feel that they are not actually in a high-risk zone, or they feel that the compensation they would receive would not actually fully compensate them anyway. Generally, the feeling seemed to be that visible protection such as a seawall was valued much more highly than the safety provided by insurance. Overall results from the insurance aspect of the study show that the following three factors could be playing a part in the limited uptake of flood insurance:

1. property owners think that government disaster relief will compensate them;
2. owners systematically underestimate their subjective possibilities of loss; and/or
3. owners' perceptions that NFIP under-compensates for losses.

However, the common suggestion that coastal property owners are risk-takers has been refuted by the study due to the homeowners' views on armouring and elevation. Reason number 3 is suspected to be the major cause.

A worrying suggestion is that, because coastal armouring appears to increase the value of coastal properties, coastal homeowners may campaign for increased use of hard defences, though this is likely to have knock-on effects along the coastlines and prevent the formation and maintenance of a natural, large beach, as well as reducing the value of inland properties due to loss of beach amenities. As there are more inland than waterfront properties, and because loss of a recreational beach will also mean loss of tourist facilities and therefore jobs, this would represent an overall decline in property prices.

A conservative estimate of average willingness to pay for erosion coverage was \$1.88 per \$100 coverage, but a high percentage (21.2%) of respondents were not willing to pay anything. This depended strongly on household income, as would be expected. Figure 1.7 shows how years of Geotime remaining affects the amount that people are willing to pay for erosion coverage, and as can be seen there is a slight but not significant trend for people to pay more if they have less Geotime remaining for their property. However, the figure shows the mean but Kriesel *et al* (2000) comment that the median would be a more suitable analysis tool for these data as the mean does not allow for people who are willing to pay zero.

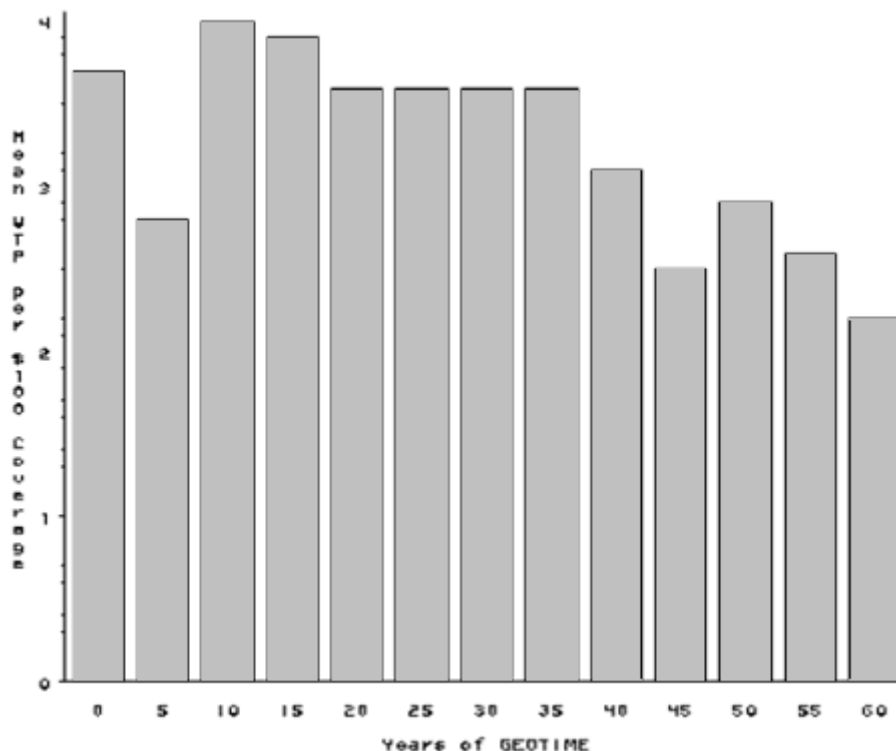


Figure 1.7: The relationship between erosion risk (years Geotime) and estimated mean willingness to pay (\$ per \$100 coverage). From Kriesel *et al* (2000).

Overall, a higher willingness to pay is seen than is currently charged for flood coverage (\$0.75 per \$100 coverage) so it is likely that a high number of home

owners would purchase this erosion insurance. However, as a very small percentage of people have signed up to voluntarily protect their homes against flood risk, even though the cost is quite low, this could suggest that either people have overestimated their actual willingness to pay of erosion cover, or the public feel that erosion is a more threatening issue than flooding.

A potential problem with erosion insurance would be if homeowners waited until their house was in extreme danger before they bought the policy, in which case the NFIP funds would be at risk. Therefore, purchase of the policy would have to be made mandatory for all within the 60 year Geotime zone. However, as most people seem to be willing to pay a certain amount for erosion insurance, as long as premiums are kept below about \$2 per \$100 coverage there should be little opposition to this proposal.

1.1.7 Consequences of Coastal Erosion for Communities

Using Leatherman's book, *America's Best Beaches*, high quality beaches were separated out from average and poor quality ones to find any correlations between house prices and beach quality. These *Best Beaches* had house prices of 41.2% higher than an ordinary coastal community on the Gulf Coast. Waterfront properties were found to be highly priced whatever the beach quality due to the uninterrupted sea views, regardless of the ecological or recreational potential of the beach. The benefits of a good beach may be offset to a degree by the disadvantages of tourists and the major differences in local trade between summer and winter than beach tourists lead to.

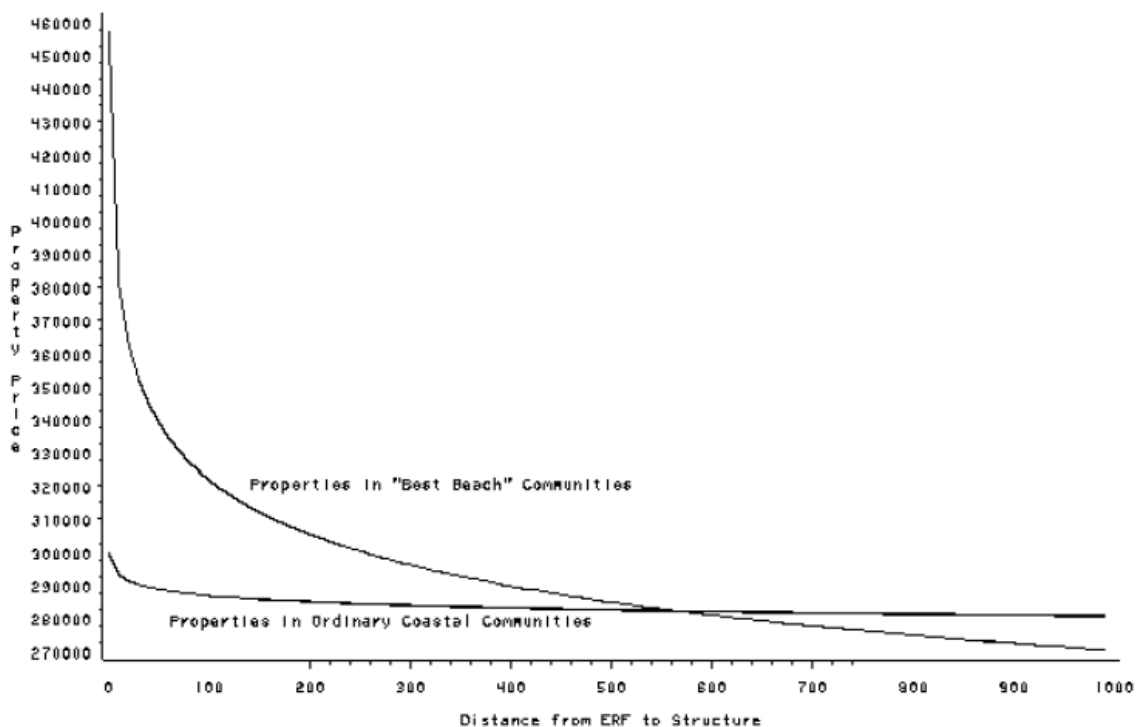


Figure 1.8: How property price responds to distance from erosion feature, comparing an ordinary beach to a Leatherman *Best Beach*. From Kriesel *et al* (2000).

Figure 1.8 shows the importance of the beach to the community if the beach is good quality. The price gradient for a *Best Beach* is very steep when price is

plotted against Distance from ERF, so there would be major losses to a community like this if the beach were eroded. In ordinary coastal communities, there is only an impact on house prices if only about 20m remain between houses and the ERF, and this price difference is not very great, so loss of beach has little impact.

Another loss to coastal communities can occur if the beach is armoured. This can create loss of habitat, loss of beach due to disrupted long shore drift, and can mean that the beach totally vanishes at high tide, causing tourists to re-locate elsewhere so that the local community suffers from loss of income. For example, on the Pacific coastline, waterfront properties on Leatherman beaches lose 36.9% of their value following armouring. This is statistically significant, as is the finding that waterfront properties in ordinary coastal communities gain 13.9% in value following seawall creation. Inland properties also gain from beach armouring, but in affluent Pacific communities, coastal residents can afford to pay inland residents to prevent beach armouring so that the coastal properties retain their value.

Overall, beach communities stand to lose out if the beach becomes less attractive, but conversely if communities cleaned up the beach and possibly tried to restore them to their natural states, money would flood into the community from increased tourists and it becoming seen as a nicer place to live. Beach nourishment is a coastal defence strategy that would allow this development to occur, as nourished Leatherman beaches have increased property values of 15.5%.

The amenity value of waterfront properties is nearly the same between Leatherman beaches and ordinary coastal communities. This suggests that buyers bid up waterfront property at an equal rate, regardless of the beach amenities that are available. Thus, it seems that property buyers value the clear view of water independently of the beach conditions.

1.1.8 Conclusions and insights from this study

Overall, this study from the University of Georgia shows clearly that property prices decline as the houses become increasingly threatened by erosion, but these losses can be offset to an extent by beach armouring (as long as the beach is not classed as a *Best Beach*) and sand nourishment. Once only 60 years of Geotime remain for a property, house prices fall rapidly. Coastal armouring increases the value of waterfront properties, but if the recreational beach is damaged then neighbouring, inland property values will be reduced sharply.

Erosion insurance would be taken up by the majority of homeowners, but the premiums would have to be kept below \$2 per \$100 coverage and it would have to be compulsory for all houses within the 60 year Geotime zone to prevent people taking advantage of the system. People will probably be more likely to buy insurance if the risks of coastal erosion are made clear to them, so education and media coverage will be beneficial to current homeowners, but not

if they want to sell their homes as they will be less likely to find a buyer willing to risk living so close to the sea.

1.2 Discussion of the Heinz Centre study (2000)

This is the main report of which the above evaluated study from the University of Georgia (Section 1.1) is only a part. As such, the study area considered is the same as above, but this report mainly focuses on potential changes to the National Flood Insurance Program to incorporate erosion risks, as erosion is not currently covered by the insurance and areas of erosion hazard have not been mapped.

As well as affecting property prices, as shown by the University of Georgia study, coastal erosion has been shown to also affect development density. Within the 60 year erosion hazard zone, development density was lower than average and decreased closer to the ocean, but beyond the 60 year zone, development density increased closer to the shore. The introduction of NFIP has increased the development density slightly within the hazard zone, but it is still lower than average.

A worrying claim by the Heinz Center (2000) is that in the next 60 years, 25% of houses within 500 feet of the US coast will have been lost due to erosion (excluding major cities). This is an average of 1500 homes per year, costing homeowners \$530 million/yr. A key recommendation is the need for erosion hazard maps to be produced by FEMA (Federal Emergency Management Agency). This will aid with mitigation, decisions made by homeowners, and land-use planning, as well as hopefully leading to changes in the way flood insurance is managed, as currently there is no discrimination between flood insurance premiums in eroding and non-eroding areas. The cost of mapping is estimated to be \$5 million per annum, but if all empty coastal lots were built on, the annual cost due to erosion losses would be an additional \$100 million, so the maps will be cost-effective if developers take notice.

Currently, the National Flood Insurance Program reimburses most erosion-related losses, but current premiums are only based on flood risk, so policy holders in non-eroding areas end up paying for erosion damage in other locations. This report suggests that premiums in eroding areas should be, on average, twice those in areas which are only at risk from flooding, in order for the risks to be adequately represented. Some problems with the NFIP are that it does not cover cost of land lost, and only the first \$250,000 of loss is covered, which will not cover the cost of many coastal homes.

This report lists approaches to erosion management at many different levels, and this is summarised below:

- Individuals can protect their property through structural and non-structural methods, or through compliance with building codes;

- Communities and Local Governments can enforce building codes, enforce NFIP building management requirements or participate in federal shoreline management schemes;
- States can enforce set-back policies, regulate the use of shoreline stabilisation structures, require real estate agents to disclose erosion information to buyers, or participate in federal shoreline management schemes; and
- Federal agencies can provide insurance cover, provide disaster response and recovery, support state erosion management plans, or participate in federal shoreline management schemes.

The report then goes on to analyse nine possible future policy options relating to coastal erosion, stating that the key issues that need to be covered by policy are:

1. the public need to be kept informed about what is happening on their coasts;
2. the changes need to alleviate economic hardships resulting from erosion;
3. the policy option chosen must be fair, with insurance rates reflecting damages;
4. the policy option needs to reduce damages;
5. ideally, there will be other benefits as well, such as environmental; and
6. change must be cost-effective for the public who will be affected.

1.2.1 The Appendices to the study

Parts of Appendix D to this study (Sections ii and iv) discuss in detail the patterns of development along coasts and the associated costs of insurance, and they make predictions for the next 60 years using GIS.

A key finding is that the public underestimate the erosion hazard that coastal communities face, which was shown by the implementation of NFIP: only 3,000 out of 21,000 coastal communities joined in its first four years. Participation had to be encouraged by withholding mortgage loans. A possible reason for the low participation rates is that people with optimistic perceptions of risk, or people who are not aware of the risks of coastal living, are more likely to live in high risk areas: they may have been attracted by the lower priced houses. If an event did occur to make them aware of the dangers, it would be expected that participation in insurance programs would increase.

Coastal risk is classified into four types: flood damage, direct erosion damage, higher wave heights and high and powerful waves in areas that have not previously experienced them. Direct erosion damage is estimated by the study by finding the distance between the ERF and the structure, and the average erosion rate, in order to find the decade in which the structure will be lost to the sea. No erosion damage is assumed before or after this decade. Table 1.1 shows damage by decade caused by each of the four coastal risks on the Atlantic and Gulf coasts.

Table 1.2: Flood and Erosion damage by decade – Atlantic and Gulf of Mexico.			
	Expected annual damage at 10, 30 and 60 years averaged over the V-zone (\$/\$100/year)		
Decade (years)	10	30	60
Flood damage	0.70	0.70	0.70
Higher wave heights	0.07	0.12	0.11
Zone change	0.00	0.03	0.02
Erosion damage	0.51	0.56	0.51
Total	1.28	1.41	1.34
Source: The Heinz Center (2000): Evaluation of Erosion Hazards , April 2000, Appendix D (iv).			

As Table 1.2 shows, erosion damage costs less than flood damage, but much more than damage due to higher wave heights or zone changes (high waves in areas that have not experienced them before) even though these last two factors are likely to be caused by hurricanes in this part of America, so it could be expected that they would produce a lot of damage. At an average of \$0.53 per \$100 per year, erosion damage is a significant issue for homeowners and insurance really ought to be provided to compensate for their losses.

1.3 Discussion of other relevant studies

Overall, there does not appear to be a great deal of relevant literature on the subject of property values being affected by coastal erosion. However, what information could be gleaned is discussed below, and there are several studies relating to insurance for coastal erosion, as well as a useful study of the UK by Defra and the Environment Agency, including case studies of coastal areas.

Similar to the Heinz Center report, there is a study by Keeler *et al* (2003) from an American perspective, which looks at whether or not erosion is covered by NFIP, as there is uncertainty surrounding this issue. The NFIP wording is ambiguous, as it insures against “a general condition of flooding”, so if erosion occurs during a storm that also causes floods, a claim is likely to be successful. Lack of available insurance can lead to over-investment in hard shoreline engineering to protect houses, with the associated loss of habitat and recreational facilities that this results in. Coastal property owners may also attempt to build their own sea-walls which, as it this unregulated, could be dangerous. However, the findings from this paper suggest that, while there is major demand for erosion insurance, people’s willingness to pay is too low compared to the costs of providing the insurance so it may not be cost effective.

Landry *et al* (2003) investigated the economic efficiency of three different beach erosion management policies, taking account of the potential benefits from recreation, changes in property values and costs of the management scenarios. Edwards & Gable (1991 in Landry *et al*, 2003) and Pompe & Rinehart (1995 in Landry *et al*, 2003) suggest that beach width and stability are important determinants of property value, as they affect recreational/amenity value and

flood and erosion risk. However, the relationship between the property value, time to erosion (measured as distance from an erosion reference feature, ERF) and erosion rate has been found to be complex (ibid, 2003). This is because shorter distances from ERF are valued for recreational purposes, but value is also placed on protection from erosion risks which increases with greater distance from ERF and a lower erosion rate (ibid, 2003). Further complications are added due to expectations of future coastal management actions (ibid, 2003).

Landry *et al* (2003) found that each additional one metre width of beach increased property values by \$233, or 0.17% of the property value. This is similar in magnitude to the decrease in value as the age of the house increases (-0.16%). Each additional metre distance from ERF increased property values by \$91, or -0.06% of the property value. Furthermore, presence of the property in the high erosion risk zone reduced property values by \$9,269, equivalent to -6.8% of the property value. This is similar in magnitude to the increase in value from presence of a fireplace (6.3%) and more significant than number of bedrooms (3.5%). The case study area was one where beach nourishment schemes in the past, which meant homeowners' expectations were that there would be future management actions. The case study area is also one where property owners are required to hold insurance. However, there is considerable uncertainty as to whether damage caused by erosion that is not associated with flooding would be covered¹¹.

Landry *et al* (2003) raises some important issues when attempting to understand the impact of erosion risk on property values. The identification of a complex relationship between distance, erosion rate and expectations of protection as well as recreational/amenity opportunities means that we could expect different responses to erosion risk in different locations and with different policies. It will be necessary to try and understand this relationship in order to predict if and how property prices would respond to changes in erosion risk. Landry *et al* (2003) also identifies the need for good understanding of the relationship between coastal management, recreational and property benefits and the housing market since an abrupt change in management strategy could shock the property market. Such a shock could result in larger changes in property values than those identified through the hedonic price study.

Kriesel *et al* (2000a) discuss the relative impacts of coastal erosion (likely to have a negative impact on property value) and amenity (likely to have a positive impact on property value). If property buyers value amenity more than the reduced erosion risk, the overall impact will be a price premium, and vice versa. Overall, the results showed that a degraded beach (which would impact negatively on both erosion risk and recreation) resulted in a price reduction of 13.9%. This decline is seen out to a distance of 600 feet from the shore. The impact of loss of recreation access is more strongly demonstrated by a

¹¹ The Federal Emergency Management Agency (FEMA) answers to questions about the NFIP states that 'Subsidence of land along a lake shore or similar body of water which results from the erosion or undermining of the shoreline caused by waves or currents of water exceeding cyclical levels that result in a flood is covered. All other land subsidence is excluded.' FEMA (2007).

reduction of 36.9% of property value following beach armouring on Pacific sites. Conversely, beach nourishment, which helps to maintain access to recreation, increased prices by 15.5%.

Kriesel *et al* (2000a) identifies that buyers' awareness of erosion risks is related to the reporting of problems in the media. It is stated that buyers will tolerate some risk if the property is buffered by the distance between the property and the water. Publication of the Flood Insurance Rate Map (FIRM) potentially reduced property values in the flood zones by providing evidence of the risk to potential buyers.

Part of the contribution of Working Group II of the IPCC (2007) was to develop a factsheet on climate change impacts, adaptation and vulnerability. This covers details of coastal systems and low-lying areas and how these will be impacted by climate change. In summary, climate change will lead to increased risks due mainly to sea level rise, which will lead in turn to higher erosion rates. This is exacerbated by human activities that result in loss of mangroves and salt marshes, and sea level rise then creates further losses of ecosystems. The report states that millions will be affected by sea-level rise-related flooding by 2080, particularly if adaptive capacity is low, e.g. Asia, Africa and the Pacific islands.

Some literature from a UK perspective is the CIRIA Proposal (2008) which is discussing a potential project to analyse people's awareness of flooding risks and create an online self-diagnostic tool to help people to develop property resilience. There would also be a phone service to help people both before and after flooding events, and both of these services should help to educate people of the risks. This suggests that there is recognition in the UK that the public are not as aware of environmental hazards as they need to be in order to make informed decisions about where to buy property and whether to invest in insurance etc.

Defra and the Environment Agency have a joint *Flood and Coastal Erosion Risk Management Research and Development Programme* which looks at several aspects of coastal erosion, including coastal defences, social factors and management policies. The 2007-08 Annual Review details the progress that has been made over the year by Defra, and the key developments in coastal erosion are:

- a joint programme to manage erosion risks using models and maps etc;
- achieving international best practice guidance on estimating wave-overtopping relating to coastal defences;
- a new beach management manual to give guidance on coastal defences, and improve knowledge of the erosion of barrier beaches and cohesive shore platforms;
- looking at social justice relating to erosion-threatened areas to improve understanding of current policy and what it judges to be 'fair', as well as studying local communities dealing with erosion issues; and
- the development of a risk-based framework to assess coastal erosion nationally.

However, most of the review is given over to a discussion of flood management issues, which universally seems to be given more research time than coastal property issues, according to the literature that has been found.

Another element of the Defra and EA (2008) *Flood and Coastal Erosion Risk Management R&D Programme* is a discussion of compensation for flooding and coastal erosion losses. This reviews why such compensation would not be beneficial overall, listing the reasons for not providing compensation for coastal erosion as:

1. compensation would reward those who have made unwise decisions on where to live;
2. compensation might lead to unsuitable developments along coasts;
3. the public might then expect compensation for other hazards and disasters;
4. this could distort the insurance market for flood risk; and
5. the desire to maximise risk reduction is not complementary with providing compensation.

(In the UK, homeowners are generally unable to purchase insurance that will cover against coastal erosion losses.) Alternatives to compensation are then reviewed. A method is needed that takes into account all types of individuals who may be disadvantaged by eroding coastlines, and also educates people about the dangers of living near the coast. Possibilities are providing coastal defences, maintaining the existing defences, or the government buying properties and land from people in order to improve coastal defences and save people from imminently losing their homes and losing all the money that was bound up in their property. An interesting alternative option is a “coastal erosion indemnity fund” which residents pay into, possibly as an additional amount on top of their council tax, and the money is used for coastal protection or to reimburse homeowners whose homes have been lost to the sea. A government grant or lottery funding could be used to start the fund off initially.

Within these options, several issues must be borne in mind. Firstly, future as well as present generations need to be accounted for when deciding on a course of action, which will aid with the development and achievement of realistic long term goals. Secondly, community must be a factor in decision-making: people will not want to be relocated far from their friends, family and work. Finally, stakeholder meetings need to be held so that the local people, who will be affected by any decisions and any new legislation, are able to see that the process is fair and just.

A key issue is the need to follow the Human Rights Act from the European Convention on Human Rights when looking at how people can be moved away or protected from eroding coastal sites. Key stipulations of the Act are “the right to peaceful enjoyment of possessions and protection of property” and “the rights to respect for private and family life, home and correspondence” (in Defra/EA, 2008). This means that people cannot be forcibly moved without sufficient governmental compensation, they can expect the government to protect their property, and the public can demand that their wishes are respected regarding

how they want to personally face up to imminent property loss due to coastal erosion. A solution to this is the drawing up of contractual agreements with homeowners in case of future need, covering stipulations such as the right to flood their land if necessary. Regardless of the Human Rights Act, the 1949 Coast Protection Act states that land can be purchased by the Coast Protection Authority in order to undertake coastal protection work. Overall, there are a lot of Acts that can be called into play when it comes to coastal protection, from the Town and Country Planning Act 1990 to the Countryside Act 1968.

The key message from this section of the Defra/EA report is the need to **adapt** to climate change and other future uncertainties through flood defence schemes, **integrate** erosion and flood management into land use planning taking account of wider social policies, adopt **appraisal** methods that are fair and open, and that consider impacts in the long term, and protect the natural **environment** by reducing current impacts and developing new solutions to problems.

Later on in the report (Topic Note 11), Shoreline Management Plans (SMPs) are discussed in the context of providing sustainable risk management. SMPs need to relate to local planning policies, and need to inform local authorities and developers of how any proposed plans will fit into the overall coastal picture in the area. For example, if the SMP recommends managed realignment, developers should not build on low-lying land near to the coast.

One of the case studies covered by Defra and the EA (2008) in their *R&D Development Programme* is the North Norfolk Shoreline Management Plan (SMP) from Sheringham to Lowestoft. In general, this SMP calls for protection of major population centres and tourist areas, but cliffs in other areas need to be allowed to continue to erode as this is the sediment supply for the rest of the coastal cell. Conservation, habitat and heritage sites need to be protected, as do tourist beaches and landscape quality, while protecting the local economy and educating residents about coastal processes. Some of these issues do conflict, particularly allowing some areas of cliffs to continue eroding but having to protect so many features at the same time.

The four options that the SMP1 reviewed for each area were do-nothing, hold the existing line, advance the line, or retreat the line (otherwise known as managed retreat). SMP2 re-named some of these, with do-nothing becoming “no active intervention” and retreat the line becoming “managed realignment”, in order to clarify the meaning. Stakeholder meetings, workshops and consultations are undertaken during the creation of SMPs to aid with information-gathering and to establish different views. Once all this had been completed, a preferred policy option was assigned to each section of the coastline.

Specific objectives of the North Norfolk SMP2 include:

- ensuring continued provision of port facilities at Great Yarmouth;
- preventing loss of historical pier;
- preventing loss of historical seawall;

- preserving Bacton gas terminal;
- reducing pressure on shingle beaches, allowing them to rollback; and
- maintaining designated conservation sites and geological exposures.

In order to achieve these objectives, there must be an understanding of how the coastal system in this region works with respect to the expected extent of future erosion and sediment loss, as well as environmental sensitivities in the region so that the natural environment can be preserved. Any decisions made must be fully economically justified.

The conclusions of the North Norfolk SMP1 were Hold the Line for stretches of the coast with residential or commercial interests, but Do-nothing or Managed Retreat were preferred elsewhere. In the SMP2, however, this has changed to Hold the Line only in major population centres, e.g. Great Yarmouth, while No Active Intervention or Managed Realignment have been adopted in the medium term for other areas which were previously being defended.

Even though these decisions have been made and the SMP2 finalised, there are some problems. There remain conflicting issues with certain aspects of the chosen policy options; uncertainty remains over details of erosion processes and rates; local authorities do not actually have the facilities to implement the policies; and most importantly there is no land available for rollback development, and compensation is not being offered. A case study of rollback is found in Box 1. Benefits produced by the SMP2 include public education on the issue, and a lack of political influence over the outcome. As a result of certain failures with the SMP, the Defra/EA review (2008) states that it may not be adopted, and as it was developed in 2004 it can be seen that there is a long decision-making process behind SMP production.

Box 1: “Rollback” of Coastal Caravan Park

The Holderness coast, which runs from Flamborough Head in the North to Spurn Point in the South is a rapidly eroding coastline but is also an important tourist destination with caravan parks along the waterfront. As these caravan parks are an important source of income for the region, a method was needed to maintain this income in the face of coastal erosion. In the face of this need, local authorities, the Environment Agency and the caravan park owners developed the concept of “rollback” which not only involves moving the caravans inland away from the coastal erosion dangers, but also looks at environmental and sustainability issues for the local community. Moving the caravans back means that the coastline itself is less disturbed, so tourists have access to natural beaches and cliffs, but the income from the caravan parks is not threatened. However, this approach requires “land-banking”, ensuring there is sufficient inland space for homes and caravans etc to move into. Public support is also necessary.

A major issue with the SMP2 is the move, for some areas, from Hold the Line to Managed Realignment, which has been affecting property values in these areas even though the policy is not yet effective, and may change in the intervening years. The property value effects may be related to the fact that the public do

not fully understand that erosion and offshore dredging effects are not yet clear, so the SMP will change over time as the science becomes clearer.

The Heinz Centre has produced other useful documents relating to issues of coastal erosion, insurance and so forth. Their 2002 book on *Human Links to Coastal Disasters* aims to study the social factors associated with coastal disasters, such as the effects on schools, families, places of worship etc. and how disaster resilience is needed in order to reduce the effects of the disaster aftermath – this can be achieved through increased social interactions.

A key aspect of the Heinz study is vulnerability, and how this can be divided up into biophysical (e.g. the location of a town on a cliff), built (e.g. the quality of housing, this particularly applies in earthquake-prone regions) and human (e.g. age, gender, health, resources etc. This also helps with post-disaster recovery and would presumably affect insurance premiums). The paper focuses mostly on what would be termed “natural disasters”, such as earthquakes and hurricanes, rather than longer term, gradual issues such as the coastal erosion problems faced by Britain today. However, despite this it covers relevant information such as details of the move to the coasts in America, stating that coastal counties represent 17% of the US land area, but 53% of the population live there, with average coastal population densities increasing from 187 per square mile in 1960 to an estimated 327 by 2015. Also discussed is the fact that issues such as that of coastal erosion cannot be studied in isolation, but social and political issues must be taken into account. For example, in the aftermath of a disaster, or in the coastal erosion case, for a person whose home has just been lost to the sea, there can be mental repercussions that need to be taken seriously and dealt with carefully, e.g. depression. Also, community-wide issues are important, as again mental illnesses could be caused by the gradual and unstoppable encroachment of the sea into a community-centred village.

NFIP is reviewed again, with a key issue noted: due to premiums being set at low, non-actuarial levels, NFIP actually encourages settlement in flood-prone areas as house price decreases are not offset by high enough insurance premiums, and people feel safe in the knowledge that if a disaster occurs they will be covered. A major issue is when money has to be paid out to the same house several times, for example, if it floods annually. These insurance payouts can easily become greater than the value of the house. Beach nourishment programmes can also create problems as they lead to higher coastal development behind the refreshed beach so the beach replenishment must continue, at costs of up to \$17.5 million per mile. These programmes are often a result of the short electoral cycle, as elected politicians are unwilling to put into place long-term schemes which may be unpopular at the time.

Overall, the study does not relate a great deal to the issues of coastal erosion and house prices because the situation in America is very different, especially as regards the coastal hazards that they face: this report was mostly about hurricanes. However, there are lessons to be learnt from it because, especially for the North Norfolk coast, a storm similar to that in 1953 could lead to large portions of the cliffs being lost in a single day, creating large scale disasters that would need to be dealt with efficiently and considerately. Any flood insurance

offered in the UK would have to take account of the possibility of a similar storm occurring and affecting lives and communities.

A New Zealand study (Turbott, 2006) looks at different methods used to manage coastal hazards, summarised as holding the line, or retreating the line. Managed retreat seems to be becoming more popular the world over if this study and knowledge of coastal policy in the UK are anything to go by. This study reviews the potential implementation of managed retreat in New Zealand and the effects that this would have on home owners and other stakeholders. Muriwai Beach, Auckland, is a case study example of where deliberate coastal retreat is being allowed to take place due to extreme erosion rates making protection unviable.

Educating people on the dangers of living near the coast is not enough to deter them from the sea views that they desire. In order for managed retreat to work, therefore, education is important but preventing installation of new engineering strategies and providing spaces for buildings to be relocated to are key. Alternatively, rather than relocating the houses when they enter the danger zone, a variety of lease types could be used e.g. lease-hold land with a defined term of tenure, or the government buying the houses and renting them back, so people would not own the land *ad infinitum* – beneficial as the land will not be there forever.

Generally, managed retreat tends to be viewed favourably by people who live further from the coast as it will maintain natural beaches without unsightly seawalls and groynes, but for people who live on the waterfront there are problems due to loss of money that is currently invested in their property and land. Turbott's (2006) survey showed that people tend to prefer rock armouring out of all the possible coastal defence methods, and they feel very secure once their property is behind a rock wall. Beach nourishment is also popular as this preserves the recreational value of the beach.

As with the American studies reviewed here, Turbott (2006) states that coastal property values in New Zealand are appreciating at a much faster rate than the national average: after inflation, returns are 14% per year on beachfront properties. This value decreases further back from the shore. In one of the case study areas, Waihi Beach, there are protection works as there have been several well-publicised erosion events in the area, but house values for shorefront properties continue to increase, so hazards do not affect property values in the region. Another case study is Mokau Spit, in Waitomo, which was sold for development in 1957 and began to experience erosion problems in 1960. When this issues became too severe and some properties were lost to the sea, the Crown (former Department of Lands and Survey) actually paid out to the property owners up to 100% of the property value (if the owners had purchased the property in 1957). Moving houses back or attempting unauthorised protection works are some of the methods people are using on the Spit to protect their homes.

No New Zealand insurance is specific to coastal erosion but it may be covered by some policies (Turbott, 2006). However, effects caused by sea level rise are

not covered by any policy and it may be difficult to differentiate this and coastal erosion losses. If insurance does exist in areas, it may lead to unwise development and pressure for hard engineering works (therefore resistance to managed retreat).

Turbott (2006) makes the interesting point that if the situation is of a road running along the coast with houses only on the inland side of the road, then the road will be affected by erosion before any of the private properties are. However, the properties depend on the road for access and amenities such as water and gas which are likely to be in pipes running under the road, and other communities may also depend on the road if it is the only road to a particular village. It is therefore up to the local council to make the decision about what needs to be done about coastal erosion, and not the homeowners. It is a difficult situation as homeowners are likely to feel that they are deserving of some compensation if they are forced to move when their homes are not themselves damaged, and if the road is moved landwards this is likely to involve some purchase of property. Both these options would be costly. Situations where the road is landwards of the properties, or where the road is perpendicular to the shore each also have their own individual problems to face.

An article on Property Wire (2008) tells of the new risk zoning system in France where in the highest risk areas new development will be banned and some existing buildings will be demolished. Properties in the red zones (high risk) will not necessarily be re-built if they are damaged by flooding, and planning permission for extensions would not be granted.

2. Hedonic Pricing

2.1 Introduction

Hedonic pricing is based on regression analysis and is used to assess the impact of particular characteristics of a property or its neighbourhood on the market value of that property. Only limited research has been undertaken on the impact of coastal erosion risk on property values, as described in Section 1. Hedonic pricing has been used, though, to investigate the impacts of other hazards and events. These include fire risk, earthquake risk, flood risk, noise, explosions, road, railway, etc. It is useful to examine the findings of studies in these other areas as there may be parallels in terms of impact on property values. The findings of the research also give ranges of property price impacts; these can then be compared with the impacts from coastal erosion found during our study.

2.2 Fire Risk

Like coastal erosion, wildfires result in loss of the property. Unlike erosion, the land remains and can be redeveloped. Furthermore, there is a risk that a fire could occur each year, but no certainty that the property would be lost in x years. Fire risks also carry a risk to life, but there is usually sufficient warning

time for this to be reduced. Fire risks, therefore, may be more similar to flood risk than erosion risk.

Mueller *et al* (2007) found that a first forest fire reduces the prices of houses located near the fires by around 10%. A second forest fire reduces house prices by almost 23%, even where the fires are several years apart. This finding suggests that repeated exposure to a risk exacerbates the impacts on house price.

Loomis (2004) found that house prices reduced by 15% in a town that was two miles away from a major wildfire. This shows that impacts occur on house prices even where the wildfire was far enough away that it did not threaten the buildings within the town, instead suggesting that a fire *could* affect the property and the forest around it. He concluded that home buyers appeared to revise their perception of risk after a wildfire event, which results in a reduction in the desirability of living in a forest. Loomis (2004) attributed some of this loss to the time needed for recovery after a fire (longer than that associated with recovery after an earthquake or flood) and the disamenity associated with blackened trees.

2.3 Earthquake Risk

Similar to fire risk, earthquakes can result in loss of the property. In some cases, land may also be lost (e.g. through landslips) or may become unsuitable for redevelopment. Thus, there are similarities with erosion risk. However, while there is an annual risk that an earthquake could occur, there is no certainty that a property would be lost, as with erosion. Also, earthquake risk cannot be predicted with a high degree of certainty and it therefore includes risk to life.

Beron *et al* (1997 in Daniel *et al*, 2005) showed that house prices in an earthquake risk zone were 4% lower before the Loma Prieta earthquake in 1989, compared with 3.4% lower after the quake. This is explained by the residents in Loma Prieta already being fully aware of the risks, with extensive media coverage and educational campaigns about earthquake preparedness over previous decades (Bin & Polasky, 2004).

Willis & Asgary (1997) used interviews with estate agents to assess the impact on price of an earthquake-resistant house. They found a difference in value between a resistant and non-resistant house of 35% of the construction costs. The authors also compared the results with the willingness to pay of residents for construction methods to reduce earthquake risk. The two values corresponded well (ibid, 1997).

Bernknopf *et al* (1990, in Smith *et al*, 2002) examined the influence of earthquake and volcano hazards on property values. They found that exposure to these risks reduced house prices by between 8.2% and 11.4%.

2.4 Flood Risk

Flood risk can result in significant damage to, or loss of, properties but, unlike erosion risk, the land usually remains and can (if desired) be redeveloped.

Zhai (2006) found that willingness to pay (wtp) in Japan for flood control measures increase with individual preparedness, income and flood experience. WTP may decrease with distance to river, flood risk acceptability and provision of environmental information. Although not directly comparable with coastal erosion risk, these results suggest that better understanding of risk and its consequences increases willingness to pay to avoid that risk. If the same holds for coastal erosion, it would be expected that people would be willing to pay more to live in a property at lower risk. Thus, property prices outside the risk areas could be elevated while properties at risk could be expected to attract less interest.

Zhai (2006) investigated the acceptability of flood risk to residents of Toki City and Nagoya City, Japan. The findings showed that 50% of respondents accept no flood risk at all. This contrasts with the suggestion that people in Japan may not take flood risk seriously as they perceive that earthquake and fire risk are more important. However, a lack of acceptance of *any* risk could be expected (were the same to hold true for coastal erosion) that people would not choose to purchase a property that would have some risk from erosion. Such views could mean that people would avoid properties in areas perceived to be at risk, even if that risk were long-term and outside the time that they would own the property for.

Daniel *et al* (2005) found that willingness to pay for a probability of risk exposure of 0.01 of between -0.229 and +0.575% of the average property value. Thus, for every £1,000 of property value, willingness to pay varies between -£2.29 to +£5.75.

Daniel *et al* (2005) identifies the potential use of hedonic pricing to take account of location choices and the choice of consuming a particular level of risk. However, there are two problems with this approach. Firstly, there is potential bias in individual perceptions of the level of risk. Secondly, the proximity of a property to water/coast means there are potential water-related amenities (*ibid*, 2005).

Perception bias relates to the divergence between the objective probability of a given risk and an individual's perception of that risk. An individual can be completely blind to a risk or may have distorted view of the real risk. To avoid these biases, Daniel *et al* (2005) suggest consideration of estimates before and after an event. New information is available after an event that can affect subjective probabilities. The information can come from increased visibility of the risk, for example, through media coverage but could also be reflected by higher insurance premiums or a change in the rules requiring disclosure of the risk.

Daniel *et al* (2005) undertook a meta analysis of 16 studies, giving 86 estimates of the change in property value due to location in a floodplain. The results show that when a house buyer has the opportunity to update his knowledge of flood risk, the implicit price of risk increases (-0.023). This is because they are better able to assess the risks, although the result can also be explained by an over-reaction (e.g. due to the difficulty of providing information on low probability risks). The ability of individuals to update their perception of risk is able to explain the variability between estimates (ibid, 2005). It could be concluded, therefore, that exposure to a risk (e.g. evidence of erosion, media coverage, publication of erosion lines) is likely to result in individuals' updating their perception of risk. As a result, it may be more likely that the price of risk would increase, and the value of the property at risk would decrease.

Daniel *et al* (2007) reported on the confidence of Dutch citizens in the systems that protect them from flooding. This showed that people do not think about the possibility of dike failure; those living on the coast are generally unaware of the potential implications of sea level rise and do not consider coastal flood risk to be a significant issue. As a result, there is a general underestimation of the magnitude and relevance of works required to maintain coastal safety. Following the floods in 1993, households considered the lack of information available on the possibility of flooding a significant shortcoming, with 80% of households having received no information about flood risk and 65% claiming they were not conscious of the risk. The authors conclude that an analysis of flood risk should cover both the objective response (i.e. the likelihood of flooding) and the subjective elements based on perception and experience.

Daniel *et al* (2007) assessed the extent to which house prices decreased after a flood to explore the consciousness of risk before the event took place. If the risk was known perfectly before the flood, there should be no adjustment in prices for the risk. The study also explored whether there were effects are the first and second floods and if the impacts declined over time as memories of the event faded. The study found that housing markets in the Netherlands are sensitive to flood risk. The study found that location in the flooded zone varies between -7.9% and -11.4%, but that this did not change significantly after the second flood (-6.6% to -9.8% after the first flood). After the second flood, the discounts persisted (Daniel *et al*, 2007):

- within two years: -7.3% to -10.7%;
- between two and four years after: -6.3% to -9.2%;
- between four and six years after: -8.9% to -13%;
- between six and eight years after: -7.3% to -10.6%; and
- remaining period (unspecified): -8.4% to -12.3%.

The persistence of the discount is possibly explained by increased communication of flood risks (Daniel *et al*, 2007).

Daniel *et al* (2007a) used a meta analysis of 19 studies from the USA to show that houses located in a 100 year floodplain have a price reduction of 0.3% to 0.8%. These are much lower values than seen from other studies reviewed here. The authors explain the results as reflecting the difficulty of separating

the positively valued amenity effects with the negatively valued effects of exposure to flood risk.

Schultz & Fridgen (2002, in Loomis, 2004) found that flood events reduced property values by 10%.

Bin & Kruse (2006, in Bin *et al*, 2008) reported that the average values of houses in a Special Flood Hazard Area (SFHA), which have a 1% chance of flooding per annum, was 10% higher than comparable properties outside the flood zone. The difference was even more marked for properties facing greater risks (SFHA with additional vulnerability to wave action, V-zone) where values were 27% greater than non-flood zone properties (ibid, 2006 in Bin *et al*, 2008). These high values are thought to be associated with amenity values, with the study unable to include both waterfrontage and location in the V-zone due to their high correlation.

Bin *et al* (2008) find that location of a property in the SFHA zone results in an 11% reduction in property value. This compares with a 14.7% decrease associated with proximity to the beach, interpreted as the net effect of erosion (minus benefits associated with recreation). The mean willingness to pay to avoid location in SFHA is \$36,082, equivalent to 12% of the average property value (ibid, 2008).

Another American study (Okmyung *et al*, 2008) looks at flooding and flood insurance in North Carolina. As with erosion, location within the danger zone lowers property prices, so property prices, insurance premiums and flood zone designations all allow buyers to appreciate the risks of buying a house in this location. Their results show that houses situated on flood plains have a reduced price, and this is reduced further if the house is in e.g. the 1-in-100 year floodplain compared to the 1-in-500 year. Insurance premiums are found to be closely correlated with house prices, and it can be expected that this would be the case if coastal erosion insurance were to be introduced. Discounts on coastal or floodplain properties thus represent the willingness to pay of homeowners to avoid the risk, as long as all other factors are considered equal.

Okmyung *et al* (2008) also consider the impact of multiple risk factors, noting that the effect of one disamenity reported in hedonic pricing studies may be over-estimated unless other factors affecting house prices (e.g. sea views) are controlled. The study also reports on the effect of education campaigns on wildfire hazards and how these can result in reducing house prices (Donovan *et al*, forthcoming in Okmyung *et al*, 2008). Okmyung *et al* (2008) find that the flooding appears to have no impact on house prices when amenities (sea view, recreation) are not included. Taking account of amenities, the authors find that location within a floodplain lowers the average property value by 7.3%. Location within the 1-in-100 year floodplain reduces values by 7.8%, while location in the 1-in-500 year floodplain reduces values by 6.2%.

Bin & Polasky (2004) investigate the impacts of Hurricane Floyd on property values. Hurricane Floyd caused some \$6 billion worth of damage, mostly

caused by flooding. Prior to the event, many people were unaware that they were living in a floodplain. The event itself, therefore, raised awareness of the risk. The authors report that the market value of a house in the floodplain is lower than a similar house outside the floodplain, by \$7,530 on average (5.8%). A comparison of the differences before and after Hurricane Floyd shows that the estimated discount associated with being in the floodplain has more than doubled. After Hurricane Floyd, the value was reduced by \$10,770 (8.2%) compared with \$4,930 (3.8%) before. The increase in the reduction of the value of properties is explained by the lack of knowledge of the risks of flooding prior to the event, with the hurricane causing people to reassess the risks (ibid, 2004).

Samarasinghe & Sharp (2008) assessed the impact of a floodplain location on property values in New Zealand. There is good knowledge of the risks since floodplain maps are available and it is standard practice for buyers to obtain reports that include this information. Thus, potential property buyers are able to make informed decisions on buying a property in a flood prone area. They found that houses in flood hazard areas sold for 4.3% less than equivalent properties outside the flood hazard zone. The authors compare the estimated reduction with that from other studies, concluding that their estimate may be lower because there is a lack of recent flood experience, no mandatory insurance purchase (as in the USA) which results in buyer perception of risk being based on assessment, and poor integration of the risks associated with flood prone areas, especially when the risk is low likelihood but high consequence.

Speyrer & Ragas (1991, in Smith *et al*, 2002) reported that homes located in a floodplain in New Orleans were discounted at 6%.

2.5 Man-Made Risks

There are numerous impacts caused by man that can result in destruction or loss of a property. These include explosion risks and some environmental risks (e.g. release of contamination).

Zabel & Kiel (2000, in Boyle & Kiel, 2001) found that pollution problems caused by a malfunctioning waste treatment works reduced property prices in a bay by 20%. The reduction related to the value of seasonal recreational properties. These results may reflect the impact of lost recreational opportunities, which is also an effect of coastal erosion. Although, in this case, the results relate to potential health issues associated with pollution, it can be assumed to be equivalent to the reduction associated with loss of recreation. Leggett & Bockstael (2000, in Boyle & Kiel, 2001) found that each additional 100 faecal coliform count/100 ml resulted in a reduction in property prices of 1.5%. The results were attributed more to the potential for odour than recreation.

Smolen *et al* (1992, in Boyle & Kiel, 2001) assessed the impact of existing and proposed hazardous waste landfill sites. The results showed that each additional mile from the site for houses within 2.6 miles resulted in price increases of \$9,000 to \$14,000. The study also showed that the impact on sale

price associated with a proposed site disappeared once the local population were assured that the proposal would be defeated. This is interesting as it suggests that property prices could rebound very quickly if a policy or proposal is changed, suggesting that there is no stigma effect. Conversely, Kiel & McCann (1995, in Boyle & Kiel, 2001) found no significant impact on house prices located near to a proposed incinerator until construction began (impact of \$2,283 per mile). The impact increased by more than 350% (to \$8,100 per mile) when plant went online before falling back to \$6,607 per mile during the ongoing operation (ibid, 2001).

Two studies found no impact on house prices: one following the nuclear accident at Three Mile Island (Nelson, 1981 in Boyle & Kiel, 2001) and one considering the impact of proximity to a nuclear reactor (Gamble & Downing (1982, in Boyle & Kiel, 2001). Nelson (1981, in Boyle & Kiel, 2001) suggests that the results may reflect that residents expect the Government to provide financial aid or that properties were sold to people that did not perceive the nuclear reactor to be a risk. Gamble & Downing (1982, in Boyle & Kiel, 2001) found that there was a statistically significant difference before the accident. After the accident though, distance from the reactor was not significant. This may be explained by the greater employment opportunities after the accident for clean-up workers and nuclear technicians (ibid, 2001).

Carroll *et al* (1996, in Boyle & Kiel, 2001) assessed the impact of the 1988 PEPCON explosion in Nevada. They found that property prices increased by 4.6% at two miles from the plant and that the explosion caused prices to reduce by 17.8%. After the announcement that the plant was to be relocated, prices increased by 38% (ibid, 2001). These findings suggest that there could be a significant rebound after a decision is taken to 'remove' the factor causing an impact on house prices. The study does not mention if prices fell back again at some later date. If not, it could be concluded that the assessment of the impact of the explosion may have been under-estimated. A petroleum pipeline rupture in Virginia was found to result in a reduction in property values of 5.5% (houses within 2 miles of the rupture) (Simons, 1999, in Boyle & Kiel, 2001).

2.6 Noise

Impacts from noise come from various sources, although the hedonic pricing literature tends to focus on aircraft noise, railway noise and road noise. Unlike fire, earthquake and flood risks, noise is constantly occurring resulting in repeated and/or continuous exposure to the risk. This is similar to erosion risk where erosion is progressing.

Rahmatian & Cockerill (2004) found that house prices increased by 21% if the property were located 6 to 7.5 km from an airport. Houses located within 100m of a flight path had a value that was 23% lower than the average value. This is equivalent to a reduction of £230 per £1,000 of property value. House price varies with distance from the flight path:

- houses within 100m: -23% (from average);
- houses within 300m: -18%;

- houses within 500m: -16%;
- houses within 1km: -11%;
- houses within 3km: -9%; and
- houses within 5km: -7%.

The study also found that a home with a view could expect an increased value of \$11,600 (6% of the average value) and that each additional mile from the beach reduced house price by \$2,170 (1% of the average value) (Rahmatian & Cockerill, 2004).

Cohen & Coughlin (2007) found that houses in an area where aircraft noise disrupts normal activities (defined as day-night sound levels of 70-75 dB) sell for 20.8% less than houses where there is no disruption.

2.7 Views

Garrod & Willis (1994, in Boyle & Kiel, 2001) found that a waterfront location increased house prices in Britain by 3% to 5%.

Lake & Easter (2002) estimated the value of open space and found that homeowners pay \$115 (0.05%) more to live 100 feet closer to any type of open space. Proximity to natural areas was worth an additional \$111 dollars (0.05%), but there was no statistically significant effect associated with wetlands. Mahan *et al* (2000, in Lake & Easter, 2002) found that decreasing the distance of a house to a wetland increased property values by \$436 per 1,000 feet reduced distance. Moving 1,000 feet closer to a lake was found to increase property values by \$1,644, and by \$259 for a stream (ibid, 2000 in Lake & Easter, 2002).

Daniel *et al* (2007) found that properties in the Netherlands within 500 metres of the River Meuse were worth up to 3.8% more than houses located further than 500 metres away. This premium is expected to reflect the positive effect of amenity associated with water.

Tyrvaainen & Miettinen (1999, in Lake & Easter, 2002) found that residential property prices in Salo, Finland decreased by 5.9% with a 1 km increase in distance from a forest. Properties with a view of forests were typically 4.9% more expensive than those without a view (ibid, 1999 in Lake & Easter, 2002).

Bin *et al* (2008) consider the impact of sea views in detail, focusing on spatial factors, type of view and access to a beach or pier for recreational purposes. Erosion risk along the shoreline is constant at 2 feet per year such that the authors expect the results for proximity to the beach to reflect both the recreation/amenity benefits associated with being close to the shoreline and the negative impacts associated with erosion. The overall impact of both features combined shows a net negative effect on property values of 14.7% (ibid, 2008). Bin *et al* (2008) estimate that decreasing distance from the beach by 10 yards results in property values increasing by \$854 (equivalent to 0.3% of average property value), presumably reflecting recreation benefits. Mean willingness to pay to improve views by one degree is \$995 (0.3% of average property value) (ibid, 2008).

Samarasinghe & Sharp (2008) found that properties with a wide view of water sell for around 28% more than property with no views. A slight water view has a premium of 4% and a moderate water view, a premium of 10%. Other views (e.g. cityscape, parks) showed no significant premium.

Bourassa *et al* (2003) found that wide waterside views in New Zealand added an average of 59% to the value of a waterfront property and 33% for medium views. The impact diminishes quickly away from the coast, reducing to 14% (wide views) and 12% (medium views) at 2km from the coast. If the immediate surroundings include particularly attractive improvements, then property prices can be increased by 27%. Views over land show much smaller value increases, at just 4% to 6% (*ibid*, 2003).

Bourassa *et al* (2003) also include a summary of the results of other studies on views. These include Plattner & Campbell (1979) which found that properties with a lake view in Massachusetts, USA typically sold for 4% to 12% more than those without a view. Abelson (1979) found that good views of water in Sydney, Australia increased values by 3.4% and average views increased values by 1.7%. In Los Angeles, Gillard (1981) found that a view increased values by 9.2%. River views in Perth, Australia were found to add 28% to the value of a property (McLeod, 1984). Graves *et al* (1988) found that sea views in California added 13%, while Benson *et al* (1997) report that ocean views in Washington State, USA add 32% to the value (partial views add 10%). Tse (2002) identified that sea views in Hong Kong increase property values by 6% to 10%.

Yiu *et al* (2008) found sea views in Hong Kong attracted a premium of 5% to 6%. However, reclamation of land from the sea meant that these properties reduced their sea views by more than 30%. The premiums found after reclamation though were 6% to 14% suggesting that the additional value may not be derived from the sea view itself. There was a decrease in value during reclamation, but the values rebounded rapidly and then continued to grow. The authors conclude that these observations may occur because (i) there is no added value of sea view in general, (ii) the value of a sea view is very similar to that of a park or (iii) the value of the sea view was derived from other characteristics associated with sea views such as openness or air quality (*ibid*, 2008).

An article in *The Independent* newspaper dated 2 March 2005 (Norwood, 2005) found price premiums of 40% to 50% in the most desirable areas, with premiums in less fashionable areas (including Scarborough) at 25%. The article also quotes a buying agent who notes that "retired and second-home buyers - the main sea-view purchasers - tend not to think long-term, so are undeterred by climate change or generations of maintenance". The article goes on to note that "There is never enough supply to meet demand, especially of the character properties...The debate about floods and costs hasn't deterred people. They all want to see the sea."

2.8 Other Impacts on Property Prices

A US study (Vanderford *et al*, 2005) reports on the results of some thirteen hedonic price analyses which showed that characteristics such as lot size, house age, living area (square footage), house quality, presence of garage, number of fireplaces, number of bedrooms and number of bathrooms all produced significant results in at least one of the studies. However, there was significant variation in the results that may be accounted for by location and data source.

Vanderford *et al* (2005) also reports that neighbourhood variables can affect property value. This includes characteristics such as vacancy rate, owner-occupancy rate and median house age. Results on neighbourhood variables tended to be fairly inconsistent across studies.

Coastal erosion could be expected to affect characteristics such as lot size and neighbourhood vacancy rate in advance of loss of the property itself. Loss of these characteristics alone would be expected to result in a decrease in property value, with smaller lot size having a negative impact in seven out of eight studies (88%). Vacancy rate was found to be a negative influence on property value in two out of four studies (50%), although vacancy rate is reported to be a variable with 'potentially good explanatory power' (as does median house age) (Vanderford *et al*, 2005).

Andersson *et al* (2008) found that a 1 dB increase in areas with a total noise level of 50 dB increase in road and railway noise is associated with a 1.3% and 0.4% decrease in property price. In areas with a total noise level of 55 dB, the impacts of a 1 dB increase are slightly higher at 1.7% (road) and 0.7% (railway).

Blomquist (1974, in Boyle & Kiel, 2001) considered the impact of proximity to an electrical power plant on house values. He found that property prices were reduced by around 0.9% for houses within 6.5 miles of the plant compared with houses at 7.2 miles.

Nelson *et al* (1992, in Boyle & Kiel, 2001) found that proximity to a landfill site reduced property values by 12% for those houses located on the boundary compared with 6% for those houses located one mile away. Reichert *et al* (1992, in Boyle & Kiel, 2001) found that houses located near to a landfill had their values reduced by 5.5%.

Wilhelmsson (2008) found that depreciation rates differ significantly between a maintained and not maintained property. The value of a 40 year old property that is not maintained both indoors and outdoors is about 13% lower than one that is maintained. A lack of outdoor maintenance has a higher impact on value than indoor maintenance.

Kopits *et al* (2007) report that the size of a lot is important. A 10% increase in lot size is predicted to increase the value of the property by 0.6%. This could be important in determining the gradual impact of lost garden areas for houses or even open space for commercial properties such as caravan parks.

2.9 Summary of Findings

Although the risks posed by coastal erosion are very different to those discussed in the hedonic price analyses above, there are some general conclusions that can be drawn. It is also possible to provide a summary of the impact of different types of risk and nuisance for comparison.

Table 2.1 provides a summary of the percentage price reductions found during the literature review. Only results presented as a percentage reduction are included as actual price reductions cannot be compared.

Price Change	Details of Risk/Nuisance	Source
-23%	Reduction in property value after a second forest fire, several years after the first (increased from 10% reduction after the first forest fire) (USA)	Mueller <i>et al</i> (2007)
-23%	Reduction in property price for houses located within 100m of a flight path (USA)	Rahmatian & Cockerill (2004)
-21%	Reduction in property price of houses located near to an airport (USA)	Rahmatian & Cockerill (2004)
-20.8%	Reduction in house price associated with aircraft noise that is sufficient to disrupt normal activities (70-75 dB) (USA)	Cohen & Coughlin (2007)
-20%	Impact of pollution from wastewater treatment works on value of recreational properties (USA)	Zabel & Kiel (2000) in Boyle & Kiel (2001)
-18%	Reduction in property values after an explosion (prices increased by 38% upon the announcement that the plant was to be relocated) (USA)	Carroll <i>et al</i> (1996) in Boyle & Kiel (2001)
-15%	Reduction in house price in a town two miles away from a major wildfire (USA)	Loomis (2004)
-14.7%	Reduction in property value due to proximity to beach (interpreted as the net negative effects of coastal erosion minus any benefits associated with recreation and amenity) (USA)	Bin <i>et al</i> (2008)
-13%	Reduction in price of 40 year old property that has not been maintained (inside and out) compared with one that has been maintained (Sweden)	Wilhelmsson (2008)
-12%	Reduction in property value for houses located on the boundary of a landfill. One mile from the landfill, the impact decreases to 6% (USA)	Nelson <i>et al</i> (1992) in Boyle & Kiel (2001)
-11%	Reduction in property value due to its location in a flood zone with 1% annual chance of flooding (USA)	Bin <i>et al</i> (2008)
-8% to -11%	Reduction in property values due to exposure to earthquake and volcano risks (USA)	Bernknopf <i>et al</i> (1990) in Smith <i>et al</i> (2002)
-8% to -11%	Reduction in house prices after flooding from the Meuse. Prices were still reduced by 7% to 11% two years after the event (Netherlands)	Daniel <i>et al</i> (2005)
-10%	Reduction in property prices after Loma Prieta earthquake (USA)	Murdoch <i>et al</i> (1993) in Loomis (2004)

Price Change	Details of Risk/Nuisance	Source
-10%	Reduction in property prices after a flood event	Schultz & Fridgen (2002) in Loomis (2004)
-7.3% (-6.2% to -7.8%)	Reduction in property prices associated with location in the floodplain (low value relates to location in the 1:500 year floodplain; high value to location in the 1:100 year floodplain)	Okmyung <i>et al</i> (2008)
-6%	Reduction in value of homes located in a floodplain (USA)	Speyrer & Ragas (1991) in Smith <i>et al</i> (2002)
-5.8% (-3.8% to -8.3%)	Reduction in value in a floodplain compared with a similar house outside the floodplain. Before Hurricane Floyd the discount was 3.8%, after it was 8.2% (USA)	Bin & Polasky (2004)
-5.5%	Reduction in property value for houses located near to a landfill (USA)	Reichert <i>et al</i> (1992) in Boyle & Kiel (2001)
-5.5%	Reduction in property values for houses located 2 miles from the location of a petroleum pipeline rupture (USA)	Simons (1999) in Boyle & Kiel (2001)
-4.3%	Reduction in property value due to its location in a flood prone area (4.3%)	Samarasinghe & Sharp (2008)
-4%	Reduction in house prices in an earthquake risk zone <i>before</i> an earthquake occurred. Reduction fell to 3.4% after an earthquake, explained as being due to the overestimation of low probability events (USA)	Beron <i>et al</i> (1997) in Daniel <i>et al</i> (2005)
-1.3% to -1.7%	Impact of increased noise associated with railway over 50 dB and 55 dB (Sweden)	Andersson <i>et al</i> (2008)
-1.5%	Reduction associated with a change of 100 faecal coliform count per 100 ml (USA)	Leggett & Bockstael (2000) in Boyle & Kiel (2001)
-1.1%	Reduction in house price caused by one additional year of age (USA)	Bin & Polasky (2004)
-0.9%	Reduction in house values located within 6.5 miles of an electrical power plant compared with houses located 10% further away (USA)	Blomquist (1974) in Boyle & Kiel (2001)
-0.4% to -0.7%	Impact of increased noise associated with roads over 50 dB and 55 dB (Sweden)	Andersson <i>et al</i> (2008)
-0.6%	Reduction in lot size by 10%	Kopits <i>et al</i> (2007)
0%	No significant reduction found in a study investigating the impact of the nuclear reactor at Three Mile Island before and after the accident on house prices (USA)	Gamble & Downing (1982) in Boyle & Kiel (2001); Nelson (1981) in Boyle & Kiel (2001)
+0.05%	Increase in property price associated with being 100 ft closer to open space or natural areas (USA)	Lake & Easter (2002)
+1.7% to +3.4%	Increase in property value due to average to good water views (Australia)	Abelson (1979) in Bourassa <i>et al</i> (2003)
+3% to +5%	Increase in house values due to a waterfront location in Britain (UK)	Garrod & Willis (1994) in Boyle & Kiel (2001)

Table 2.1: Summary of Impact on Property Price by Risk/Nuisance		
Price Change	Details of Risk/Nuisance	Source
+4.9%	Increase in property values for houses with a view of forests (Finland)	Tyrvaïnen & Miettinen (1999) in Lake & Easter (2002)
+6%	Increased price associated with a home with a view (reducing by 1% of total property price for each additional mile from the beach) (USA)	Rahmatian & Cockerill (2004)
+9.2%	Increase in property values having a view (type not specified) (USA)	Gillard (181) in Bourassa <i>et al</i> (2003)
+6% to +10%	Increased values associated with sea views (Hong Kong)	Tse (2002) in Bourassa <i>et al</i> (2003)
+10%	Increased value of houses located in the flood zone with 1% annual chance of flooding. Additional value thought to be associated with amenity. The value increases to +27% for houses that are also vulnerable to wave action (USA)	Bin & Kruse (2006) in Bin <i>et al</i> (2008)
+4% to +12%	Increase in value of properties with a lake view (USA)	Plattner & Campbell (1979) in Bourassa <i>et al</i> (2003)
+13%	Increased value associated with sea views (USA)	Graves <i>et al</i> (1988) in Bourassa <i>et al</i> (2003)
+28%	Premium associated with wide water views (slight views: 4%; moderate views: 10%) (New Zealand)	Samarasinghe & Sharp (2008)
+28%	Increased value associated with river views (Australia)	McLeod (1984) in Bourassa <i>et al</i> (2003)
+10% to +32%	Increased value associated with partial to full ocean views (USA)	Benson <i>et al</i> (1997) in Bourassa <i>et al</i> (2003)
+25% to +50%	Estimated premiums associated with sea views in less to more fashionable areas (UK)	Norwood (2005)
+59%	Increased value associated with wide water views for waterside coastal properties. Medium views add 33%. The benefits reduce quickly to 14% (wide views) and 12% (medium views) at 2,000m from the coast (New Zealand)	Bourassa <i>et al</i> (2003)

3. Case Studies of Sites of High Erosion around the English Coast

3.1 Overview

This Section provides an overview of the main features of the three case study areas:

- North Suffolk and North Norfolk;
- East and North Yorkshire; and
- Isle of Wight and South of England (specifically Dorset and Weymouth).

3.2 North Suffolk and North Norfolk

3.2.1 North Suffolk: Corton

<http://www.suffolkcam.co.uk/corton08032003.htm>

Corton is situated a couple of miles up the coast from Lowestoft and is the last village in Suffolk. It is inundated with visitors in the summer due to an array of holiday parks. The village sits precariously on cliff tops and until recently the future of some homes was in doubt due to coastal erosion but work has recently started putting in new sea defences to try and stop any further erosion.

http://www.bbc.co.uk/suffolk/content/articles/2008/10/03/50_pence_house_feature.shtml

My fifty pence house with a sea view By Guy Campbell

It seems the property crash is affecting some areas worse than others. A woman living at Corton near Lowestoft says her home has dropped in value from £90,000 to just 50p.

And Sandra Hawkins says eventually it will drop even further - right into the sea. Sandra bought her large, lovely home perched on the cliff top in 2005. She was fully aware it was at high risk from the voracious North Sea, but was told defence work would give her at least 20 years of protection. But now coastal engineers say wooden defences near her home are crumbling away and they can't afford to maintain them.

"When I go for walks with my dog I can see where the cliff is collapsing and you see new falls regularly," said Sandra. "The council never has any money to do anything important." Waveney District Council has admitted timber breastwork defences at Corton are falling apart and will now have to be abandoned. New rock defences completed in 2005 at a cost of £3.5 million will also not be replaced when they reach the end of their lifespan in 20 years' time. But nearby homeowners like Sandra believe that lifespan is now hopelessly optimistic without more investment. She thinks erosion is speeding up and says the sea levels appear to be higher as waves routinely break over the rocks, scouring sand from the cliff base.

"My house is 15 feet from the cliff edge. We were told we would be protected for 20 years, but it won't be anywhere near that long with the pace of erosion going on. If they just delivered some more rocks it would help. I think the harbour project at Great Yarmouth is making the problem worse.

"There was a lady near Yarmouth who applied for a mortgage and was told her home was worth a pound, but I think maybe my house is worth less than that, perhaps fifty pence. We spent £90,000 on it. But now with the council saying they can't afford to shore up the crumbling wooden defences at Corton it's probably worth next to nothing."

Case for the defence

With an annual sea defence budget of just £350,000, Waveney District Council says it's having to battle for national funding with coastal communities across the country. It says the rock defences are holding up well, but small areas of cliff erosion as seen beneath Mrs Hawkins' home are to be expected.

The timber work, which protects the cliffs from Corton village to the Broadland Sands Holiday Park, is falling apart and the decision has been taken not to invest any more in its maintenance. A report shows 40 buildings could be lost on the seaward side of Corton Road and The Street by 2055 and, by 2105, a further 60 properties could be claimed by the sea. Ken Sale, the council's Portfolio Holder for the Environment, said: "As politicians all we can do is carry on lobbying the government to get more funding, but you can't just put a concrete wall around the whole of the country."

3.2.2 North Norfolk

Table 3.1 identifies those villages and lengths of coastline that may be at risk of coastal erosion and the timing of that risk.

Table 3.1: Proposed policies from the Kelling Hard to Lowestoft Ness SMP

Village/coast	Proposed SMP policy		
	To 2025	To 2055	To 2105
Kelling Hard to Sheringham	No active intervention	No active intervention	No active intervention
Sheringham	Hold the line	Hold the line	Hold the line
Sheringham to Cromer	No active intervention (maintain defences at East and West Runton)	No active intervention	No active intervention
Cromer	Hold the line	Hold the line	Hold the line
Cromer to Overstrand	No active intervention	No active intervention	No active intervention
Overstrand	Hold the line until defences fail	Managed realignment	Managed realignment

Table 3.1: Proposed policies from the Kelling Hard to Lowestoft Ness SMP

Village/coast	Proposed SMP policy		
	To 2025	To 2055	To 2105
	then managed realignment		
Overstrand to Mundesley	No active intervention	No active intervention	No active intervention
Mundesley	Hold the line	Hold the line	Managed realignment
Mundesley to Bacton Gas Terminal	No active intervention	No active intervention	No active intervention
Bacton Gas Terminal	Hold the line	Hold the line	Managed realignment
Bacton, Walcott and Ostend	Hold the line	Managed realignment	Managed realignment
Ostend to Eccles	No active intervention	No active intervention	No active intervention
Eccles to Winterton Beach Road	Hold the line	Hold the line	Hold the line
Winterton to Scratby	No active intervention	No active intervention	No active intervention
California to Caister-on-Sea	Hold the line	Managed realignment	Managed realignment
Caister-on-Sea	Hold the line	Hold the line	Managed realignment
Great Yarmouth	Hold the line	Hold the line	Hold the line
Gorleston	Hold the line	Hold the line	Hold the line
Gorleston to Hopton	No active intervention	No active intervention	No active intervention
Hopton	Hold the line	No active intervention	No active intervention
Hopton to Corton	No active intervention	No active intervention	No active intervention

Source: Hacrow (2006)

<http://www.thisislondon.co.uk/news/article-23538609-details/Parts+of+Britain's+coastline+will+need+to+be+evacuated+due+to+rising+tides,+Government's+environment+chief+warns/article.do>

Plans to evacuate parts of the crumbling coastline are being drawn up by the Environment Agency, it emerged yesterday (05/10/08). The agency's new head - Lord Smith of Finsbury, the former Labour minister Chris Smith - said stretches of the UK coast would have to be abandoned to the waves in the face of rising sea levels.

In his first interview since taking up his role, he said some coastal areas would be doomed, with an additional threat to low-lying areas from rising sea levels.

Lord Smith, a former Culture Secretary, revealed detailed work was already underway to identify areas of the east and south coasts most vulnerable to erosion. Plans would have to be drawn up to evacuate people from the worst-hit areas.

'This is the most difficult issue we are going to face as an agency,' he said. 'We know the sea is eating away at the coast in quite a number of places, primarily - but not totally exclusively - on the east and south coasts. It's a particularly huge issue in East Anglia, but in quite a number of other areas as well.' While promising to do his 'level best' to fund engineering solutions to the problem, Lord Smith warned that all coastal areas could not be saved.

He said: 'We are almost certainly not going to be able to defend absolutely every bit of coast - it would simply be an impossible task both in financial terms and engineering terms.' The agency, working with ministers, would have to identify 'priority areas' to defend, he said. Lord Smith suggested that parts of north-east Norfolk and Suffolk faced the greatest threat, according to research by the Agency which will be released in 2009. In an interview with *The Independent*, he went on: 'We will publish next year details of the work that's been done, where we think the particular threats are, where we think there is current defence in place.

'We will begin to talk with communities where we think defence is not a viable option.' He also warned that ministers could no longer rely on insurance companies to cover families who lost their homes, suggesting they would have to be rehoused at the taxpayer's expense. His comments will embarrass the government, which in May this year was forced to deny that areas of the Norfolk coastline would be surrendered.

Flooding Minister Phil Woolas said there was 'no question' of abandoning seaside villages from Eccles to Winterton if sea levels rise. The flooding scenario was one of four options examined by the government's environment quango Natural England to tackle climate change. The plans by Natural England stated that sea defences in this area were unsustainable 'beyond the next 20 to 50 years'.

Its proposal to allow the sea to breach about 15 miles of the Norfolk coast, was denounced as 'horrifying' by local campaigners. Six villages, 300 properties, thousands of acres of farmland and a section of the Norfolk Broads would be wiped off the map if the radical proposals got the go-ahead. Campaigners also fear the Suffolk coast between Lowestoft and Felixstowe could fall victim to the Agency's plans within the next few years.

The Environment Agency's latest shoreline data, first drawn up in 1996, revealed this year that sea levels would rise by up to three feet as a result of climate change. Maintenance of sea defences was withdrawn two years ago along some sections of the Norfolk and Suffolk coastline, after it was considered too expensive and fruitless, prompting fury from campaigners. Natural England, set up in 2006, is the government's land management body overseeing the countryside, coasts and urban areas. The Environment Agency implements

government environmental policies in England and Wales through its network of regional offices.

<http://www.happisburgh.org.uk/>

The wooden sea defences built in the late '50s at Happisburgh, North Norfolk have been failing over the last few years, and large chunks of the sandy cliffs are regularly falling into the sea. Changes in Government policy now limit funding for coastal protection, but there is no compensation for any losses suffered.

This website launched in 2002 to support the fight for renewal of Happisburgh's failing sea defences. Since then problems experienced by Happisburgh are now being experienced at more and more locations around this country. CCAG has gained national and international recognition for its work campaigning for proper coastal governance and social justice. It has been contacted by communities from as far afield as Cleveland and Yorkshire in the north to Kent and Hampshire along the south coast.

Set out below are a few of the multitude of reasons why we are fighting to protect Happisburgh:

- Happisburgh is a national asset, historically and architecturally.
- Happisburgh has no less than 18 listed buildings, including the Grade I listed 12th Century church, the lighthouse which is the only working lighthouse in the UK privately run and maintained, and its principal house, Happisburgh Manor (known locally as St. Mary's) recognised as one of England's seminal Arts and Crafts houses.
- Happisburgh has a thriving, unique community.
- Along with all the necessary physical ingredients of a church, village shop and post office, pub and school, Happisburgh has a tangible yet undefinable community spirit. This can be seen from the generations of sons and daughters who volunteer to man the local inshore lifeboat and coastguard team, who fought for an Act of Parliament to allow them to continue to operate the Happisburgh Lighthouse as a private trust, and who are now fighting for the existence of the village itself.
- Happisburgh has contributed to tourism revenue of the region for centuries.
- Throughout recorded history, Happisburgh has attracted visitors and with them their vital contributions to the local economy.
- At the turn of the 18th century, sea bathing was a popular pastime for the upper classes. Happisburgh was on a par with other Norfolk coastal towns such as Sheringham and Cromer. Both Sir Arthur Conan Doyle and Charles Dickens stayed and wrote novels.
- Two of the assets currently at risk to the sea contribute a large portion to the village's tourism - the caravan park, and the tea rooms / guest house.
- Happisburgh is protecting the northern Broads.
- Happisburgh bridges the gap between the hard defences to the south and north - a potential weak link in the chain of measures put in place to protect the low-lying northern Broads from flooding.
- The arguments for restoring 'natural processes' are flawed.

The composition of Happisburgh's cliffs is mostly mud thus the sediment supply from the cliffs at Happisburgh is of very little or no benefit to long shore drift rates of the North Norfolk coast. It is also documented that low lying cliffs are not a good source of sediment

The natural flow of sediment is along a strip, or river approximately 1Km wide from the cliffs out to sea. Protection measures at Happisburgh are unlikely to affect this flow to any degree. Cromer and Sheringham have both been defended since the mid 1800's without any serious sustainability problems. There has been some downdrift effects from sediment starvation but this has been minimal and certainly not sufficient to make a case for the permanent loss of these communities.

The North-east Norfolk coastline can hardly be described as behaving naturally. Natural equilibrium cannot be achieved along a 3km stretch of coast where there is a 4km seawall to the north and an 11km seawall to the south, not to mention the reefs and all the other defences nearby. The story of the village is inseparably linked with the sea. For residents of Happisburgh, and for hundreds who visit each year, the sea represents many different things: a source of livelihood; a place of recreation and fun; a sight to gaze at and wonder over; a worrying, unpredictable, dangerous and potentially destructive power.

Happisburgh has lost land to the sea throughout the centuries. The rate of erosion has been erratic - at times large areas have disappeared overnight, and at others the cliff has remained virtually the same for some years.

Whimpwell was a parish adjoining Happisburgh. The Abbot of St Benets was Lord and patron of the church. Destruction its was very rapid. By 1183 only one field remained. but the name lives on in Whimpwell Street and Whimpwell Green. In 1987, the Yarmouth Sub-Aqua Club discovered a large stone structure partly buried beneath the seabed of Happisburgh. It is L-shaped, 75 yards by 200 yards and at points rises to 40 feet. Could it be a quay heading from the medieval village of Whimpwell?

1845 A twelve-acre field at Happisburgh was drilled with wheat. A north-west gale raged all night, and by new morning the field had disappeared.

1854 White's Directory for this year reported that the sea had encroached 250 yards in the last 70 years at Happisburgh.

1855 Doggett's Farm - the house, a large barn and the premises - were lost to the sea.

1883 The Low Lighthouse was threatened with erosion. It was withdrawn from service and demolished.

1938 The sea broke through at Horsey near the Nelson's Head forming a gap of 100 yards in the dunes. Land from Horsey Church to West Somerton was flooded with salt water to a depth of a foot for months, killing many willow trees and all other vegetation.

1953 On Saturday 31st January, a strong north-wester of over 110 miles an hour caused the worst disaster since the flood in 1287. The sea claimed the lives of 76 Norfolk people flooded thousands of homes. An exceptionally high

evening tide whipped up by the gale was two hours earlier predicted. It surged down the East Coast smashing defences and flooding low-lying land. A bungalow at Happisburgh, which at teatime on Saturday stood 15 feet from the cliff, was hanging over the cliff edge on Sunday morning. By 8.00 p.m. the surge reached Sea Palling and burst through the sand dunes, carrying away four houses, a cafe, a general store and a bakery. Families clung desperately to roof tops until rescued by Stalham Fire Brigade in a commandeered dingy. Twenty or more were saved, but seven died, including a mother and her three children.

1976 During January heavy seas caused considerable erosion on the south cliffs of Happisburgh resulting in two bungalows hanging over the edge of the cliff.

21st February 1993 Ferocious tidal waves again caused considerable erosion along the coastline. At Happisburgh a large portion of the south cliff was swept away causing a bay to be formed and farm land lost.

19th February 1996 During a prolonged gale and snowstorm the defences were breached and another bungalow was perilously close to the cliff top, eventually succumbing to the sea.

March 1999 Encroachment continued, resulting in the destruction of more bungalows and an increasingly large bay. As a result of these latest incursions a village meeting was held to express concern to the local district council. In 2001 a study was conducted to come up with possible solutions.

Preventative Measures over the years.

Many schemes have been tried over the years to prevent erosion:

1802 The Revd. John Hewitt, Perpetual Curate of Wale Vicar of Granchester, spent £100 in an attempt to fill up the breach between Waxham and Horsey. The Hon. Harbord, the first Lord Suffield, lent implements to aid the undertaking. The dunes were levelled to increase width at the base, the seaward side being sloped at such an angle that, it was hoped, waves would roll up and recede harmlessly. Transverse groynes were also erected. Unfortunately, before the work was completed, a spring tide coinciding with a north-west wind broke through the bank.

1803 During the 18th century land between Happisburgh and Great Yarmouth was flooded on numerous occasions, and disputes arose as to whether landlords should be responsible for the protection of their land. In this year the Court of the Commissioners of Sewers determined that No particular persons are bound to sustain or repair the sea walls adjoining their land.

1836 An entry under Happisburgh in White's Directory states 'it is calculated the Church will be engulfed in the ocean before the middle of the ensuing century. In the same year, William Hewitt, MRCS, a relative of the Revd. John and a Stalham surgeon, suggested that breakwaters should be constructed parallel with the cliffs. He believed that these would cause sand to accumulate on the foreshore. He noted that those set at right angles to the cliff caused sand to build up on one side only. His idea was based on observations of the wreck of the Revenue cutter the Hunter. A sandbank had formed between the wreck and the shore, and stretched almost to Walcott. A violent storm shifted the vessel and the bank disappeared. Hewitt also suggested sinking old ships a short

distance from the shore. Some landowners acted upon his advice, but the wrecks became a hazard to shipping and were later removed.

1954 A sea wall was built at Walcott, and a local inhabitant is reported to have said. 'Do you mark my words. Now they've built the wall at Walcott, Hasbro' Church will be in the sea in twenty years. That's the southern end, and wherever they've built they've never been able to stop the sea getting round the southern end of it.'

1958 Early in the year, the 40 foot cliffs at Happisburgh suffered severely from erosion. Falls of cliff were frequent and access to the beach at Town Gap was impossible. No boats could be launched.

1958/59 The first sea defences were built at Happisburgh and were later extended. Steel, greenheart and jarrah wood were used in their construction. The rate of erosion decreased, any loss of land being due mainly to surface water causing falls of cliff.

During the last forty years portions of the revetment have been destroyed, and repairs have been carried out on numerous occasions, but have not succeeded in preventing the formation of a large bay to the south of Happisburgh. To attract grant aid for capital works, stringent Government criteria must be satisfied, which relies heavily on the value of land and property at risk, thus prejudicing the relatively low property value in Norfolk as opposed to for example the South Coast of England. The Government's declared present policy is to maintain a sustainable coastline.

3.3 East and North Yorkshire

3.3.1 East Yorkshire (Holderness)

3. Holderness Coast

http://cgz.e2bn.net/e2bn/leas/c99/schools/cgz/accounts/staff/rchambers/GeoBytes/GCSE%20Revision/Unit%201/Coasts/Coastal%20Case%20Study/case_study_of_coastal_erosion_Humberside.htm

The Holderness Coast is on the NE coast of the UK, facing the North Sea. The coastline is mainly made up of cliffs (20-30m high), consisting of soft, easily eroded boulder clay. Where the cliff line meets the Humber Estuary, a spit has formed due to the change in the direction of the coastline - Spurn Head.

The cliff line is retreating at an alarming rate - greater than 1m / yr (fastest rate in Europe) - 4km of land have been lost since Roman Times, including many villages and farm buildings. Easington Gas Station (a North Sea Gas terminal) is situated on the cliffs top and its position is under threat.

Why is Cliff Erosion such a problem here?

1. The cliffs are made up of soft glacial material (Boulder Clay - made up of sands and gravels). This is easily eroded by the waves and the cliffs are easily undermined.
2. The Holderness Coast is very exposed, approaching waves have a long fetch over the North Sea.
3. The waves are mainly destructive - eroding the base of the cliffs (hydraulic action etc.)
4. Most of the Material eroded from the cliffs is washed out to sea, the rest is moved by long shore drift - the beaches are therefore narrow and do little to protect the coastline. (If the beaches were wider, the waves would break on the beaches reducing their erosive power).
5. The coastline is threatened further by sea-level rise.

Attempts at Coastal Management along the Holderness Coast include:

- use of groynes to trap moving beach material and provide a protective beach in front of the cliff
- the construction of sea walls and revetments as wave-resistant structures at the base of the cliffs
- artificial off-shore breakwaters like tyres and concrete blocks, forcing waves to break off-shore.
- sea wall used to protect Easington Gas Station (cost £4.5 million)

Due to extensive costs - only the most valuable areas of land are protected. Much of the area is farmland which is not protected.

Example of the impacts of Coastal Management: Mableton -

The village of Mableton is greatly under threat by coastal erosion along the coastline and by 1998, the main road running through the village was only 500m from the cliff top and in places it is now only 50m. The village is under threat due to the easily eroded boulder clay (glacial till) which makes up the cliff line. The area suffers from erosion rates of up to 2m per year.

Protecting Mableton

To reduce the amount of erosion threatening Mableton, two rock groynes were constructed in 1991 to encourage the build up of beach in front of Mableton by trapping longshore drift. This meant that that waves would break on the beach rather than attacking the cliffs.

Problems for further down coast

Those living south of Mableton village have experienced the 'knock-on' effects of the coastal management. The groynes at Mableton have disturbed the natural longshore drift movement, trapping the coastal material. Therefore whilst material is still being moved south of Mableton, there is no fresh sediment to replace it. Beaches have become even narrower and the cliffs are unprotected. Estimates suggest that it has accelerated cliff erosion south of Mableton to 10m / yr.

<http://www.fortunecity.com/greenfield/ecolodge/25/erosion.htm>

The coastline of Holderness is eroding at around 2m per year. The erosion occurs mainly during storms and tidal surges and a loss of 6m was recorded over two days at Barmston in October 1967. It is estimated that about 76,450,00 cubic metres of material have been lost from the Holderness coast in 100 years (Valentin, 1954). Only 3% of this material is deposited at Spurn Point, the remainder is deposited in deeper water offshore or is carried across the mouth of the Humber to be deposited within the estuary itself or on the North Lincolnshire coast. Erosion increases as one moves southward.

The town of Bridlington at the northern extreme is protected by Flamborough Head to the north and the Smithic Sandbank which lies just offshore; this sandbank is 10 km long and at spring low water rises 2.7m from the sea. South of this the 5 and 10 fathom (approx 10 and 20 meters) submarine contours lie close to the shore and there is no shelter from the maximum fetch across the north sea from the north east.

The cliffs are made up of loosely consolidated glacial till but there is no relationship between rates of erosion and type of till, nor with the height of the cliff.

There are several factors resulting in the Holderness coast suffering such rapid erosion. The first is that the Holderness plain is a former bay in filled with easily eroded glacial tills. Waves undercutting the cliff produce slumping type landslips and the debris from these is easily swept away by the sea. A paleo-cliff runs from Sewerby on the south side of Flamborough Head to Hessle in the south and the sea is rapidly, in geological terms, cutting back to this pre-glacial shoreline.

R.G. Allinson-Winn (1904) showed that deep sea erosion was occurring as well as cliff line erosion since the deep water has advanced over the sites of former cliff line villages. The submarine contours drop off rapidly offshore, at Dimlington High land in the south the 10m submarine contour is only 600m from the beach. The coast is thus subject to the full force of the waves from the north sea with little attenuation before they reach the cliffline.

The chalk headland of Flamborough Head prevents transport of materials from the north by the dominant north easterly waves. The resistant upper chalk, with very little flint produces a beach of rounded pebbles at Sewerby. These are easily destroyed by mechanical and solutinal action and decrease very rapidly in quantity southward.

The result that little beach material is transported southward to the beaches of Holderness. The sea attempts to build up an equilibrium gradient by eroding the soft cliffs behind the beach, to which the strong waves have easy access.

<http://www.geography.learnontheinternet.co.uk/topics/holdernesscoast.html>

The Holderness Coast is one of Europe's fastest eroding coastlines. The average annual rate of erosion is around 2 metres per year. This is around 2 million tonnes of material every year. Under lying the Holderness Coast is

bedrock made up of Cretaceous Chalk. However, in most places this is covered by glacial till deposited over 18,000 years ago. It is this soft boulder clay that is being rapidly eroded.

The Holderness Coast is a great case study to use when examining coastal processes and the features associated with them. The area contains 'text book' examples of coastal erosion and deposition. The exposed chalk of Flamborough provides examples of erosion, features such as caves, arches and stacks. The soft boulder clay underlying Hornsea provides clear evidence of the erosional power of the sea. Mablethorpe is an excellent case study of an attempt at coastal management.

Spurn Point provides evidence of longshore drift on the Holderness Coast. It is an excellent example of a spit. Around 3% of the material eroded from the Holderness Coast is deposited here each year.

<http://www.herb.hull.ac.uk/Erosion/index.htm>

The coastline of Holderness, East Yorkshire, is one of the fastest eroding in the world. The soft boulder clay cliffs, left after the retreat of the Devensian ice sheets about 12 000 years ago, are rapidly being eaten away by the sea. This web site brings together data collected by the Ordnance Survey of Great Britain almost 150 years ago with the most recent aerial photographs, courtesy of Getmapping plc. By examining this data-set it is possible to calculate the rate at which the cliffs are receding and how effective the sea defences have been at combating this loss.

RPA and Terry Oakes Associates, Review of MAFF's Cost-Benefit Methodology, 2001

Holderness Coast Case Study

- South of Bridlington to Spurn Head. This is a rural area with few permanent residents (i.e. many visiting tourists).
- Coastline is characterised by severely eroding cliffs, with hard points along the coast (such as the town of Hornsea).
- The overall policy for the coast in the SMP of 1998 was "Hold the line where current defences are in place and do-nothing on undefended frontages." The East Riding of Yorkshire Council felt unable to adopt the SMP given the implications of this policy.
- Increasing the number of defended frontages may decrease sediment movement into the Humber estuary.
- In the very long-term, if the protected frontages are maintained, the coastline can be expected to re-align into a series of stable bays.
- This coastline is key to the tourist industry and much of this is "beach-based" so sediment input must be maintained.
- If protection of assets from erosion is not justified, then a do-nothing approach is adopted.
- There will be objections to every scheme until sediment transport is fully understood, and it is hard to achieve the required level of benefits given the nature of the coastline.
- The cliffs are currently eroding, on average, 2m yr^{-1} (increasing to around 4m in some places). This is affecting commercial and residential

properties and caravan sites, which may not have enough room for roll-back.

- There are possible severe effects to people's health due to stress and uncertainty and the knowledge that they will receive no compensation.
- Low house prices in Yorkshire and Humberside mean that cost/benefit ratios tend not to favour saving houses in this area.
- Do-nothing on unprotected frontages may be a benefit as it maximises the recreational potential of the area.
- This report makes the suggestion that the value of tourism and sense of community ought to be taken into account in a case like this.

This case study shows that there is far too much emphasis on environmental sustainability at the expense of social and economic sustainability.

3.3.2 North Yorkshire

1. Robin Hood's Bay

May (2007)

The cliffs mainly comprise till resting on the Lias and are subject locally to considerable mass-movement and rapid cliff-retreat.

From calculations for four points around the bay, Agar (1960) estimated that the coastal retreat rate varied from a maximum of 0.305 m a^{-1} to a minimum of 0.046 m a^{-1} . Here, as elsewhere along the north Yorkshire coast, bays were retreating more rapidly than headlands (Table 4.3). In addition, there was a considerable difference between the rates of retreat of the till and the Lower Liassic strata at the cliff foot.

He regarded present-day conditions as 'optimal', i.e. the sea breaking on the gradually sloping foreshore and attacking the vertical face of the cliffs at high tide to develop a cliff-foot notch. Erosion rates could thus be interpreted as being maxima. Agar argued that a slightly lower sea level would result in the action of the waves being concentrated on the platform and having a much less important role in coastline retreat. A higher sea level would similarly have only a limited effect because waves would be reflected from the vertical cliffs. He argued that most of the local erosion has occurred only during the last six centuries.

Robinson identified five erosion processes here:

1. Micro-quarrying;
2. The expansion and contraction of clay mineral lattices by hydration and desiccation. He estimated that processes 1 and 2 together lowered the platform by 0.144 cm a^{-1} ;
3. Wave-quarrying, by which removal of small blocks from the cliff foot lowered the platform surface by 2.3 cm a^{-1} ;
4. Corrasion: direct abrasion of the in-situ rock by wave-transported sediment lowered surfaces by $5.79 \times 10^{-3} \text{ cm tide}^{-1}$;
5. Wedging, in which small sediment particles forced into cracks in bedrock gradually force it apart. This lowered surfaces by $11.05 \times 10^{-3} \text{ cm tide}^{-1}$.

Robinson (1974) showed that erosion was more rapid when a thin beach was present, but seasonal variations in wave action also affect the efficiency of erosion of the ramp.

<http://www.northyorkmoorsholidays.com/visit/robin-hood-s-bay/>

Due to steady erosion by the unforgiving sea, two hundred cottages have been lost in as many years and many are still under threat.

<http://hansard.millbanksystems.com/commons/1923/apr/17/coast-erosion-robin-hoods-bay>

This is from a commons sitting in 1923. It concerns the Board of Trade being asked about the removal of sand and shingle from the Bay.

Viscount WOLMER: Reports were recently received from the Board's local officers that the removal of materials from the foreshore below high water mark in Robin Hood's Bay was likely to cause erosion of the coast. As the foreshore is Crown property under the management of the Board of Trade, whose consent was therefore necessary to the removals, the notices to which my hon. and gallant Friend refers were issued. In view of the representations made, I propose to instruct one of my professional officers to inspect the locality at an early date, confer with the local interests concerned, and make, a report to me on the subject.

Mr. R. RICHARDSON: Is the Noble Lord aware of the great amount of coast erosion that has taken place, because of the removal of sand and shingle from the beach?

Viscount WOLMER: It is for that reason that the Board of Trade has to be very careful in the matter.

http://www.yorkshiremoors.co.uk/gazetteer/robin_hoods_bay.html

Like many villages on the east coast, Robin Hood's Bay has been greatly threatened by erosion, and a number of buildings lost to the sea – even the original main street had gone, swept away in 1780. At the moment that erosion is being held back by a modern sea wall, which also provides an alternative route between the harbour and the cliff top.

http://findarticles.com/p/articles/mi_hb5243/is_200003/ai_n20073576

Morley announces £3.3 million grant for coastal defences at Robin Hood's Bay and Whitby. A grant of some £3.3 million - for coastal defences at Robin Hood's Bay and the Haggerlythe, Whitby has been awarded by the Ministry of Agriculture, Fisheries and Food. The grant will contribute to works jointly costing £4.6 million and being promoted by Scarborough Borough Council. The works primarily involve the provision of rock armour revetments and slope stabilisation measures.

http://books.google.co.uk/books?id=UOZS6Asg8K0C&pg=PA61&lpg=PA61&dq=robin+hood's+bay+coastal+defences&source=web&ots=mOPqcNA_6b&sig=ZEaj6G1ybl9vC0nhWBEzDAB5DFg&hl=en&sa=X&oi=book_result&resnum=9&ct=result

The old properties next to the shore...are protected by a small concrete wall, apron and ramp. The massive, unattractive concrete retaining wall behind and to the right was built in 1975 to prevent further cliff collapses and housing losses above the unstable tall cliffs composed of shales and sandstones with a capping of boulder clay.

http://news.bbc.co.uk/1/hi/england/north_yorkshire/5167896.stm

Large stretches of the North Yorkshire coast will be left at the mercy of the elements under sea defence plans for the next 100 years, it has emerged. The Shoreline Management Plan covering the coast from Staithes to Flamborough Head predicts "a substantial loss of land" because of erosion. It acknowledges properties will be lost but says "action to defend them would be difficult to justify economically". A public meeting to discuss the plan is being held in Scarborough on Tuesday.

Other meetings will be held at the Evron Centre in Filey on Wednesday morning and Whitby's Pavilion Complex on Wednesday afternoon. The plan has been drawn up by officials from local councils, led by Scarborough Borough Council, and representatives of other bodies including the Environment Agency, English Nature and the North York Moors National Park. In places like Whitby, Scarborough and Filey, the policy will be to maintain the existing coastline by shoring up defences. However, in places like Staithes and Robin Hood's Bay some properties are likely to be allowed to fall into the sea because it would cost too much to protect them.

The report predicts "a significant area of loss to some of the more mobile or softer commercial activities of the area" - such as farmland along much of the coastline, golf courses at Seaton Carew, Whitby and Filey, and caravan parks at Coatham, south of Whitby, and at Filey. Similarly, nothing would be done to protect properties at Flat Cliff, a small community on the coast a couple of miles south of Filey. It says at Sandsend, north of Whitby, an alternative route should be found for the road which currently runs along the coast.

The document says: "Within 100 years the plan acknowledges a substantial loss of coastal land currently supporting agriculture, recreation and leisure activities. "The challenge in managing such frontages will be to examine the balance between natural, technical and economic considerations. There is a presumption against active intervention over the majority of the length of coastline. It is important, therefore, that monitoring is put in place, or continued, so as to work with owners in providing best advice as to when change is occurring."

2. Knipe Point

<http://www.whitbygazette.co.uk/wg-television/Homes-on-edge.3942807.jp>

April 2008 - a landslide occurred putting several houses in danger which had to be evacuated. Not thought to be coastal erosion related which affects the insurance.

The National Trust is working together with Scarborough Borough Council for ground investigation.

Landslide believed to be due to drainage issues rather than coastal erosion.

3.4 Isle of Wight and South of England (Weymouth)

3.4.1 Isle of Wight

9. Isle of Wight

The SMP policies for the Isle of Wight are taken from Halcrow (1997) and relate to management units around Ventnor and Bembridge:

- Pier Road, Seaview to Horestone Point (Ryd 8): southern extremity is subject to rotational failure which has been artificially stabilised. Policy is to hold the line;
- Horestone Point to St Helens Tower (Ryd 9): undeveloped coastal strip with evidence of historical failure. Policy is to retreat the line with potential impacts on a holiday camp;
- The Duver, St Helens (Ryd 10): agricultural land, limited properties and some recreational infrastructure south to Bembridge Harbour. Policy is to hold the line;
- Bembridge Harbour (Ryd 11): amenity harbour with extensive intertidal mudflats. Policy is to hold the line;
- Bembridge Point to Foreland Fields (Ryd 12): residential village of Bembridge. Policy is to hold the line;
- Foreland Fields to Culver Cliff (Ryd 13): mainly agricultural land with some set back areas of Bembridge. Policy is do-nothing (continuation of current practice);
- Culver Cliff (San 1): predominantly agricultural and undeveloped land. Policy is do-nothing;
- Culver Cliff to Yaverland (San 2): predominantly agricultural and undeveloped land. Policy is do-nothing;
- Yaverland (San 3): village is set back and fronted by agricultural land and a car park. Policy is hold the line;
- Sandown Zoo to Fort Street, Sandown (San 4): mainly low lying area at risk of flooding. Policy is to hold the line;
- Fort Street, Sandown to Ferncliff Road, Sandown (San 5): low lying densely developed residential frontage. Policy is to hold the line;
- Ferndown Street, Sandown to Hope Beach (San 6): developed to cliff edge with residential and commercial areas. Policy is to hold the line;

- Hope Beach to Shanklin Chine (San 7): reclaimed area at cliff foot with residential property and tourist amenities. Policy is to hold the line;
- Shanklin Chine to Horse Ledge (San 8): development along cliff which is exposed to limited erosion causing instability. Policy is to hold the line;
- Horse Ledge to Monks Bay (Ven 1): development on debris of massive landslides with instability triggered on slopes where the toes have been eroded by coastal erosion. Policy is to retreat the existing line to help limit losses of property;
- Monks Bay to Steephill Cove (Ven 2): All development is on the landslide complex. Policy is to hold the line;
- Steephill Cove to East of Binnel Bay (Ven 3): Village of St Lawrence developed on landslide complex. Policy is to retreat the existing line to help maintain stability and minimise impacts on properties;
- East of Binnel Bay to Puckaster Point (Ven 4): Wooded and undeveloped cliffs that are more stable. Policy is to retreat the existing line;
- Puckaster Point to West of Castlehaven (Ven 5): sparsely developed along cliff edge, most of village is set back. Cliffs within the Bay are unstable. Policy is to hold the line;
- West of Castlehaven to St Catherines (Ven 6): National Trust land, mainly agricultural. Policy is do-nothing.

Isle of Wight SMP under construction, due to be published in 2009.

<http://www.isleofwightattractions.co.uk/Erosion.htm>

The Isle of Wight has had a battle with losing land every year as far back as Victorian times and possibly before. The amount of land the Island loses varies between 1 - 3m a year in some places, thankfully not all areas of the Islands coast is affected by this problem. Erosion is a gradual problem and is quite easily slowed down or stopped, unlike landslips which are more responsible for land lost.

Shoring up of the sides of the coast are very common in Lake, Sandown, and Shanklin. Sea resistant wood is used with long bolts fixed deep into the adjacent sound rock, wire netting is also used where the edge is very crumbly.

The Undercliff of the Isle of Wight: A Review of Ground Behaviour, Rendel Geotechnics

- Ventnor and St. Lawrence lie within an ancient landslide complex called the Undercliff – ground movement has been recognised as a problem for 200 years.
- Landslide and land instability problems.
- 1960 – Cliff falls etc. following very heavy autumn rain.
- South Wight Borough Council have a landslide management strategy involving ground movement monitoring.
- Parts of the land are rising, others are falling.
- Costs over the last 50 years: demolition of unsafe properties, construction and maintenance of coastal protection schemes, road maintenance costs and disruption to services, compensation for damages in 1960 and 1993, and insurance claims.

- St Catherine's is further west than Niton but appears from the map on P.31 to still be a part of the Undercliff and to have experienced landslides related to it.
- Coastal erosion has long been appreciated to be a major factor in the long-term instability of the Undercliff. Most of the urban frontage of the Undercliff has been protected by coastal defences and it is unlikely, therefore, that marine erosion remains a significant cause of slope instability. However, the coastal sections from Monks Bay to Shanklin and west of Steephill Cove remain unprotected and unchecked marine erosion (estimated to result in an average retreat of the coast by around 0.3m per year) is likely to act as a major de-stabilising influence on the largely undeveloped landslides in these areas. Coastal erosion has progressively reduced the overall stability of the slopes, and together with other factors, such as periods of heavy rainfall, has promoted landslide activity.
- Rainfall events may trigger landslides in areas that have been prepared for failure by coastal erosion or human activity.
- Development has acted as a destabilising influence in parts of Ventnor. The removal of Collin's Point in Ventnor Bay during the construction of an artificial harbour in the 1860s caused beach depletion, rapid coastal erosion and an increase in reported landslide activity in the 1870s.
- Properties have been affected by a range of ground movements, including heave, subsidence, settlement, rotation and tilting.
- What is happening about it? Monitoring ground movement, raising professional and public awareness, preventing unsuitable development, and improving ground conditions.

Landslides, Glissements de terrain, Bell (1992):

Protection of the toe of the Ventnor Landslip from marine erosion is of course of prime importance and to its credit the Council has recognised the need for this and made a substantial budget provision. Removal of rocks from the foreshore to construct the ill-fated Ventnor Harbour in 1863 had a devastating effect on Ventnor Bay through accelerated erosion at that time. This was a reminder of the need for proper foreshore management as well as coastal protection.

Severe landslippage within cliffs of the Carstone series at Monks Bay, Bonchurch as a result of winter/spring storms in 1990 presented a hazard to adjacent properties as well as significant land loss. A £1.3 million scheme for this 0.4km frontage has now been prepared with work to be commenced before winter 1991. This will involve the construction of a substantial rock breakwater parallel with the coast at low water mark protecting a tombolo-shaped artificially nourished beach. Existing groynes will be given added protection with rock haunching. The Gault clay, which overlies the Carstone and forms the coastal slope, will require cliff reprofiling and counterfort drainage.

The other remaining unprotected frontage along the Ventnor Undercliff is the Western Cliffs immediately to the west of the Ventnor Esplanade. Here also, rapid undercutting of the 25-30m high cliffs of reconsolidated chalk and Greensand landslide debris has taken place. Uncontrolled erosion could result in the loss of amenity land, the coastal footpath, and a car park, but more

important have a destabilising effect on the land behind which is heavily developed with residential properties. A £1.2 million rock protection scheme is scheduled for completion during the coming winter.

<http://www.scopac.org.uk/>

Developing Shoreline Management Plans (Round Two)

The purpose of a Shoreline Management Plan (SMP) is to provide a large-scale assessment of the risks associated with coastal processes and to present a policy framework to reduce these risks to people and the developed, historic and natural environment in a sustainable way. It determines the natural forces that are sculpting the shoreline and predicts, so far as it is possible, the way in which it will be shaped into the future.

The plan then goes on to identify the main issues of concern relating to erosion and flooding, the management of these natural processes and identification of coastal assets that may be affected by the flood risk or the management practices. Details of these assets will be obtained from those with an interest in the coast, residents, businesses or those with a concern for natural or built heritage. All the issues are then considered together to determine the coastal defence policies for the next one hundred years. These policies should then be applied to allow society's objectives to be achieved in full acknowledgement of the potential impact of the coastal defence works on the natural environment and the likely environmental, financial and social costs involved.

The management of the SCOPAC coastline

The coastline is undergoing constant change from the effects of waves and tidal currents. The amount of physical change that results generally depends on the degree of exposure of each length of coast and the predominant geology. These change processes have usually taken place over long historical periods and many examples exist where settlements have been lost through erosion or where former coastal villages are now landlocked because of coastal build up.

Another influence on the development of the coastline has been the human intervention throughout the ages, particularly in attempts to arrest the effect of erosion or flooding at particular locations. In many cases this has taken place without any acknowledgement of the effect these works have on other locations up and down the coast.

In order to combat the often adverse effects that the ad hoc coastal management practices were having on neighbouring shorelines, MAFF (now Defra) commissioned research to determine a more appropriate approach to implementing flood and coastal defence. This research suggested that the coastline could be divided into major sediment cells. A sediment cell is a length of coastline that is relatively self-contained, as far as the movement of sand and shingle is concerned, and where interruptions to such movements should not have a significant effect on adjacent sediment cells. The boundaries of the sediment cells generally coincide with the mouths of major estuaries or prominent coastal headlands.

To provide a more co-ordinated response to coastal erosion and flooding, 'Regional Coastal Groups' comprised of local authorities, the Environment Agency, Natural England and other organisations with a direct role in shoreline management were set up. These Groups are arranged around the natural coastal sediment cells rather than administrative boundaries, which encourages a more strategic approach to coastal defence management based on natural coastal processes. Coastal Groups help to co-ordinate the preparation of Shoreline Management Plans and coastal defence strategies, provide a link with central government policy-makers through the national Coastal Defence Forum, as well as helping commission and disseminate strategic research.

http://www.iwight.com/living_here/planning/images/UndercliffHEAPDraft.pdf

Ground instability and erosion is a major force for change in this area. Erosion has led to the closure of paths, including the coastal path from St Lawrence to Niton and the Cripple Path leading up the inner cliff near Niton. There is a specific threat to the Undercliff Drive (A3055) from ground instability. This has led to the construction of a new section of road to the east of Niton which has altered the character of the Undercliff Drive to some extent. A much larger proposed realignment scheme has now been abandoned. This will have implications for future communications within The Undercliff but offers the possibility of turning the Undercliff into a 'green lane' that will be attractive to pedestrian visitors.

3.4.2 Dorset

10. Dorset Coast e.g. Lyme Regis

<http://www.dacda.org.uk/1-3coastalform/3detailed.html>

The combined effects of tides, currents and waves as well as the sub-aerial effects of weathering and erosion working on the different rocks and structures along the Dorset coast have produced a complex and intricate coastline. This is well illustrated by the earliest charts (for example Lieutenant Mackenzie's 1787 chart of the coast and seabed between St Alban's Head and Abbotsbury). The changes in the bays and headlands reflect the strength of the rocks which occur at the coast.

Cliff and platform erosion take place as a result of:

- marine processes, (direct hydraulic impact on the materials, abrasion by sand and gravels carried by the waves, and solution),
- biological processes (by boring organisms which carve burrows in the platforms and weaken the rocks, burrowing animals on the cliffs, and the effects of plants in the soil and subsoil of the coastal slopes) and
- sub-aerial processes (weathering by freezing and thawing, wetting and drying, by the impact of wind and rain, by gullyng and by landsliding in all its many forms).

Some cliffs collapse as large rock falls affect the whole or part of the cliff face. Others particularly in the weaker sands and clays in the eastern part of the county are affected by gullyng and small surface slides of sand or clay. The effects of the sea upon the detailed structures of the coast are especially well

illustrated at Ballard Down (see the photograph of Old Harry). Here, well-developed stacks, arches and caves have formed where joints and faults cross the headland at Handfast Point. As the Chalk dips northwards, harder bands dip below sea level and weaker materials form more and more of the base of the cliffs. The harder pedestal band provides greater strength at the base of rock columns and channels water through the joints. The sea opens up well-developed, near-vertical joints at the foot of the cliffs, and small blocks in the upper parts of the cliffs fail because of very close jointing in the upper part of the cliffs. The joints are harder than the surrounding bedrock, but individual blocks within the joints are vertical and are more likely to drop out than the horizontal and better-supported blocks that surround them. The stacks are a result of the narrowing of the headland, erosion along the larger joints and the relative resistance of a pedestal band to erosion.

As the cliffs retreat, sediment is supplied to the beaches, although the clay cliffs contribute little as the small sized material was carried in suspension by currents along and offshore. In harder rocks, a platform is often formed, its width depending on the slope of the strata. At Kimmeridge for example, the platforms are mainly structural, i.e. their surfaces are formed by the upper surfaces of strata dipping gently seawards. In contrast, the very hard and steeply dipping Portland Stone has very narrow benches along the Purbeck coast but wider ones on the south side of Portland where the dip is much gentler. The cliffed coasts may form steep vertical cliffs such as those in the Portland Stone or much of the Chalk. In contrast, in the clays of the Kimmeridge and the Lias, there are extensive landslides. Although the sea removes both bedrock and debris from these cliffs, the most active landslides depend upon the effects of groundwater on their strength. Both physical and chemical changes within the clays make them less resistant to the forces from overlying rock and rainfall accumulating within the rock.

It is also possible to judge the changes that have taken place at the resorts from the contrasts between the old photographs and prints and present-day photographs. The mainly sandy cliffs fed the beaches and there were beaches wide enough for bathing machines. However, as the resort grew the construction of promenades cut off the supply of sand from the eroding cliffs and Bournemouth, like many other resorts began the fight to retain its beaches. In the early 20th century the Bournemouth cliffs provided about 115 000 cubic metres annually (of which 80% was coarse enough to stay on the beaches). By the mid 1980s, this had fallen to only 4000 cubic metres per year, mostly from the cliffs between Solent Road and Hengistbury Head. More rapid erosion in the 1990s may have raised this to about 12 000 cubic metres per year (of which 55% may stay on the beaches). Given this reduction, it is not surprising that the coastal towns have taken such extensive steps to maintain their beaches.

*<http://www.dceda.org.uk/3-1impacts/3detailed.html>
Vincent May*

Along the Dorset coast, evidence of coastal change is found on maps, aerial photographs and eye-witness accounts. Frequently, historical records report the loss of land or property or the problems of flooding by the sea, but until the

late nineteenth and early twentieth century there are few measurements of coastal change. Landslides were places to avoid or to dump quarry waste or were regarded as natural (or even supernatural) phenomena. Landslides are usually recorded best where property was damaged. Although landslides occurred east of Weymouth, there are many fewer descriptions of them than of landslides in west Dorset and east Devon probably because many appeared inactive and affected few properties.

However, with the growth from the mid-nineteenth century of the resort and cliff-top settlements at Swanage, Bournemouth, Southbourne and Highcliffe, cliff retreat and active landsliding became a problem. Construction of sea walls (or promenades) cut off the supply of sand from the retreating cliffs and beaches began to diminish. The new resort of Southbourne-on-Sea was built and destroyed within 30 years. In contrast, Lyme Regis continues to rest on an active and extensive landslide.

The Royal Commission on Coast Erosion and Afforestation reported in its Final Report (1911) that, although in Dorset and Hampshire there had been a net gain of land from the foreshore, there had been a net loss of foreshore to the sea. Put another way the foreshore was becoming steeper. Although later writers all comment on the Royal Commission's conclusion that "far more land has been gained by accretion and artificial reclamation in recent years than has been lost by erosion" (Final Report : Vol. III, 79), the potential problem of the steepening foreshore is not recognised until the 1970s (May 1973; Bird and May 1976). The problem of increasing loss of beaches was missed by coastal engineers and, even after the 1953 North Sea floods, it was also ignored, especially as the effects of storm surges were emphasised.

Table 1: Extract from the Royal Commission on Coast Erosion Final Report

Dates of survey	Original survey 1856-1870 Revision 1895-1897	Original survey 1862-1888 Revision 1900-1902
County	Hampshire	Dorset
Loss of land to foreshore (acres)	198	35
Gain of land from foreshore (acres)	852	52
Net change(acres)	+ 654	+17
Loss of foreshore to sea (acres)	738	394
Gain of foreshore from sea (acres)	281	109
Net change (acres)	- 457	-285

The Minutes of the Royal Commission record that considerable concern was expressed about the effects of removal of shingle from the beaches in West Dorset and the loss of land at Highcliffe in the East. During the same period as the surveys carried by the Ordnance Survey for the Commission, only one Dorset local authority (Swanage) had a loan (£4600) sanctioned by the Local

Government Board for coastal works. The Ordnance Survey had, however, identified erosion at Portland and Weymouth and throughout the cliffs between Christchurch Bay and Poole Harbour. Nevertheless, development accelerated on the cliffs between Canford Cliffs and Southbourne.

Today Shoreline Management Plans for the Dorset coast provide detailed summaries of the protective structures and the forms and processes along this coast. Current observations of coastal change east from Portland Bill are on the Channel Coast Observatory site (<http://www.channelcoast.org>). May and Hansom (2003) summarise the coastal geomorphology for much of the coast west of Poole Harbour.

http://www.channelcoast.org/southwest/programme_aims/
Programme Aims

"A strategic regional coastal monitoring programme for the southwest of England, to provide freely available data of consistently high quality to inform coastal management and future strategy".

The maritime Local Authorities, Coastal Groups of the southwest of England and the Environment Agency (South West Region) are working with a collective vision, to develop a long-term, region wide coastal process monitoring and analysis programme.

Following many years of ad-hoc monitoring of coastal processes within the southwest, an extensive integrated survey programme was developed to cover approx. 1000km of open coastline and estuaries between Portland Bill, and Sand Point, Somerset. The programme is expected to cost approx £7.2m over a period of five years, but with an expectation that the programme will continue indefinitely. It is 100% grant aided by DEFRA. Funding commenced in April 2006. The programme has been designed in a very similar format to that formulated for the South East Strategic Regional Coastal Monitoring Programme. Data are collected via a series of contracts which were awarded in late 2006/early 2007.

Large quantities of data will be made freely available from the survey and analysis programme; this is expected to be useful to Local Authorities within the region, the Environment Agency, consultants in coastal defence, conservation management, academic research and for educational purposes.

A specialist team has been established at the Plymouth Coastal Observatory to manage the programme and develop the data analysis, storage and dissemination procedures. All data collected by the Programme and analysis reports will be made available via this website, which also acts as the data storage facility for the Southeast coastal monitoring programme.

Plymouth Coastal Observatory has been set up at University of Plymouth with the aim of establishing strong links with research communities in the southwest, to provide opportunities for value added research programmes.

<http://www.dorsetforyou.com/index.jsp?articleid=2068>

This stretch of coastline has been described as one of the most rapidly eroding coasts in the world. Not surprisingly it presents a huge challenge to the engineers to protect West Bay and area from flooding and coastal erosion. Cliff failure and recession at West Bay are due to mass movement, such as slipping, slumping (in the clays) and rock falls (of sandstone) caused by both coastal and non-marine weathering and erosion processes.

East Cliff sea erosion processes such as wave pounding, hydraulic action, abrasion and attrition, are clearly at work here. The base of the East Cliff is naturally protected by its deep shingle beach, and the man-made shingle ridge, built up by the Environment Agency for flood prevention.

A wave-cut platform is in evidence when not covered by shingle, and reveals the recession of the cliff. Clearly the effects of rain wind and spray are also very erosive and have created gullies in the Bridport Sands. Vertical fissures and joints in the cliffs have been picked out and eroded by wave pounding, hydraulic action abrasion and corrosion, which weaken the cliff structure. After many years of slow weathering, the harder calcite-cemented bands project and show honeycomb weathering. It is chemical weathering which gives the exposed cliff face its orangey colour (limonite) as fine-grained pyrite is oxidised. When rock falls occur the newly exposed cliff face is much flatter and blocks of fallen and shattered rocks are found at the cliff foot. There have been incidents of people narrowly escaping such rock falls as they sat on the beach and warning signs are in place (and often ignored by visitors).

East Beach

This is in fact the most westerly end of the Chesil Bank. In 1986 a sea defence bank of shingle was constructed to a height of 7.5m AOD. The bank is highly mobile and provides varying degrees of protection dependant on its width. The Environment Agency is responsible for maintaining this and uses shingle from Burton Bradstock to re-profile the beach.

In recent years there has been a major loss of material from this beach with a consequent increase in flood risk. Serious flooding occurred in 1990. Periodic beach overtopping has enforced the need to build up the shingle ridge and replenish it to create a stronger flood barrier, especially for the cottages on the beach itself. Unlike the West Beach, there has been no hard engineering approach to the East beach, as it's an SSSI.

West Cliff

A comparison of old and recent photos of West Cliff gives a fascinating insight into the extent of coastal erosion over the years. The West Cliff sea wall and rock armour have effectively protected the foot of the cliff from recession since 1969, but by 2000 this defence was already under threat itself due to construction failure. The recession of the West Cliff is not only a result of coastal erosion processes; West Cliff appears to have been affected by landslips over a long time and the photographic and map evidence show several properties on the cliff top that are now protected by stabilisation work.

Mass movement within the cliff's Frome Clays is caused when slipping and slumping occur, as the wet clays slide over the underlying rocks. It seems likely that the presence of the faults has weakened the overall structure of the Frome Clay, and that the flow of ground water within the fault zone will have increased its instability. The cliff was regraded in 1969 when the construction of the new sea wall and esplanade took place. Despite this and further remedial action, there has been a series of slips. Engineering attempts to stabilise the cliff in the 1990s included the insertion of drainage pipes and the use of gabions (heavy wire mesh boxes filled with stone). The coastal footpath was upgraded at this time too.

West Beach

This is a narrow sand and shingle beach which is backed by a sea wall, originally built in 1887 and replaced in 1982. The West Beach has been steadily reducing in width and height over the years. It has suffered from lack of natural replenishment from the east, ever since the piers were constructed in 1740. Also the westerly sediment drifts have been limited by landfalls on the beaches west of West Bay, notably at Golden Cap, effectively cutting off the sediment supply from the Charmouth end. Additionally the beach has lowered by 2.5m since the construction of the additional sea wall at the western end in 1969. This wall has itself been eroded by wave attack, especially attrition of its limestone cladding in storms, and corrosion of the steel pile toe and will need attention.

In order to maintain its value as an amenity for holidaymakers it has been recognised that protection and enhancement/replenishment of this beach is most important. The sea wall at the eastern end is frequently overtopped during storms, which results in flooding and damage to properties from wave borne gravel.

<http://news.bbc.co.uk/1/hi/england/dorset/7544599.stm>

The owners of about 40 homes perched on a cliff top in Dorset have been told their houses are at risk of falling into the sea over the next 20 years. The residents, in the Old Castle Road area of Weymouth, have already had part of their gardens fall into the sea. A survey to assess the risk was carried out by coastal engineers from the local authority following recent landslips.

Because the cliff is part of the World Heritage Jurassic Coast, the government policy is for no intervention. A further 30 homes are at risk over the next 150 years, the report said. One resident, 90-year-old Reg Bratt, started building his own wall against the erosion 30 years ago.

"In 1978, I started building a wall, with no plans of what I was going to do," he said. "I just knew that I had to build a wall. I built massive buttresses, supporting the cliff and the wall just went up." Mr Bratt said he had not had any problems since, but some of his neighbours had.

David Webber had to buy his home outright when he moved to the road three years ago because he could not get a mortgage for the property. He thought the problem would not affect him during his lifetime. "About two years ago we

had very very heavy rainfall, and that completely saturated the earth and we had some drop off - about a foot dropped off, which was alarming," he said. However, the residents said house sales had not yet been affected and people had not had problems getting their homes insured.

A Weymouth and Portland Borough Council spokesperson said councillors were trying to change the government's policy of no intervention. Councillor Doug Hollings said: "I think we must try and protect, obviously, the areas where the most valued assets are. And that's obviously people's properties." The residents will have the chance to study the survey in-depth next month.

Meanwhile the council has applied to the Environment Agency for money to carry out another, even more detailed, survey.

http://www.dorsetecho.co.uk/mostpopular.var.2445331.mostviewed.coastal_erosion_threat_to_homes.php

Coastal erosion threat to homes By Harry Hogger

Residents of homes threatened by coastal erosion in Weymouth are demanding a change in government policy to protect their properties. People living on Portland Harbour's north west shoreline were invited to a special meeting after a study by Weymouth and Portland Borough Council revealed up to 40 homes in Old Castle Road could be cut off due to erosion in 20 years' time.

Councillors and officers were on hand to discuss the study, which looked at the possible impacts on the coastline over the next 100 years if the current government policy to simply leave the land alone, or retreat the line', is maintained.

The study showed that as well as properties in Old Castle Road, parts of Belle Vue Road, Douglas Road, Dundee Road, Osprey Road and the Rodwell Trail are at risk from coastal erosion over the next century. Council spokesman for environment and sustainability Doug Hollings said: "The residents are obviously greatly concerned by the possible impact on their properties. This was an opportunity to inform them about the possible erosion and to make sure they are as well acquainted as the council is about the problems. They had the opportunity to talk to councillors and officers and we are encouraging them to work out with the council what is the best way forward."

The council is hoping the residents' responses will be taken into account as the government considers whether to continue with the policy of retreating the line. Highways and design manager Robert George said: "We have maps showing erosion as far ahead as 100 years down the line but these are based on the fact that at the moment the existing policy is one of no intervention. The Shoreline Management Policy is currently under review and this could be an opportunity to review these policies and see if they are still appropriate. We have completed an initial study that was required by the Environment Agency and we are hoping to carry out a further study which could look at options of protecting the coastline if the policy is changed."

David Albin bought a plot of land on Old Castle Road a year and a half ago and was shocked to find it could be under threat from erosion of the cliffs. He said: "We were hoping to build a family home on it and then this has popped up. We came down to investigate it before we go ahead with anything. We knew there had been slippages over the years but nothing to the extent of the whole road collapsing. I think it's just a case of getting the residents protected, getting them together and trying to challenge the government. It is a concern and I'm glad the council are giving us an opportunity to do something about it."

Terry Philips lives in Belle Vue Road and said his previous neighbours lost some of their garden to a landslip in 2001. He added: "Of course we cannot just do nothing. Our properties are worth a lot of money and we need to protect them. It's not a very difficult job. They need to do a proper study but to do that they need some funding and I can't see that happening in the current climate."

Geoffrey Poole, an expert in coastal erosion from Weymouth, was in favour of taking action. He said: "I would have thought the value of the properties and all the services along there is certainly worth saving and it would not cost too much to save it. The idea of a managed retreat is possible in other areas of the country but not where you have properties so close to the edge."

Chris Purkis, of Old Castle Road, welcomed the council's actions but said he was confident something will be done before his home actually comes under threat. He said: "It is very good news the council is looking into it as the residents have concerns. I would rather they did something to protect it as my house is right on the cliff, but I see no particular rush and from what I've heard I am confident something will be done and we will be OK."

Reg Bratt, who has lived in Old Castle Road for over 40 years, believes residents should take matters into their own hands if the government refuses to do anything. That is exactly what he has done himself, building a concrete wall at the bottom of his land. Mr Bratt said: "The important thing is we should be free to protect our own homes. "It doesn't require a vast expense, all it needs is a simple sea wall and that will protect the land on a one hundred-year scale. I'm not too worried about it myself because I know how to protect my land."

Council spokesman for environment and sustainability Doug Hollings said: "The residents are obviously greatly concerned by the possible impact on their properties. This was an opportunity to inform them about the possible erosion and to make sure they are as well acquainted as the council is about the problems. They had the opportunity to talk to councillors and officers and we are encouraging them to work out with the council what is the best way forward."

Some residents, though, were not convinced by the council's arguments. Roger Glencross, of Old Castle Road, said: "It's absolute nonsense. My garden has actually gained eight feet in the last 13 years. I think they want a coast path along the cliff."

10:38am Friday 12th September 2008

<http://www.dorsetforyou.com/index.jsp?articleid=1277>

Lyme Regis coast protection works

HRH The Princess Royal officially opened the council's multi-million pound land stabilisation and coast protection scheme on 4 April 2007 (phase 2 environmental improvements). The scheme is vital in order to save the town from destructive landslides and coastal erosion. The work programme is largely complete and has been specially drawn up to minimise disruption wherever practical and to keep the town running as normally as possible.

The work has seen Lyme Regis benefit from newly stocked sand and shingle beaches plus a new promenade which stretches right around the sea front. And the town's public gardens were stripped for stabilisation work but are now largely reinstated. Lyme Regis is located on an actively eroding stretch of the West Dorset coast and faces considerable challenges from coastal erosion and landslipping. Problems have been particularly serious during the last 100 years, with many properties destroyed or damaged, erosion of the foreshore and major breaches of the sea walls.

The Lyme Regis Coast Protection Scheme was initiated by West Dorset District Council in the early 1990s. It aims to provide long-term coast protection for the town and to reduce damage and disruption caused by landslipping, through a long-term programme of engineering works.

Phase 1 of the scheme, which includes a new sea wall and promenade next to the mouth of the River Lim, was completed in 1995. Urgent stabilisation work was carried out in several locations during winter 2003/2004. Detailed designs have been drawn up for a £17 million Phase 2 scheme to protect the foreshore along the main frontage from the sea and to stabilise the land behind. Construction works on Phase 2, for the town frontage and gardens, commenced in April 2005 and should be completed by April 2007.

West Dorset District Council has also been carrying out preliminary studies and preparing conceptual designs for economic and environmentally acceptable coast protection works for other areas of the town. Emergency stabilisation work has taken place recently in critical areas to provide short-term protection while the main schemes are being developed.

Funding from the Department for the Environment, Food and Rural Affairs (DEFRA) has now been received for the start of the preliminary design study relating to Phase IV - the Church Cliff and East Cliff area on the eastern edge of Lyme Regis. This scheme will be of a similar magnitude to Phase II and the preliminary design will aim to develop a solution to protect the coast, property and the natural environment which makes this area so attractive to locals and visitors alike and to enable a bid to be made for coast protection funding.

<http://archive.thisisdorset.net/2002/3/14/91538.html>

Bid to 'recharge' beach in coastal erosion strategy

From the Echo, first published Thursday 14th Mar 2002.

Purbeck residents were being invited to share their views tonight (March 14) on £500,000 plans to put sand back on Swanage beach. The scheme is part of a £102,000 study funded by Defra to investigate future options for the coastline between South Haven Point and Durlston Head. Also under investigation as part of a 50-year coastal and flood protection strategy is the problem of erosion at Studland.

Members of the public can study scheme details at Swanage town hall tonight from 6.30pm to 9pm. Mike Goater, Purbeck District Council's engineer, said: "People should attend to put their views forward on the future of the Purbeck coast.

"What residents of Swanage may be particularly interested in learning more about is the proposal for putting sand on the beach there - a recharge scheme." He added: "Views expressed can be taken on board for the final proposals."

Sand has ebbed away from Swanage beach over recent years and experts are studying the option of recharging the beach with some 52,000 cubic metres of sand. The study is expected to take just over seven months to form a detailed mathematical model of the effects of this option.

Mr Goater said: "We have to be fairly reassured the solution we are proposing is actually going to work." He believes part of the reason for the sand ebbing away is a national one - development and coastline protection stopping cliff falls is preventing sand from being created. Mr Goater said: "The beach at Swanage has been starved of further supplies of sand. The area for waves to run up and dissipate their energy has been reduced and as a result they crash against the sea wall and scour the beach of sand."

In some ways, he says, the jetty which hides a flood water outfall may have acted as a very efficient groyne - benefiting the southern half of Swanage's beach and helping keep sand there. He went on: "The problem is that there isn't sufficient sand in the bay itself - this is something that has happened all along the south coast."

Details of the strategy study can be viewed at Purbeck District Council offices, Westport House, Wareham, and public responses can be mailed to Mike Goater.

4. Other Literature

4.1 Mortgage Underwriting (Oxera Consulting, 2006)

By 2006, most major lenders with significant market share are using automated underwriting, which includes credit scoring and affordability techniques. The proportion using automated underwriting tools increased from 10% in 2000 to more than 50% in 2006. Automated valuation models (AVM) are a recent innovation. Their use has increased from almost 0% in 2003 to 30% in 2005 (and predicted to reach 40% in the next few years). AVMs are typically used to value properties for re-mortgages.

It is the larger lenders that are more likely to use automated processes, which speeds up decisions over whether or not to grant the mortgage. Speed is important to quickly let consumers know if they will get a mortgage and on what terms. The time saved means costs are less such that savings can be passed on in more favourable terms. Prior to the use of credit scoring, lending was often based on local knowledge or where there was already a relationship with the customer.

However, increased automation has not resulted in a one-size-fits-all approach. Applicants in certain market segments may have different characteristics and risk profiles, so require a bespoke approach.

The process of mortgage underwriting involves assessing the likely performance of the applicant in light of the experience of similar applicants in the past and the value of the property being offered as security. There are two stages involved: assessments of the applicant's ability to service and repay the loan applied for and assessment of the adequacy of the property being offered as security for the loan.

Assessment of the adequacy of security consists of two steps:

1. policy rules surrounding the property – these are minimum criteria that the property must satisfy in order for the loan to be granted. The criteria are specified by the lender, but may reflect the requirements of insurers; and
2. valuation of the property – with an important innovation being the development of AVMs.

Automation offers few benefits for applicants and/or properties with characteristics outside the mainstream.

Most (94%) lenders with manual underwriting processes have a system of underwriting mandates in place. This means that senior/experienced staff have the authority to underwrite higher value lending or less straightforward applications.

There are four ways used to value the property offered as security:

- full physical valuation: expert visits and values the property. This is typically used for house purchase mortgages with medium to high LTVs;
- drive-by valuation: property valued by assessing its outer boundary, without entering the property. They are typically used for re-mortgages with medium LTV;
- desk-top approach (house price index): property valued without visiting it by using a house price index. This is typically used for further advances; and
- automated valuation model (AVMs): where a computer model creates the property valuation. This is used to estimate the current market value of the house based on various analytical methodologies and statistics. The approach offers prices of comparable houses in the neighbourhood, characteristics of the house itself, historical property price appreciation, etc.

4.3 England's Seaside Towns (CLG, 2008)

The report uses population thresholds which means that many North Norfolk towns (including Cromer and Sheringham) are excluded from the study. The 37 principal towns considered do include Scarborough and Bridlington, Great Yarmouth and Lowestoft and Weymouth.

The percentage of the population that is 60/65+ is:

- Scarborough: 23%;
- Bridlington: 29%
- Great Yarmouth: 23%
- Lowestoft: 24%; and
- Weymouth: 24%.

This compares with an overall average of population that is 60/65+ for England of 19%.

The percent of owner-occupied properties is (England average = 69%):

- Scarborough: 66%;
- Bridlington: 69%
- Great Yarmouth: 62%
- Lowestoft: 70%; and
- Weymouth: 73%.

Three of the towns within the case study areas are identified as being within the ten most disadvantaged seaside towns (Bridlington, Great Yarmouth, Lowestoft).

4.4 Rural Evidence Base for Yorkshire and The Humber (Yorkshire Futures, 2007)

Information on second homes suggests that the coastline of East Riding around Hornsea has 1.4% to 4.3% of second homes. South of Hornsea, the percentage is much lower, at 0% to 1.4%. In Scarborough, the proportion of second homes is higher (up to 12.7%). Percentages taken from map showing distribution of second homes (Figure 4.1).

4.5 Housing in England 2006/2007 (CLG, 2008a)

The median length of time that owner occupiers have lived in their houses is 11.6 years (mean of 15.6). This increases to 22.4 years (mean = 23.0 years) for those who own their property outright, compared with 7.1 years (mean = 9.8 years) for those buying with a mortgage. These figures relate to the spent in the home at the time of the mortgage (not the complete length of time that residents will spend in their property).

The number of second homes reported by local authorities shows that North Norfolk is the fourth highest (after Westminster, Birmingham, and Kensington & Chelsea) for second homes, at 4,700. Scarborough is 9th highest with 3,700 second homes. Isle of Wight has 3,400 (11th), while Great Yarmouth has 2,700 and West Dorset has 2,400.

The age distribution of households with second homes shows that almost 60% of households with second homes are aged 45-64 (where this age group makes up 39% of all homeowners).

5. Conclusions of Literature Review

This Section brings together the findings of the literature review and assesses the implications for properties at risk of coastal erosion. The findings of the studies reviewed are considered in terms of what they imply for areas at risk of coastal erosion.

Table 5.1 summarises the findings of the literature review in terms of the percent premium (or discount) associated with erosion risk, and other types of risk. Results specific to erosion risk are highlighted in bold. The inferences that can be drawn from premiums and discounts associated with other risks are discussed below.

Price Change	Details of Risk/Nuisance	Source
-12% to -37%	Reduction in residential property value when there is 10 years until erosion (based on Geotime). The maximum value is for Great Lakes, minimum for Gulf of Mexico with Atlantic Region at -23% and Pacific Region at -28% (USA)	Kriesel <i>et al</i> (2000)
-9% to -29%	Reduction in residential property value when there is 20 years until erosion (based on Geotime). The maximum value is for Great Lakes, minimum for Gulf of Mexico with both Atlantic and Pacific Regions at -18% (USA)	Kriesel <i>et al</i> (2000)
-23%	Reduction in property value after a second forest fire, several years after the first (increased from 10% reduction after the first forest fire) (USA)	Mueller <i>et al</i> (2007)
-23%	Reduction in property price for houses located within 100m of a flight path (USA)	Rahmatian & Cockerill (2004)
-6% to -23%	Reduction in residential property value when there is 30 years until erosion (based on Geotime). The maximum value is for Great Lakes, minimum for Gulf of Mexico with Pacific Region at -13% and Atlantic Region at -18% (USA)	Kriesel <i>et al</i> (2000)
-21%	Reduction in property price of houses located near to an airport (USA)	Rahmatian & Cockerill (2004)
-20.8%	Reduction in house price associated with aircraft noise that is sufficient to disrupt normal activities (70-75 dB) (USA)	Cohen & Coughlin (2007)
-20%	Impact of pollution from wastewater treatment works on value of recreational properties (USA)	Zabel & Kiel (2000) in Boyle & Kiel (2001)
-5% to -20%	Reduction in residential property value when there is 40 years until erosion (based on Geotime). The maximum value is for Great Lakes, minimum for Gulf of Mexico with Pacific Region at -10% and Atlantic Region at -12% (USA)	Kriesel <i>et al</i> (2000)
-18%	Reduction in property values after an explosion (prices increased by 38% upon the announcement that the plant was to be relocated) (USA)	Carroll <i>et al</i> (1996) in Boyle & Kiel (2001)

Table 5.1: Summary of Impact on Property Price by Risk/Nuisance		
Price Change	Details of Risk/Nuisance	Source
-5% to -17%	Reduction in residential property value when there is 50 years until erosion (based on Geotime). The maximum value is for Great Lakes, minimum for Gulf of Mexico with Pacific Region at -9% and Atlantic Region at -10% (USA)	Kriesel <i>et al</i> (2000)
-15%	Reduction in house price in a town two miles away from a major wildfire (USA)	Loomis (2004)
-14.7%	Reduction in property value due to proximity to beach (interpreted as the net negative effects of coastal erosion minus any benefits associated with recreation and amenity) (USA)	Bin <i>et al</i> (2008)
-4% to -14%	Reduction in residential property value when there is 60 years until erosion (based on Geotime). The maximum value is for Great Lakes, minimum for Gulf of Mexico with Pacific Region at -4% and Atlantic Region at -6% (USA)	Kriesel <i>et al</i> (2000)
-13%	Reduction in price of 40 year old property that has not been maintained (inside and out) compared with one that has been maintained (Sweden)	Wilhelmsson (2008)
-12%	Reduction in property value for houses located on the boundary of a landfill. One mile from the landfill, the impact decreases to 6% (USA)	Nelson <i>et al</i> (1992) in Boyle & Kiel (2001)
-11%	Reduction in property value due to its location in a flood zone with 1% annual chance of flooding (USA)	Bin <i>et al</i> (2008)
-8% to -11%	Reduction in property values due to exposure to earthquake and volcano risks (USA)	Bernknopf <i>et al</i> (1990) in Smith <i>et al</i> (2002)
-8% to -11%	Reduction in house prices after flooding from the Meuse. Prices were still reduced by 7% to 11% two years after the event (Netherlands)	Daniel <i>et al</i> (2005)
-10%	Reduction in property prices after Loma Prieta earthquake (USA)	Murdoch <i>et al</i> (1993) in Loomis (2004)
-10%	Reduction in property prices after a flood event (USA)	Schultz & Fridgen (2002) in Loomis (2004)
-3.2% to -8.9%	Decrease in property prices after building codes were introduced that brought attention to the fact that the coastline was eroding and that there is a risk associated with living in the area	Kriesel <i>et al</i> (2000)
-3% to -8%	Reduction in residential property value when there is 100 years until erosion (based on Geotime). The maximum value is for Great Lakes, minimum for Gulf of Mexico with Pacific Region at -6% and Atlantic Region at -9% (USA)	Kriesel <i>et al</i> (2000)
-7.3% (-6.2% to -7.8%)	Reduction in property prices associated with location in the floodplain (low value relates to location in the 1:500 year floodplain; high value to location in the 1:100 year floodplain) (USA)	Okmyung <i>et al</i> (2008)
-6%	Reduction in value of homes located in a floodplain (USA)	Speyrer & Ragas (1991) in Smith <i>et al</i> (2002)

Table 5.1: Summary of Impact on Property Price by Risk/Nuisance		
Price Change	Details of Risk/Nuisance	Source
-5.8% (-3.8% to -8.3%)	Reduction in value in a floodplain compared with a similar house outside the floodplain. Before Hurricane Floyd the discount was 3.8%, after it was 8.3% (USA)	Bin & Polasky (2004)
-5.5%	Reduction in property value for houses located near to a landfill (USA)	Reichert <i>et al</i> (1992) in Boyle & Kiel (2001)
-5.5%	Reduction in property values for houses located 2 miles from the location of a petroleum pipeline rupture (USA)	Simons (1999) in Boyle & Kiel (2001)
-4.3%	Reduction in property value due to its location in a flood prone area (4.3%)	Samarasinghe & Sharp (2008)
-4%	Reduction in house prices in an earthquake risk zone <i>before</i> an earthquake occurred. Reduction fell to 3.4% after an earthquake, explained as being due to the overestimation of low probability events (USA)	Beron <i>et al</i> (1997) in Daniel <i>et al</i> (2005)
-1.3% to -1.7%	Impact of increased noise associated with railway over 50 dB and 55 dB (Sweden)	Andersson <i>et al</i> (2008)
-1.5%	Reduction associated with a change of 100 faecal coliform count per 100 ml (USA)	Leggett & Bockstael (2000) in Boyle & Kiel (2001)
-1.1%	Reduction in house price caused by one additional year of age (USA)	Bin & Polasky (2004)
-0.9%	Reduction in house values located within 6.5 miles of an electrical power plant compared with houses located 10% further away (USA)	Blomquist (1974) in Boyle & Kiel (2001)
-0.4% to -0.7%	Impact of increased noise associated with roads over 50 dB and 55 dB (Sweden)	Andersson <i>et al</i> (2008)
-0.6%	Reduction in lot size by 10%	Kopits <i>et al</i> (2007)
-0.3%	Depreciation rate of properties (USA)	Kriesel <i>et al</i> (2000)
0%	No significant reduction found in a study investigating the impact of the nuclear reactor at Three Mile Island before and after the accident on house prices (USA)	Gamble & Downing (1982) in Boyle & Kiel (2001); Nelson (1981) in Boyle & Kiel (2001)
+0.05%	Increase in property price associated with being 100 ft closer to open space or natural areas (USA)	Lake & Easter (2002)
+0.05% to +0.36%	Potential premium associated with a 1% reduction in erosion risk on Atlantic coast. This increases to 0.29% increase for a 1% reduction in erosion risk for Great Lakes, and 0.36% for Pacific coast (USA)	Kriesel <i>et al</i> (2000)
+1.7% to +3.4%	Increase in property value due to average to good water views (Australia)	Abelson (1979) in Bourassa <i>et al</i> (2003)
+3% to +5%	Increase in house values due to a waterfront location in Britain (UK)	Garrod & Willis (1994) in Boyle & Kiel (2001)
+3.8%	Property price premium for houses located within 500m of the River Meuse (Netherlands)	Daniel <i>et al</i> (2007)

Table 5.1: Summary of Impact on Property Price by Risk/Nuisance		
Price Change	Details of Risk/Nuisance	Source
+4.9%	Increase in property values for houses with a view of forests (Finland)	Tyrvaïnen & Miettinen (1999) in Lake & Easter (2002)
+6%	Increased price associated with a home with a view (reducing by 1% of total property price for each additional mile from the beach) (USA)	Rahmatian & Cockerill (2004)
+9.2%	Increase in property values having a view (type not specified) (USA)	Gillard (181) in Bourassa <i>et al</i> (2003)
+6% to +10%	Increased values associated with sea views (Hong Kong)	Tse (2002) in Bourassa <i>et al</i> (2003)
+10%	Increased value of houses located in the flood zone with 1% annual chance of flooding. Additional value thought to be associated with amenity. The value increases to +27% for houses that are also vulnerable to wave action (USA)	Bin & Kruse (2006) in Bin <i>et al</i> (2008)
+4% to +12%	Increase in value of properties with a lake view (USA)	Plattner & Campbell (1979) in Bourassa <i>et al</i> (2003)
+4.6% to +12.2%	Premium associated with sand nourishment (potentially capitalisation of benefit of works undertaken by federal or state government) (USA)	Kriesel <i>et al</i> (2000)
+13%	Increased value associated with sea views (USA)	Graves <i>et al</i> (1988) in Bourassa <i>et al</i> (2003)
+23%	Increased value of properties protected against erosion risk by a seawall (USA)	Kriesel <i>et al</i> (2000)
+28%	Increased value associated with river views (Australia)	McLeod (1984) in Bourassa <i>et al</i> (2003)
+10% to +32%	Increased value associated with partial to full ocean views (USA)	Benson <i>et al</i> (1997) in Bourassa <i>et al</i> (2003)
+25% to +50%	Estimated premiums associated with sea views in less to more fashionable areas (UK)	Norwood (2005)
+59%	Increased value associated with wide water views for waterside coastal properties. Medium views add 33%. The benefits reduce quickly to 14% (wide views) and 12% (medium views) at 2,000m from the coast (New Zealand)	Bourassa <i>et al</i> (2003)

Table 5.1 puts the impacts identified as a result of coastal erosion into context with the impacts caused by other risks. It is important to note that the USA has a system of insurance available to homeowners whose properties are at risk of flooding. It is unclear whether erosion not associated with flooding is covered but responses to questions on the National Flood Insurance Program (NFIP) by

the Federal Emergency Management Agency (FEMA) suggests this may not be the case¹².

Kriesel *et al* (2000) found that there was a 0.24% increase in uptake of insurance for each year of Geotime lost (the amount of time that a coastal property has before the distance between it and the coast is reduced to zero due to erosion). Furthermore, property owners in areas where there was an ongoing programme of beach nourishment are more likely to purchase erosion insurance, perhaps reflecting their greater awareness of the risk. The (potential) availability of insurance in the USA means that property owners would receive some financial assistance if their house is eroded. This is likely to result in lower price reductions than would occur without insurance such that the results from Kriesel *et al* (2000) are expected to under-estimate the impacts if they were applied to the situation in England. However, the literature also notes that there is still a price premium even where insurance is available, potentially reflecting the additional capital loss identified with flooding/erosion.

The key factors associated with impacts on house prices, as derived from the literature review, are:

- awareness of the risk;
- appropriate adjustment for the risk;
- acceptance of risk;
- distance from the hazard; and
- other factors that may counteract the negative impact of erosion risk (e.g. a sea view).

Awareness of Risk

Awareness of the risk is defined here as a potential property buyer knowing that a risk exists. Bin & Polasky (2004) found that property values in the floodplain decreased by almost 6% after flooding caused by Hurricane Floyd. This may reflect the adjustment for risk made after the event, since before it many people were unaware that they were living in a floodplain. Lower awareness of risks can also result in smaller property value reductions. Samarasinghe & Sharp (2008) explain the (relatively) low discount of 4.3% of properties in the floodplain in New Zealand as being (at least partly) due to a lack of recent flood experience. Thus, it would be expected that properties that are at risk of coastal erosion but where this is not well known or publicised would show little or no reduction in value. In fact, the influence of positive factors (sea view, access to recreation) may result in those properties attracting higher values than properties further inland.

¹² The Federal Emergency Management Agency (FEMA) answers to questions about the NFIP states that 'Subsidence of land along a lake shore or similar body of water which results from the erosion or undermining of the shoreline caused by waves or currents of water exceeding cyclical levels that result in a flood is covered. All other land subsidence is excluded' FEMA (2007).

Appropriate Adjustment for Risk

Appropriate adjustment for the risk reflects whether the price discount seen changes due to publicity or an event occurring. Mueller *et al* (2007) reported that a second forest fire in the USA caused property values to decrease by 23%, while the first had reduced property values by 10%. The additional decrease occurred even though the two fires were several years apart. Price reductions also increased after a flood event on the Meuse, Netherlands (Daniel *et al*, 2007). Prior to the flood, property values in the floodplain were 8% to 14% higher than after the flood. The additional price reductions were reduced only slightly even eight years after the flood (8% to 12%), suggesting that the readjustment was not a short-term reaction. These results can be compared with the results of a study on the Loma Prieta earthquake, USA (Beron *et al*, 1997, in Daniel *et al*, 2005; Bin & Polasky, 2004). These studies showed that property values in the earthquake zone were reduced by 4% before the earthquake occurred, and by 3.4% after. This is interpreted as showing that the residents were fully aware of the risks (due to education and preparedness campaigns associated with earthquake risks over previous decades) and that property values were adjusted accordingly such that no readjustment was necessary.

Coastal erosion is a constant risk where there are no defences or where defences are no longer maintained. Thus, it could be expected that property values would continue to fall over time, not just because the risk of erosion is increasing but because potential property buyers are constantly reminded of the risk and so may be constantly adjusting their perception of the risk. This is supported by Kriesel *et al* (2000) who found that the impact of Geotime doubled following media interest showing properties falling into the sea. Samarasinghe & Sharp (2008) noted that people find it more difficult to adjust for risk where the risk is low likelihood and high consequence. In such cases, subjective perceptions of risk tend to dominate. The nature of coastal erosion risk may, therefore, be easier for people to consider when adjusting their valuations of property.

The issues may be slightly different where a decision has been made to maintain defences for a set period, after which maintenance would be withdrawn. Publicity is likely to initially result in a significant reduction in property value, similar to that seen where erosion is progressing. This occurs because the risk is constantly being reinforced, raising awareness and 'encouraging' the readjustment of property values. Once publicity reduces though and no evidence of erosion is seen, it could be expected that there would be some recovery in property prices (at least in the short-term until the risk is again publicised). Should a decision be made to reverse the policy at some later date, there could be a significant price rebound. This was seen in the USA when property prices increased by 38% after the decision was made to relocate an industrial plant that had previously had an explosion (Carroll *et al*, 1996 in Boyle & Kiel, 2001). This compares with property price reductions before the decision to relocate of around 18%. The study does not mention if property prices fell back over time.

Acceptance of Risk

Acceptance of risk covers whether property buyers are willing to accept some risk or not. There is also a perception element to acceptance of risk that can result in impacts being seen on property prices even outside the area of (apparent) risk. Loomis (2004) found that property values decreased by 15% in a town located two miles from a wildfire. The town itself was unaffected, but the wildfire resulted in people adjusting their perception of the risk. The same could be expected in towns and villages where part of the settlement is at risk. In such cases, reductions in property values may extend to the whole town/village due to the perception that it is the area that is at risk, not specific locations.

People will view risk differently. Some people will not accept any risk, as seen in Zhai (2006) where 50% of respondents to a survey stated that they accepted no flood risk at all. Others will take a more optimistic view of risk, potentially under-estimating the consequences and so may be disproportionately attracted to properties with lower values. If the findings of Zhai (2006) were applicable in England, properties at risk of erosion would be of no interest to 50% of the population. This would reduce interest in the properties, making it potentially more difficult to sell the property with the likelihood of a price reduction. The price reduction itself may then attract those with an optimistic perception of the risk. This is supported by the research undertaken by Kriesel *et al* (2000) who found that only 3,000 out of 21,000 coastal communities joined the National Flood Insurance Program (NFIP) in the first four years. This was explained as being due to people with optimistic perceptions of risk or unaware of risk being attracted by the lower priced houses.

Distance from the Hazard

Distance from the risk (reflecting both time and erosion rates) would be expected to reduce the property value reduction. The impact of distance has been investigated when assessing the impact of aircraft noise. Rahmatian & Cockerill (2004) found that properties within 100m of a flight path were valued 23% lower than average. This reduced to 18% discount at 300m from the flight path, to 16% at 500m and to 11% at a distance of 1km. Even within 5km there was still a significant discount of 7%. Although noise impacts are very different to risks from coastal erosion, both are constant with regular reminders of the risks. Thus, it could be expected that any areas associated with coastal erosion could see a reduction in property values, even if they are outside the immediate risk zone. Loss of garden and/or land associated with the property could reduce the value because overall lot size is valued. Kopits *et al* (2007) found that property values in the USA increased by 0.6% when lot size increased by 10%.

Impact of Other Factors that may Counteract the Negative Impact of Erosion Risk

Other factors can mask the impact of the risk on property values. Coastal properties can benefit from price premiums associated with sea views and access to recreation. Separating these premiums from any discounts caused

by a risk can be difficult. Sea views can add a significant premium to waterfront properties. The percentages found in the literature vary considerably (from less than 2% to 59%), although one study in Hong Kong suggested it is not the view itself that attracts the price premium, but the openness and high air quality that the view represents (Yiu *et al*, 2008). Kriesel *et al* (2000) focused on the potential community impacts of degraded beaches, where a reduced beach can result in tourism-related properties becoming concentrated very close to the shore. Ongoing degradation of the beach is likely to result in the coastal community reflecting the structure of an ordinary residential community. The premium for sea views, though, is not lost.

Maintenance of the property and properties around it can also affect property values. While Bin & Polasky (2004) found that house prices decreased by 1.1% for each additional year of age, Wilhelmsson (2008) identified a 13% difference in the value of a 40 year old house that had been maintained versus one that had not. Vanderford *et al* (2005) found that vacancy rate had a negative influence on property prices, although the authors did not quantify the impact. These results show that lack of maintenance of a property that is expected to erode (because there is no incentive to pay to maintain a property that will be lost) could exacerbate the reductions in property values. Where a number of houses in a block or along a road are not maintained, then the impacts would be expected to extend to neighbouring properties.

Bin *et al* (2008) attempted to assess the overall impact of sea views and erosion and concluded that there was a 14.7% reduction in property values, even taking into account the benefits associated with beach recreation. The study area has a constant erosion risk making the complicated relationship between erosion risk, sea views and recreation slightly easier to assess than normal. The study shows that the impact of erosion risk can outweigh the benefits associated with sea views and recreation, but this is likely to be location-specific. The relationship will also reflect the other factors discussed above (i.e. awareness of risk, adjustment for risk and distance from the risk).

Overall Conclusions

The above discussion considers the implications of the results of the literature review when assessing the effects of coastal erosion. Overall, it can be seen that adjustments in price are strongly linked to a full and appropriate understanding of the risks.

Incomplete understanding of the risks can result in the impacts being much greater than would be expected (e.g. extending over a much wider area or reflecting media interest showing properties falling into the sea). Such impacts can result in very significant effects on property prices. Although no directly comparable figures for property price reductions are available from the literature, reductions exceeding 10% or 20% could be expected (even where properties still have significant residual lives). Given the lack of financial assistance once a property has eroded, it is likely that the reductions could be even higher.

Incomplete understanding can also result in the impacts being significantly lower than might be expected. Optimistic perceptions of the risks may result in properties maintaining price premiums associated with sea views and access to beaches for recreation. Such situations are unlikely to last, however. Publicity or an erosion event is likely to force people to adjust their perceptions and could result in property prices reducing. This may be countered where property buyers hold an optimistic perception of risk because they are retiring to the coast and value the sea view much higher than a future erosion risk. This situation may best fit those locations where defences are being maintained at present, but may be withdrawn in 50 years time. If interest in the at risk properties can be maintained by this group of buyers then property values may not decline until much closer to the time that the funding of maintenance is withdrawn.

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Appendix 2: Detailed Analysis of Questionnaires

Councillors' Questionnaire: Approach and Results

1. Introduction

This note summarises the questions asked and their purpose, the number and type of consultees contacted, response rates and a detailed analysis of the results.

2. The Questions

2.1 Overview

The final version of the questionnaire included a maximum of five questions (plus one opportunity to provide other comments and feedback). The overall objective of the councillors' questionnaire was to identify whether there are concerns that property prices or interest in properties decrease as a result of erosion risk. The questionnaire also includes questions to help us understand the extent of the risk and if this extends beyond those areas at immediate (or potential) risk of coastal erosion. This will then give information on the extent to which the area is affected by coastal erosion.

2.2 Question 1

Question 1 asked is your parish at risk of coastal erosion, or likely to become at risk of coastal erosion over time? The objective of the question was to find out which areas are at risk and perceived to be at risk. This is then used to determine which question follows. The possible responses were:

- Yes, at risk (we do not have defences);
- Yes, at risk (we had defences, but they have not been repaired/replaced and are now ineffective);
- Yes, at risk (we have been told that our defences will not be continued/repared/replaced);
- Yes, at risk (but we have defences);
- No, not at risk but we are close to parishes that are at risk;
- No, not at risk; and
- Uncertain.

2.3 Question 2 (Yes-defences and No to Question 1)

Those answering no to question 1 were then asked if the impacts from the risks of coastal erosion in nearby parishes affect your parish (even though there are no properties directly at risk from coastal erosion in your parish)? The objective of this question was to assess whether the property market could be affected even though there is not a risk. The possible responses were:

- Yes, people outside our parish seem to think that properties in our parish are at risk of coastal erosion;
- Yes, people living in our parish are worried that there might be a risk from coastal erosion in the future;
- No, I am not aware of any concerns over coastal erosion from residents in the parish;
- No, I am not aware of any concerns from people outside our parish;
- Uncertain; and
- Other (Please Specify).

If the respondent answered yes to this question, they were redirected to question 2 (yes) to assess the extent of the impacts. No/uncertain respondents were directed to the end of the questionnaire.

2.4 Question 2 (Yes to Question 1)

Those answering yes to question 1 were then asked if, in their opinion, the risk of coastal erosion affect people buying and selling properties in your parish? The objective of this question was to begin to understand what impacts were being caused, with respondents asked to tick all relevant responses. The responses were:

- Yes, property prices are lower;
- Yes, property prices are higher (e.g. because of sea views);
- Yes, interest in properties is lower;
- Yes, interest in properties is higher (e.g. because of sea views);
- Yes, properties at risk of erosion have been abandoned or are poorly maintained;
- Yes, people living in the properties at risk of erosion have tried to sell them and cannot;
- Yes, our whole parish is associated negatively with coastal erosion even though only part of it is at risk;
- There was an issue in the past but property prices and interest in them has now recovered;
- No, I am not aware of any issue in terms of the property market due to coastal erosion;
- No, coastal erosion is not important when compared with other factors that affect whether properties are bought and sold in the parish;
- Uncertain; and
- Other (Please Specify).

2.5 Question 3

Question 3 asked has the impact on property prices as a result of the risk of coastal erosion been constant, or does it change from time to time? The objective was to identify how impacts vary over time and whether there are occasional signs of recovery or not. The possible responses were:

- Once people became aware that erosion could affect properties, the prices fell and have never recovered;
- Property prices fell considerably as people became aware of the risk from coastal erosion, but have recovered fully since;

- Property prices fell considerably, but have recovered a bit since;
- Property prices fell a little as people became aware of the risk from coastal erosion, but have recovered fully since;
- Property prices fell a little, but have recovered a bit since;
- Property prices have fallen more and more over time;
- Property prices have varied, sometimes they seem to be falling, sometimes they seem to be recovering;
- Property prices have not changed much, they seem to have remained more or less the same;
- Property prices have increased, even when the risk of coastal erosion was known;
- The property prices vary so much around the parish that it is difficult to say; and
- Other (Please Specify).

2.6 Question 4

Question 4 investigates if interest in properties at risk of coastal erosion is constant, or if it changes from time to time. The objective of this question is to assess whether it is interest that is varying (rather than prices as in question 3). This gives information on operation of the property market, beyond that which might be apparent in the property values.

- Once people became aware that erosion could affect properties, interest in the properties fell and has never recovered;
- Interest in properties fell considerably as people became aware of the risk from coastal erosion, but has grown back fully since;
- Interest in properties fell considerably, but has grown back a bit since;
- Interest in properties fell a little as people became aware of the risk from coastal erosion, but has grown back fully since;
- Interest in properties fell a little, but has grown a bit since;
- Interest in properties has fallen more and more over time;
- Interest in properties has varied, sometimes it seems to be decreasing, sometimes it seems to be growing;
- Interest in properties has not changed much, it seems to have remained more or less the same;
- Interest in properties has increased, even when the risk of coastal erosion was known;
- Interest in properties varies so much around the parish that it is difficult to say; and
- Other (Please Specify).

2.7 Question 5

The final question asked ‘in your opinion, when did the impact of coastal erosion on properties and the property market first begin in your parish?’. The objective was to assess if there is an identifiable cause of the impacts on property market. The possible responses were:

- Cannot say, erosion has been going on for a long time;
- Since publication of erosion lines (e.g. in Shoreline Management Plan, SMP);
- Following media coverage (newspapers, television);
- When we lost one or more key assets (e.g. roads, beach access, first properties were lost); and
- Other (Please Specify).

3. The Consultees

Email invitations were sent to 99 parish and local councillors in the three case study areas (North Norfolk, Yorkshire and Isle of Wight) on 13 November 2008. Of these, five were returned as undeliverable giving a total sample size of 94. It is important to note though that the questionnaires were mainly sent to parish clerks. Some circulated the email to the councillors, others collated views to provide an overall response. The number of councillors sampled is, therefore, greater than 94.

4. Response Rates

To date, 15 December 2008, we have received 41 responses to the invitation of which 27 have completed the questionnaire, equivalent to a response rate of 29% of invitations sent. A further three people have emailed us to say that they are not aware of issues or did not feel able to comment.

5. Detailed Analysis of Results

5.1 Question 1

In total, 18 respondents (67%) stated that properties are at risk from coastal erosion, with 8 respondents (30%) stating no, and one (4%) respondent replying uncertain. Of the no responses, 5 (19%) stated 'No, not at risk but we are close to parishes that are at risk'.

Figure 5.1 summarises the responses to question 1. The figure shows that the most common response (7, 26%) is 'Yes, at risk (but we have defences)'. The next most common responses are 'Yes, at risk (we do not have defences)' and 'No, not at risk but we are close to parishes that are at risk (both with 5 or 19%)'. Considering the other yes responses, four (16%) respondents stated 'Yes, at risk (we had defences, but they have not been repaired/replaced and are now ineffective)' and two respondents (8%) highlighted that there are currently defences, but these will not be continued/repared/replaced.

5.2 Question 2 (Yes-defences and No to Question 1)

Only the 12 respondents answering 'Yes, at risk (but we have defences)' or 'No, not at risk but we are close to parishes that are at risk' to question 1 were directed to this question (as their final question). Figure 5.2 provides a chart

showing the responses. The figure shows that one response dominates all the others, being agreed with by 10 (83%) of the respondents: 'Yes, people living in our parish are worried that there might be a risk from coastal erosion in the future'. This highlights that even those currently not at risk are concerned about coastal erosion.

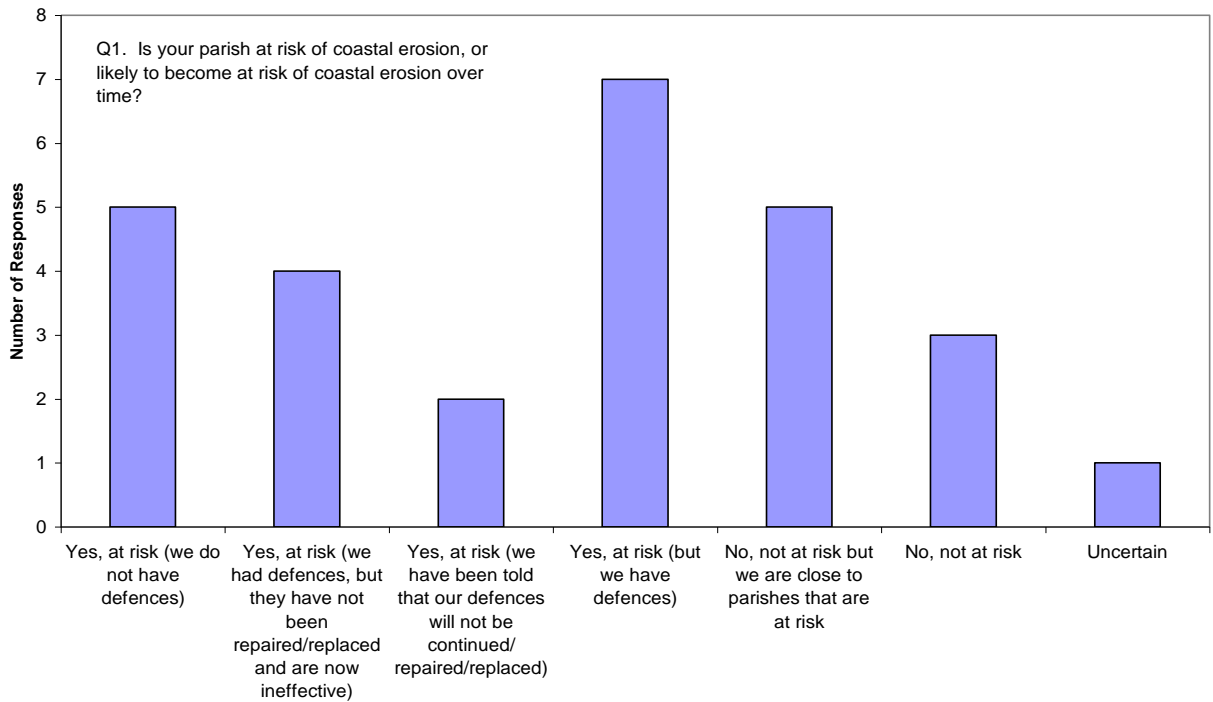


Figure 5.1: Responses to Question 1

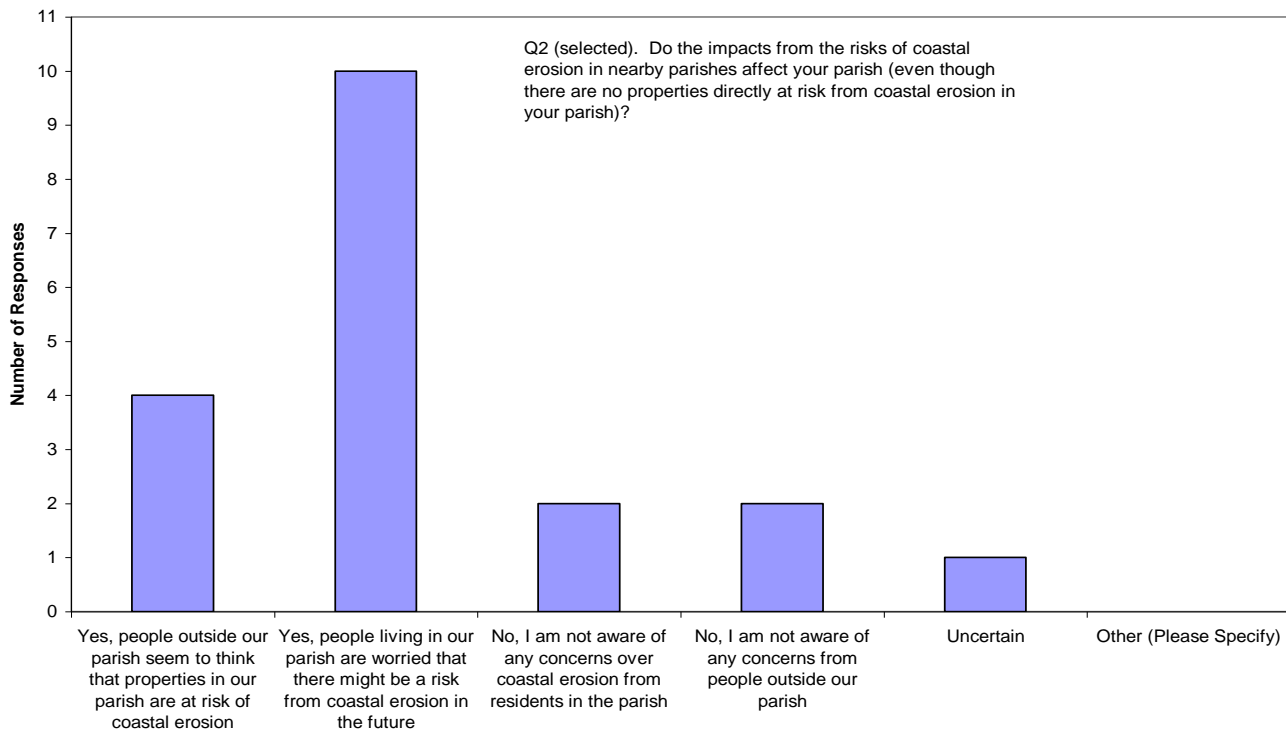


Figure 5.2: Responses to Question 2 (No, Yes but with defences)

5.3 Question 2 (Yes to Question 1)

The eleven other yes responses to question 1 were directed to this question 2 and to subsequent questions. Figure 5.3 summarises the responses to this question. The figure shows that the most common response is ‘Yes, property prices are lower’ with this statement agreed with by 13 respondents (72%). Eight respondents (44%) agreed with each of three statements:

- Yes, interest in properties is lower;
- Yes, people living in the properties at risk of erosion have tried to sell them and cannot; and
- Yes, our whole parish is associated negatively with coastal erosion even though only part of it is at risk.

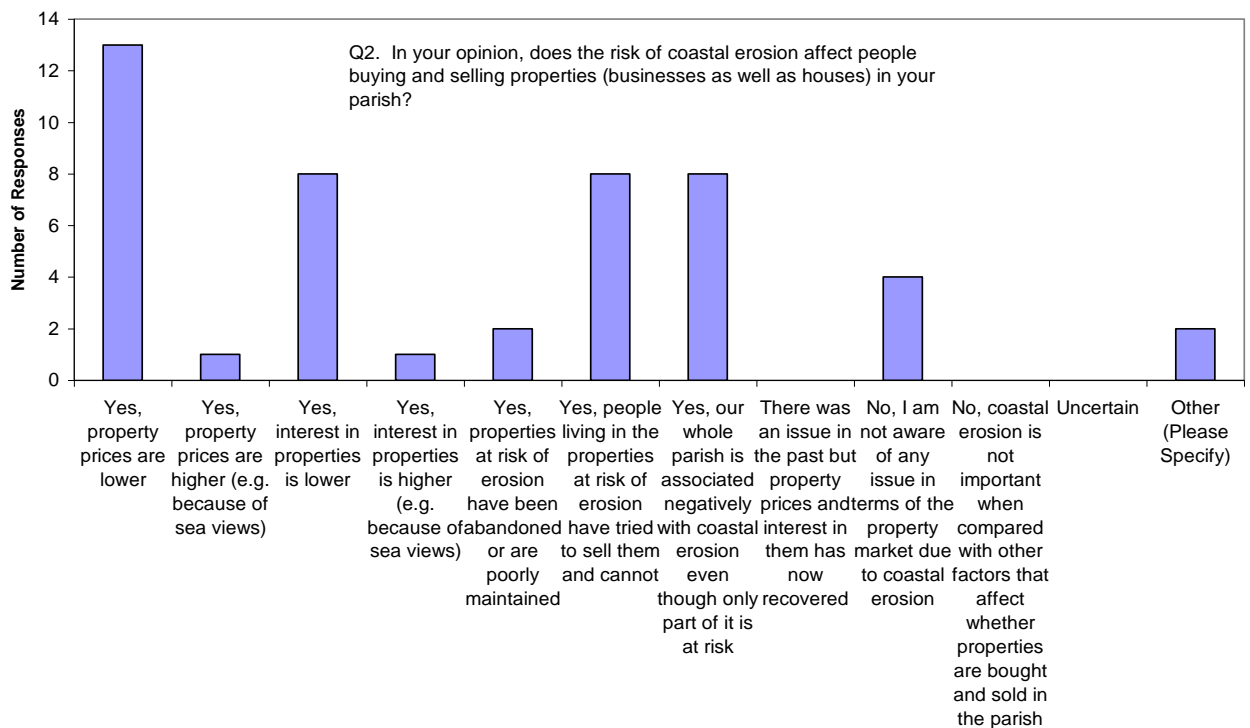


Figure 5.3: Responses to Question 2 (Other Yes Responses)

These findings show that the majority of councillors believe that coastal erosion risk is affecting both interest in properties and the property values, but also that the impacts of coastal erosion extend beyond erosion risk lines, potentially blighting wider areas. Four respondents (22%) did state ‘No, I am not aware of any issue in terms of the property market due to coastal erosion’. Thus, the impacts are not seen everywhere (two of the ‘no’ responses are from Scarborough, and two from the Isle of Wight).

One respondent stated ‘yes, property prices are higher’ and ‘yes, interest in properties is higher’. This respondent also agreed with the statements that ‘property prices are lower’ and ‘interest in properties is lower’ suggesting that the issue may be complicated: on the one hand sea views may attract extra interest and price premiums but that this may be countered by negative impacts from coastal erosion.

5.4 Question 3

Responses to question 3 show that the most common response (7 respondents, 39%) is that ‘once people became aware that coastal erosion could affect properties, the prices fell and have never recovered’ (see Figure 5.4). The ‘other’ response included a clarification that this only applies to some properties in the parish. The next most common responses are ‘property prices have fallen more and more over time’ (4 respondents, 22%) and ‘property prices have varied, sometimes they seem to be falling, sometimes they seem to be recovering’ (4 respondents, 22%).

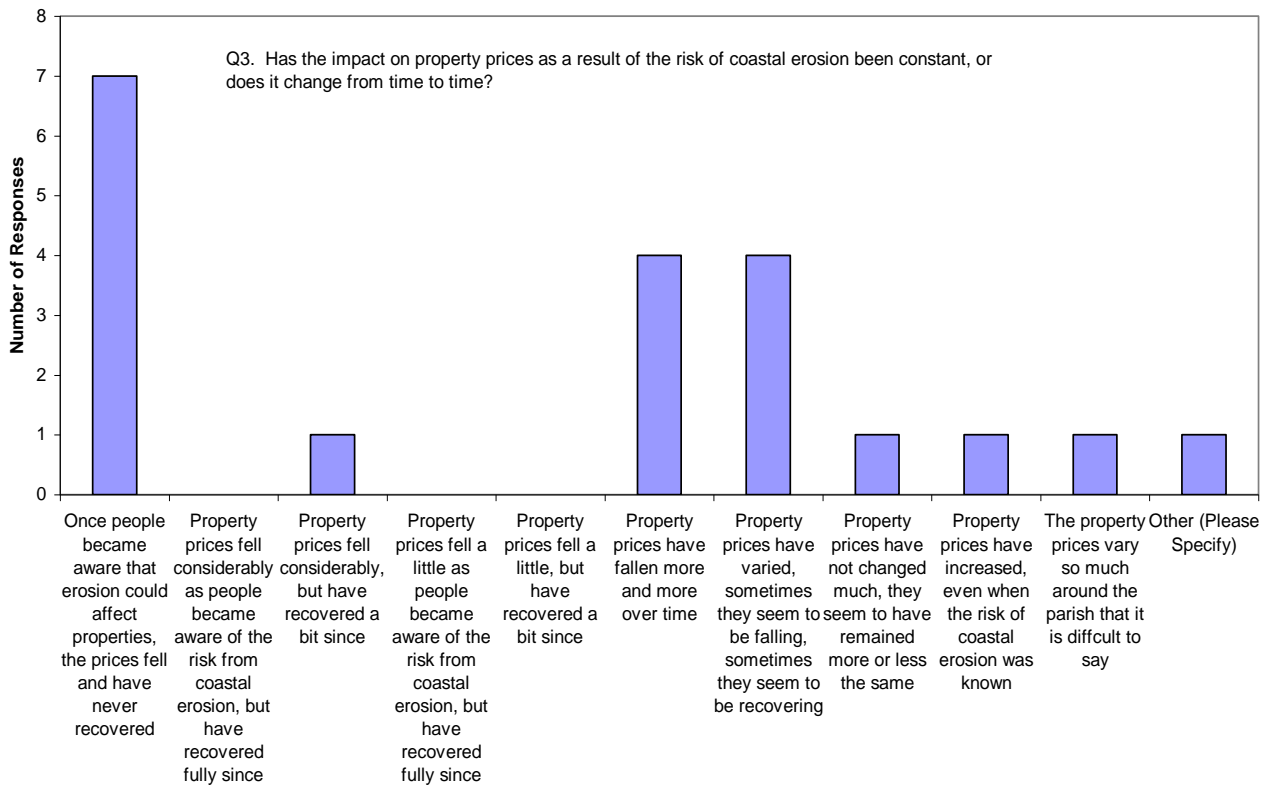


Figure 5.4: Responses to Question 3

Four other responses were agreed with by one respondent (6%) each:

- ‘property prices fell considerably, but have recovered a bit since’ (North Norfolk);
- ‘property prices have not changed much, they seem to have remained more or less the same’ (Isle of Wight);
- ‘property prices have increased even when the risk of coastal erosion was known’ (East Yorkshire); and
- ‘the property prices vary so much around the parish that it is difficult to say’ (North Norfolk).

5.5 Question 4

Question 4 relates to the level of interest in properties with responses showing a different pattern to that of prices. Here, the most common response, agreed with by six respondents (33%) was ‘once people became aware that erosion

could affect properties, interest in the properties fell and has never recovered'. This was followed by 'interest in properties has varied, sometimes it seems to be decreasing, sometimes it seems to be increasing', which was agreed with by 5 respondents (28%).

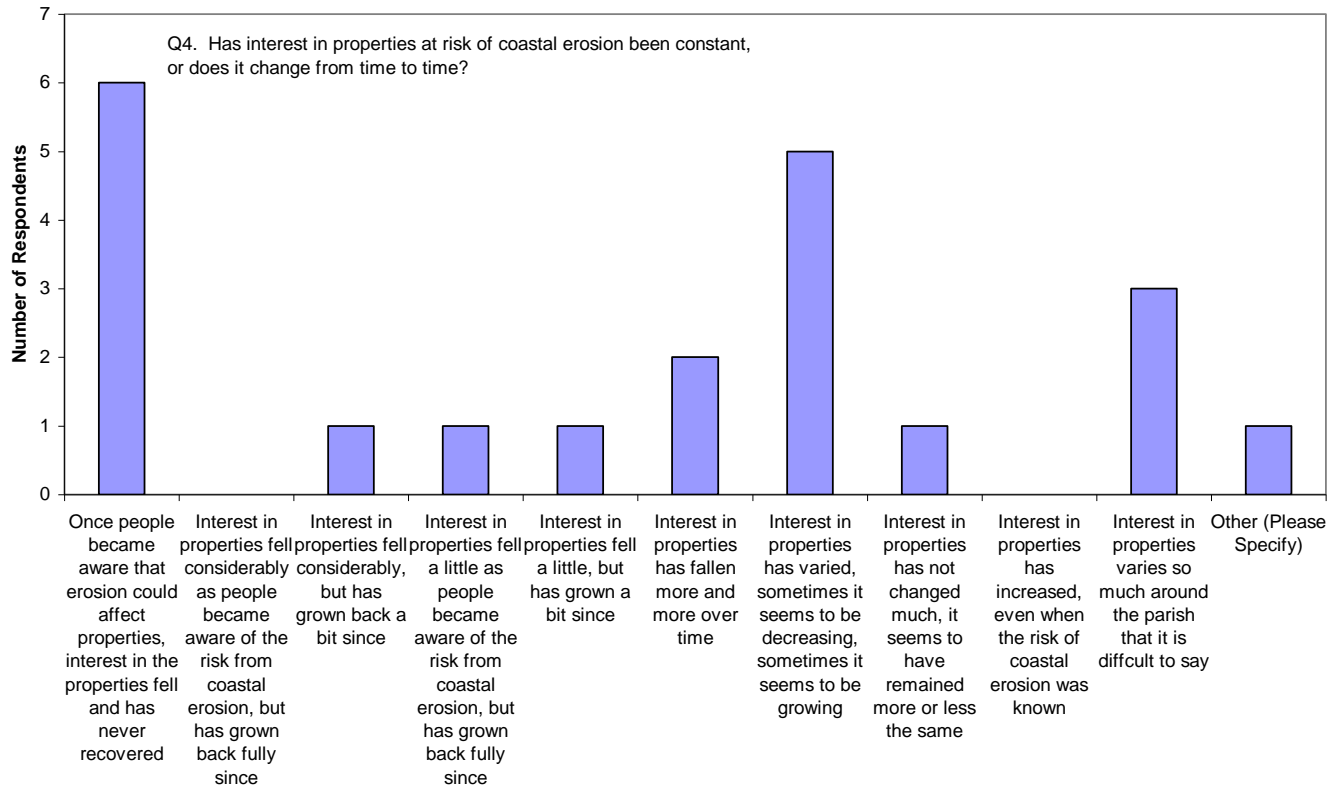


Figure 5.5: Responses to Question 4

A further two respondents (11%) believed interest had fallen more and more over time, while one respondent (6%) each agreed that interest had fallen (either considerably or a little) but had recovered a bit since. One respondent felt that interest in properties fell a little as people became aware of the risk from coastal erosion, but had grown back fully since.

Three respondents (17%) stated that interest varied so much that it was difficult to determine whether the overall level of interest had changed. One other respondent (6%) thought interest had stayed more or less the same.

5.6 Question 5

Figure 5.6 shows that there is no one event that is clearly associated with impacts on property prices. The most common response was 'since publication of erosion lines' (6 respondents, 43%). This is followed by 'following media coverage' (3 respondents, 21%). Two respondents (14%) were unable to say as erosion had been going on for a long time. The two 'other' responses both relate to Defra/local authorities failing to provide on-going protection. One respondent stated that the impacts began 'when we lost one or more key assets' (Scarborough).

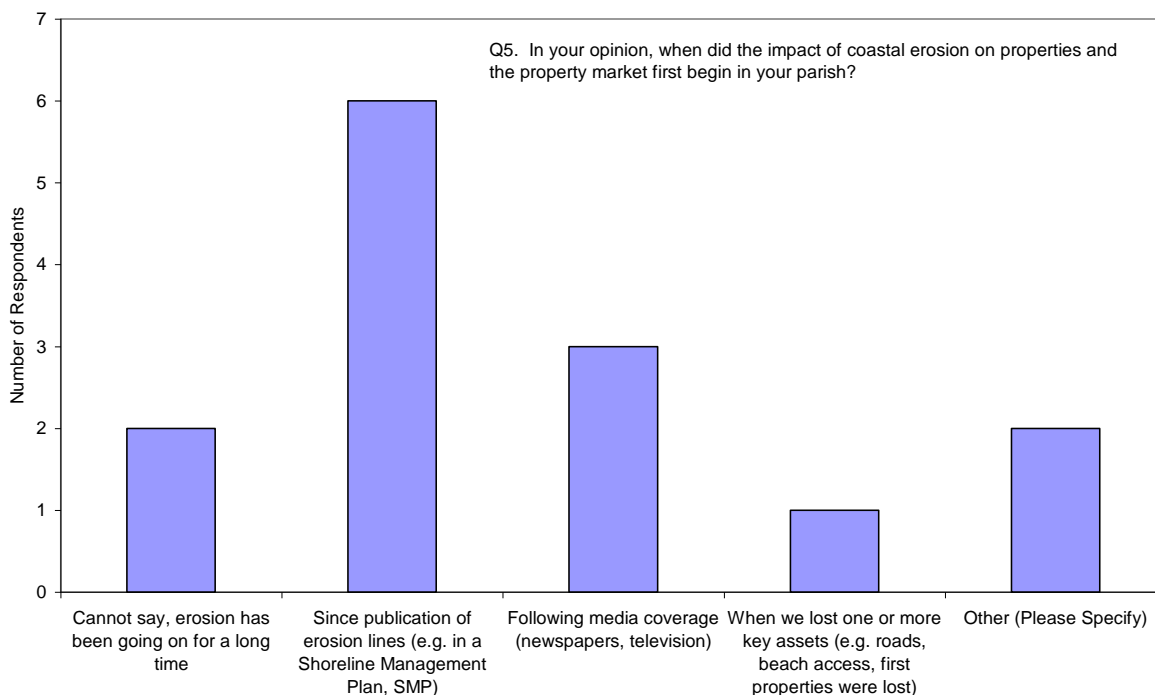


Figure 5.6: Responses to Question 5

6. Conclusions

The following discussion highlights some of the findings in terms of how they illustrate the following key factors (these are the same factors described from the literature review such that we will be able to combine the results of the different strands of the study to provide a full evidence base of the issues):

- awareness of risk;
- appropriate adjustment for the risk;
- distance from the hazard; and
- other factors that may counteract the negative impact of erosion risk (e.g. a sea view).

6.1 Awareness of Risk

Responses to the parish councillors' questionnaire identified that 18 of the 27 respondents (67%) are in parishes that are at risk from coastal erosion. A total of 30% (8) did not consider their parish to be at risk (one respondent, 4%, was uncertain), although 5 (19%) stated that they were close to parishes that were at risk. A higher response rate from those at risk would be expected since councillors for these areas are more likely to be interested in the subject area and to feel that they want to contribute. Overall, these responses generally suggest that there is good understanding and knowledge of the risks.

6.2 Adjustment for Risk

More than two-thirds (72%, 13 respondents) of parishes at risk from coastal erosion believe property prices are lower. Eight respondents (44%) thought that

interest in properties was lower. Four respondents (22%) did not believe that there was any impact on the property market as a result of coastal erosion. Two of these parishes were in Scarborough and two in the Isle of Wight.

In terms of impact on property prices, 39% (7) thought property prices fell once people became aware of the erosion risk and have never recovered. Four respondents (22%) felt prices had fallen more and more over time. Four felt prices had varied, sometimes recovering, sometimes falling. Only one respondent (each) felt prices fell and then recovered a little, that prices had stayed more or less the same, or that prices had increased. One respondent, who was unable to conclude whether there had been any effect, felt that prices varied so much around the parish that it was difficult to say.

Parish councillors disagreed over when the impacts of coastal erosion on property prices first began. 'Since publication of the SMP' (6 responses, 43%) and 'following media coverage' (3 responses, 21%) were the most popular responses. Two respondents were unable to say as coastal erosion 'has been going on for a long time'.

Overall, it could be expected that adjustments to risk should be seen in property prices, although some locations may not fully reflect the risk of erosion in the property values. Once affected, it seems that property prices are slow to recover (if they recover at all). The impacts may extend beyond those properties at immediate risk of erosion.

6.3 Distance from the Hazard

There are concerns from parish councillors that coastal risk in neighbouring parishes could affect property values in their parish. Ten (out of 12 respondents to this question (83%) thought people living in the parish were concerned, but only one out of three (33%, 4 respondents), believed people outside the parish thought the properties in the parish are at risk. In parishes at risk though, 8 respondents (44%) believed that the whole parish is associated negatively with coastal erosion, even though only part of it is actually at risk. Overall, the results suggest that impacts may extend beyond those properties directly at risk, but that the additional area affected may not be large and may be limited to local settlements/parishes.

6.4 Impact of Other Factors

One parish councillor (6%) agreed that interest in coastal properties and property prices are higher (because of sea views), with this perhaps counteracting some of the negative impacts. The same respondent considered that house prices had increased even though the risk of coastal erosion is known. Overall, the issue of sea views and recreation is likely to mask the impact of coastal erosion, but this effect may be limited to specific locations.

Local Authorities' Questionnaire: Approach and Results

1. Introduction

This note summarises the questions asked and their purpose, the number and type of consultees contacted, response rates and a detailed analysis of the results.

2. The Questions

2.1 Overview

The final version of the questionnaire included a maximum of seven questions (plus one opportunity to provide other comments and feedback). The overall objective of the local authorities questionnaire was to identify whether there are concerns from property buyers in the form of requests for information made to local authorities. This gives information on the extent to which the area is perceived (correctly or not) to have a coastal erosion problem.

2.2 Question 1

Question 1 asked whether the local authority was contacted by potential property buyers to ask for information about coastal erosion risk. Three possible responses were available:

- Yes, we get requests now;
- Yes, we have had requests in the past; and
- No.

The objective of this question was to identify if coastal erosion appears to be an issue for the local authorities contacted. The responses could be contrasted against known risks (if any) to assess whether risk may be well or poorly understood, both overall and regionally.

2.3 No Responses to Question 1

Those responding no to question 1 were asked a follow-up question to investigate why they had answered no. Respondents were asked if they knew why they do not get requests for information about coastal risk. Six possible responses were given, plus the opportunity to add a specified other response:

1. There are no properties at risk of coastal erosion (or no longer are);
2. People are not aware of the risk of coastal erosion (or are no longer aware);
3. People are not interested in the risk of coastal erosion (other factors are more important);
4. We are not the people they would contact;

5. Properties in the at risk locations are not put onto the market because buyers are not interested; and
6. Properties in the at risk locations do not sell.

The objective of the question was to sort respondents into those where there was no risk from coastal erosion (response 1), those who considered coastal erosion risk to be of low importance (responses 2 and 3), those who were not the correct contacts (response 4) and those where the impacts of coastal erosion may have significantly affected the property market (responses 5 and 6). Those highlighting response 4 were given an opportunity to provide contact details for people who may be the correct contacts.

Although there were no follow-up questions for those giving responses 2, 3, 5 or 6, these people were given the opportunity to come to one of the workshops to discuss the issues in more depth.

2.4 Question 2

Those answering yes to question 1 were next asked what sort of requests they received. Five different types of requests were specified (with space for an alternative response included):

- Whether a village or area is at risk of coastal erosion;
- Whether a specific property (business or house) is at risk of coastal erosion;
- How long before a property is expected to erode (for properties that are at risk of erosion);
- How long before a property is expected to erode (for properties not predicted to be at risk for at least 100 years); and
- Whether a property is likely to erode within a specific time period.

The objective of Question 2 was to understand the type of information that people were looking for, with respondents asked to tick all relevant responses. Identifying if requests were for specific properties or the area more generally provides data on when erosion is taken into account when looking at properties.

2.5 Question 3

Question 3 is the same as Question 2, except respondents were requested to identify which of the type of requests they most commonly received. The objective was to allow us to identify the most common types of request.

2.6 Question 4

Question 4 asked how often they receive requests. The main objective of this question was to obtain an idea of the scale of the issue. The possible responses were:

- very often - several per month;
- often - 10 to 12 per year;
- occasionally - a few times per year;
- rarely - maybe one per year or every other year; and
- other (Please Specify).

The responses were added together to give an overall indication of the scale of the problem. The average (mean) number of requests was also calculated.

2.7 Question 5

Question 5 asked about the timing of requests and whether they tended to be received more commonly after a particular event (e.g. publication of SMP, media interest) or whether requests were more evenly spread. The options were (the respondent could add their own, other, category if required):

- Bunched, e.g. in response to publication of erosion lines, Shoreline Management Plan or media interest;
- Bunched – e.g. due to an upturn in property sales;
- Evenly spread – requests seem to come in throughout the year;
- Uncertain – too few requests to allow a pattern to be identified;
- Uncertain – no obvious pattern that we have noticed.

The objective was to assess if there was an identifiable trigger after which more requests were received.

2.8 Question 6

Question 6 is similar to Question 5, but this time is focused on whether bunching is seen geographically, where one or more areas may be perceived to be at greater (or lower) risk than others.

- Bunched geographically - requests tend to focus on one or more areas than others (even though they are at similar risk);
- Bunched geographically - requests tend to focus on areas that are at greater or more immediate risk;
- Evenly spread geographically - requests seem to come in across all areas at risk;
- Uncertain - too few requests to allow a pattern to be identified; and
- Uncertain - no obvious pattern that we have noticed.

2.9 Question 7

Question 7 is intended to provide an opportunity for local authority representatives to give an overall indication of their opinion of the impact of coastal erosion on the interest of people requesting information. The possible responses were:

- interest in properties at risk of coastal erosion tends to increase;
- interest in properties at risk of coastal erosion tends to stay the same;
- interest in properties at risk of coastal erosion tends to decrease;
- they are no longer interested at all in properties at risk of coastal erosion;
- responses vary considerably from one person to the next, no common response; and
- uncertain, cannot tell.

3. The Consultees

The specific nature of the questions and the areas at risk of erosion meant that the sample size for this group of consultees was small at just eight.

4. Response Rates

To date, 15 December 2008, six people have accessed the questionnaire, with four completing it. This is equivalent to a response rate of 50%.

5. Detailed Analysis of Results

5.1 Overview

This section presents an analysis of the results, with a breakdown of the responses given for Questions 1 to 7. The results reported relate to the four respondents who actually completed the questionnaire.

5.2 Question 1

Out of the four respondents to this question, two answered yes to receiving requests for information from potential property buyers now, whilst one stated that requests had been received in the past. Only one respondent answered that their authority was not contacted by potential property buyers. This respondent did not go on to provide a reason for why they were not contacted. Considering the four respondents, 75% have therefore been contacted at some stage by potential property buyers for information on coastal erosion risk.

5.3 Question 2

Considering the types of request received by local authorities, the breakdown of responses is shown in Figure 5.1. Since this question allowed respondents to select any answers which were relevant, a total of 13 boxes were ticked by the three respondents to whom the question was applicable. The most popular types of request, which each accounted for 23% of the total, asked for information on:

- whether a specific property (business or house) was at risk of coastal erosion;
- how long before a property was expected to erode (property at erosion risk); and
- whether a property was likely to erode within a specified time period.

An additional 15% of requests related to information on whether a village or area was at risk of coastal erosion, whilst another 15% asked about the length of time before a property was expected to erode (for a property not at erosion risk for at least 100 years). No alternative responses were given.

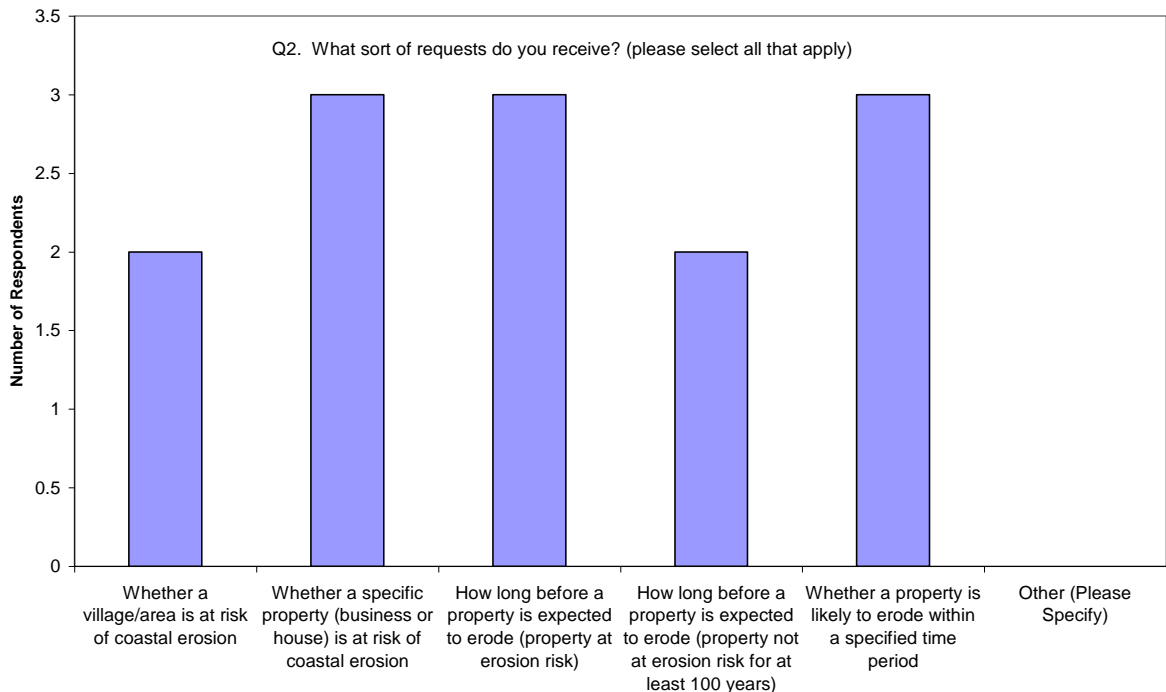


Figure 5.1: Types of request for information received by local authorities (three respondents)

5.4 Question 3

Three respondents answered this question relating to which type of request for information was most common. Two respondents indicated that the most common request asked whether a specific property (business or house) was at risk of coastal erosion, whilst the third respondent rated whether a village or area was at risk as the most common.

5.5 Question 4

Question asked about how often requests for information were received. Out of the three respondents, two stated that they received requests 'very often - several per month', whilst one indicated that requests were received 'often - 10 to 12 per year'.

5.6 Question 5

This question aimed to determine whether requests for information were evenly spread or bunched over time. All three respondents answered that requests were 'evenly spread in time - requests seem to come in throughout the year'.

5.7 Question 6

Considering the geographic spread of requests, two out of the three respondents to this question stated that requests were bunched geographically, with requests tending to focus on areas that were at greater or more immediate risk. One respondent felt that requests were bunched geographically with a tendency to focus on one or more areas, even though all areas were at similar

risk). None of the respondents answered that requests were spread evenly or a pattern could not be identified.

5.8 Question 7

Question 7 requested an opinion on whether the response to requests for information on properties at coastal erosion risk was felt to affect the interest of the person in the property. Respondents were asked for the most common response to receipt of information on at risk properties. Results given included:

- interest in properties at risk of coastal erosion tended to decrease (one respondent); and
- responses varied considerably from one person to the next, no common response (two respondents).

None of the respondents felt that interest in properties at risk of coastal erosion had increased. Equally, it was not seen to be the case that there was no longer any interest at all in such properties.

6. Conclusions

The following discussion highlights some of the findings in terms of how they illustrate the following key factors (these are the same factors described from the literature review such that we will be able to combine the results of the different strands of the study to provide a full evidence base of the issues):

- awareness of risk;
- appropriate adjustment for the risk;
- distance from the hazard; and
- other factors that may counteract the negative impact of erosion risk (e.g. a sea view).

6.1 Awareness of Risk

Three out of the four respondents stated that they received requests for information regarding coastal erosion, which suggests that potential buyers are aware of the risk.

6.2 Adjustment for Risk

Only three respondents gave their opinions of the impact their replies to requests for information had on potential buyers. Of these, two felt that 'responses varied considerably from one person to the next, no common response', with only one believing 'interest in properties at risk of coastal erosion tended to decrease'. This indicates that some people do take coastal erosion risk seriously, and alter their behaviour accordingly. However, the extent of the impact cannot really be gleaned from the information obtained here due to the small sample size.

6.3 Distance from the Hazard

The issue of distance from the hazard appears rather confused. Requests for information focus on the risks to a particular property. However, two of the three respondents had been asked whether or not a village/area was at risk of erosion, suggesting the impacts go beyond those buildings at immediate risk. Respondents agreed that requests were bunched in time and geographically, but according to one respondent, this bunching of requests did not necessarily reflect the extent to which areas were at risk.

6.4 Impact of Other Factors

Since two of the three respondents felt that people's responses to the receipt of information on coastal risk varied, it is likely there are other factors affecting the level of interest in properties. These could include nationwide issues affecting the housing market, as well as more local issues such as the desirability of sea views.

Mortgage Lenders' and Insurance Companies' Questionnaire: Approach and Results

1. Introduction

This note summarises the questions asked and their purpose, the number and type of consultees contacted, response rates and a detailed analysis of the results.

2. The Questions

2.1 Overview

The final version of the questionnaire included a maximum of five questions (plus one opportunity to provide other comments and feedback). The overall objective of the questionnaire for mortgage lenders and insurers was to identify whether there is evidence that erosion risk may affect the ability of a property buyer to obtain a mortgage and/or insurance cover.

Before entering the questionnaire proper, one question was included to allow us to identify the type of business (i.e. mortgage lender or insurance company).

2.2 Question 1

Question 1 asked whether the company or organisation had a policy regarding coastal erosion and properties at risk of erosion. The aim of this question was to determine whether mortgage lenders and insurance companies were concerned about coastal erosion to the extent that they had a particular policy on how to deal with the issue. The response 'uncertain' was available in addition to 'yes' and 'no'.

2.3 Question 2

Question 2 asked whether the mortgage lender or insurance company took risk of coastal erosion into account for specific purposes. The responses available were:

- Yes;
- No; and
- Uncertain.

This question aimed to determine if organisations considered coastal erosion risk for specific purposes, even if they did not have a general policy.

2.4 Question 3 - Insurers

Question 3 was for those who had a policy on coastal erosion and properties at risk of erosion. It was divided in two to ensure its applicability to both insurers and lenders. For insurers, the question asked if their policy on coastal erosion

affected their decision to provide insurance for a property at risk of coastal erosion. The available responses included:

- Yes, we would not insure properties at risk of coastal erosion;
- Yes, we may still insure properties at risk of coastal erosion but this would incur a premium charge/rate;
- Yes, but we would consider the specific circumstance of a property (e.g. time until it is expected to erode);
- Yes, but we would include an exclusion clause related to erosion;
- No, we have a policy but this does not affect insurance (e.g. the policy is for monitoring);
- Other (Please Specify).

The aim was to determine if there was any impact on insurance availability for properties at risk of erosion.

2.5 Question 3 – Mortgage Lenders

Question 3 for mortgage lenders was similar to that for insurers. It aimed to gather evidence on the extent to which companies with policies on coastal erosion would offer mortgages to properties at risk of erosion. The question specifically asked whether the policy on coastal erosion affected the decision to provide a mortgage offer for a property at risk of coastal erosion. The options available were:

- Yes, we would not offer mortgages for properties at risk of coastal erosion;
- Yes, we may still offer mortgages for properties at risk of coastal erosion but this would incur a premium charge/rate;
- Yes, but we would consider the specific circumstance of a property (e.g. time until it is expected to erode);
- No, we have a policy but this does not affect whether we would make a mortgage offer (e.g. the policy is for monitoring); and
- Other (Please specify).

2.6 Question 4 – Insurers

Question 4 was split in two, to make it applicable to the two different types of business. For insurers, question 4 followed on from question 2, and asked which specific circumstances would typically be taken into account. The responses available were:

- Time until the property is predicted to erode;
- Length (time period) of insurance required;
- Level of insurance cover required;
- Value of property;
- Whether there are other risks associated with the property;
- Advice from surveyor;
- Advice from engineer (e.g. landslips); and
- Other.

2.7 Question 4 – Mortgage Lenders

Question 4 for mortgage lenders followed on from question 2 and asked which specific circumstances would typically be taken into account. However, the responses were altered to ensure they were applicable to mortgage lenders:

- Time until property is predicted to erode;
- Length (time period) of mortgage required;
- Loan to value/deposit available;
- Value of property;
- Advice from surveyor;
- Advice from engineer (e.g. landslips); and
- Other (Please specify).

The aim of question 4 was to determine which particular factors relating to coastal erosion were considered.

2.8 Question 5

Question 5 was for both mortgage lenders and insurance companies. It aimed to discover if there was felt to be any impact on property sales or values due to the policies or approaches adopted by companies. The question asked if, in the opinion of the respondent, the company's policy and/or approach to properties at risk of coastal erosion was likely to affect property sales or values. The available responses were:

- Yes, both property sales and property values are likely to be negatively affected;
- Yes, property sales are likely to be negatively affected;
- Yes, property values are likely to be negatively affected;
- No, no significant effect is likely;
- Yes, property values are likely to be positively affected;
- Yes, property sales are likely to be positively affected;
- Yes, both property sales and property values are likely to be positively affected;
- Uncertain; and
- No opinion.

3. The Consultees

Consultees have been contacted via trade associations. The Building Societies Association (BSA) and the Council of Mortgage Lenders (CML) circulated the weblink to the survey to mortgage lenders. The Association of British Insurers (ABI) circulated the web-link to insurance companies.

4. Response Rates

The total number of responses received to date (28 November 2008) is ten. It is not possible to give a response rate for this group of consultees due to the method used to circulate awareness of the survey.

5. Detailed Analysis of Results

5.1 Overview

Before entering the questionnaire, the respondents were asked which type of business they were (with the request to answer on behalf of their main business). All ten of the respondents indicated that they were mortgage lenders. The questions relating to insurance companies will therefore not be mentioned below, since these were not relevant to any of the respondents.

5.2 Question 1

Considering whether companies had a policy regarding coastal erosion and properties at risk of coastal erosion, only one company (10% of the respondents) answered positively. The other nine respondents (90% of the total) did not have a policy.

5.3 Question 2

Although most of companies which responded claimed not to have a policy regarding coastal erosion, the majority did state that they took the risk of coastal erosion into account for specific purposes. Out of the nine respondents to this question, 56% did take the risk of coastal erosion into account for specific purposes, whilst 44% did not.

5.4 Question 3

The respondent who declared that the company did have a policy regarding coastal erosion and properties at risk of coastal erosion declined to provide any information on whether the policy would affect the company's decision on mortgage provision.

5.5 Question 4 – Mortgage Lenders

Question 4 followed on from question 2 and asked for more information on the specific circumstances regarding coastal erosion which would be taken into account by mortgage lenders. Out of the five respondents who said they would consider specific circumstances in question 2, all five said that they would take both advice from a surveyor and time until the property was expected to erode into account. Other important circumstances were whether there were other risks associated with the property (selected by 80%) and advice from an engineer (also selected by 80%). A breakdown of all the answers is given in Figure 5.1.

Several respondents gave additional information on this issue at the end of the questionnaire. Five respondents commented how they would rely heavily on the valuer when deciding whether or not to lend. Of these, two stressed that they did not have a policy on coastal erosion, but they would consider information provided by the valuer and might not lend if coastal erosion was noted as a risk. One company clearly stated that they ‘would not consider making a loan secured on a property at risk from coastal erosion’. Another commented that the availability of insurance was a key consideration, since if anything happened to the property, they would not even be left with the value of the site.

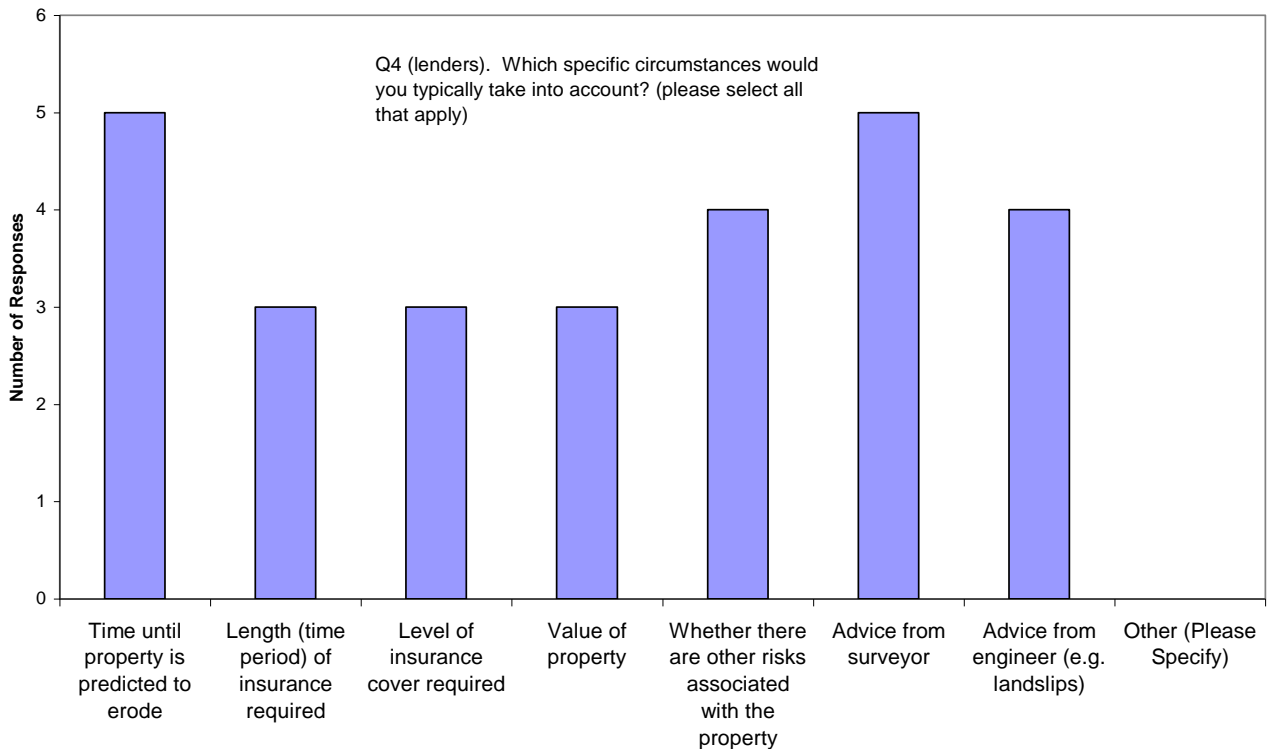


Figure 5.1: Breakdown of the results to question 4 (five respondents)

5.6 Question 5

This question aimed to determine the opinion of the respondents regarding whether their company’s policy and/or approach to properties at risk of erosion was likely to affect property sales or values. Only three respondents answered this question, with two believing that both property sales and values were likely to be negatively affected, and one feeling that no significant effect was likely. None of the respondents indicated that they were uncertain or had no opinion on this matter.

6. Conclusions

6.1 Overview

The following discussion highlights some of the findings in terms of how they illustrate the following key factors (these are the same factors described from the literature review such that we will be able to combine the results of the different strands of the study to provide a full evidence base of the issues):

- awareness of risk;
- appropriate adjustment for the risk;
- distance from the hazard; and
- other factors that may counteract the negative impact of erosion risk (e.g. a sea view).

6.2 Awareness of Risk

There may not appear to be much official awareness of risk, since only one of the ten respondents have a policy for dealing with coastal erosion. However, five (56%) of the respondents who did not have policies do take specific circumstances into account. Therefore, in practice, the majority of respondents (60%) are aware of coastal erosion risk.

6.3 Adjustment for Risk

Only three respondents gave answers to the question regarding whether their policies or approaches to properties at risk of coastal erosion were likely to affect sales or values. Two of these believed there would be a negative impact on both property sales and values. This indicates there could be downwards adjustment of prices and interest, but this is not conclusive due to the low number of respondents.

6.4 Distance from the Hazard

All five respondents who claimed to take specific circumstances into account indicated that they would look at 'time until property is predicted to erode'. However, comments at the end of the questionnaire indicate that being in a coastal parish does not automatically mean mortgages are refused. For example, one respondent commented 'we do not decline to lend in specific postal codes'. Instead there appears to be a heavy reliance on the information provided in the valuer's report, thus allowing each case to be assessed on an individual basis. This suggests that for mortgage provision, distance from the hazard to the property in question is important, rather than the distance to the nearest at risk parish.

6.5 Impact of Other Factors

Several respondents answered that the specific circumstances considered when deciding on mortgage provision would include 'whether there are other risks associated with the policy'. However, as indicated above, information on erosion in valuers' reports was seen as crucial when deciding whether or not to

lend to a coastal property. This suggests that a valuer's awareness and understanding of coastal erosion risk could well be a critical factor driving the provision of mortgages in affected areas.

Appendix 3: Workshop Report

1. Introduction and Purpose of Workshops

The study includes three main strands with the aim being to combine these strands to give a fuller understanding of the impact of coastal erosion on the property market and on property values. The three strands are:

1. Literature review: analysis of published and grey literature to assess the impact of risks on property prices. The review included the analysis of almost 70 publications and articles, initially focused on risks associated specifically on coastal erosion but expanded to cover other risks (e.g. flood, fire, earthquake) and benefits such as sea views.
2. Questionnaires: circulation of questionnaires to parish councillors, local authorities, estate agents, mortgage lenders and insurance companies to assess if coastal erosion is taken into account, and the impacts of the risk of coastal erosion on interest in properties, completion of sales and property prices. The questionnaires are supplemented by two workshops (as reported here), plus interviews with estate agents, mortgage lenders and insurers.
3. Valuation of at risk properties and comparison of sale prices with a not at risk market value.

The purpose of the workshops was to provide additional detail to the questionnaire responses. In particular, the aim was to obtain background information and examples that could be used to illustrate and support the overall findings of the study.

This note summarises the discussions at two workshops: Skipsea (for the East and North Yorkshire case studies) and Bacton (for the North Norfolk and North Suffolk case studies). The discussions are organised by how they illustrate the following key factors:

- awareness of risk: defined here as a potential property buyer knowing that a risk exists;
- appropriate adjustment for the risk: defined as whether any price discount seen changes due to publicity or an event occurring;
- acceptance of risk: covers whether property buyers are willing to accept some risk or not;
- distance from the hazard: expected to result in a decrease in the extent to which the property value reduces as distance from the coast increases, due mainly to the time before the property and/or assets supporting that property (roads, services, etc.) would be eroded; and
- other factors that may counteract the negative impact of erosion risk (e.g. a sea view): where these other factors can mask the impact of the risk on property values.

2. Skipsea Workshop (East and North Yorkshire Case Studies)

2.1 Overview

The Skipsea workshop was held on 1 December 2008 at The Board Inn, Skipsea at 7.30pm. There was a total of five attendees:

- Stewart Rowe, Scarborough Borough Council;
- Councillor Jonathan Owen, Councillor for East Wolds and Coastal Ward;
- Jerry Loft, Skipsea Parish Council;
- Mike Ball, East Riding District Council; and
- John Ellerby, Hornsea Town Council.

The discussions from the workshop are summarised below, and report the views and opinions of attendees to the workshop.

Concern was expressed that not all parish councillors had seen the questionnaire or the invitation to be involved in the survey. As a result, they received only short notice of the workshops, which meant some councillors were unable to attend.

2.2 Awareness of Risk

There is concern that the role and importance of strategic assets is not fully appreciated. Loss of these assets would have very significant consequences for the communities affected. Loss of major road links will fragment communities and affect the way the economy of the local area works. The risks to assets are increasing, raising capacity issues for local authorities. The future impacts along the East Riding coastline include major arteries; these never seem to be taken into account.

Most people living in the area are fully aware of the risks, but this does not mean they want to publicise them. Most people know that they are in an unstable zone and would not get insurance if they admitted this. There is a real benefit to them to not publicise the issues as the publicity can quickly result in blight. This has generated a culture where people do not ask about the risks, in order to avoid blight.

The majority view from those not living in areas at risk of erosion is that people who have bought the properties were 'stupid' to have done so, and that it is their own fault that they are about to lose their homes.

2.3 Adjustment for Risk

There seems to be a general perception that all coastal erosion is the same. Many people are unable to distinguish between different areas, even where the rates of erosion are highly variable. This may result in perception of risk that is greater than the actual risk. There is concern that people are not able to adjust for time. They do not appear to appreciate that a risk in 20 or so years time will affect them and then complain when the issue becomes apparent.

Estate agents will often not tell buyers about the risk of erosion (nor are they obliged to). This is understandable: they want to sell the property. Local authorities will not (and can not) give a prediction as to when a property would erode. They can only give information and advice based on historic erosion rates. The quality of legal advice for those buying properties in erosion risk zones tends to be very poor and can result in people buying properties based on assumptions that are overoptimistic and unreliable.

There is provision for roll-back, which is being used by the caravan parks. Many property owners, however, cannot afford to purchase land to build on, so they are unable to roll-back.

2.4 Acceptance of Risk

Some people living in areas that are at risk of erosion, where the residents know there is a risk of erosion, do not want defences. They are worried that defences will highlight that there is a potential risk from erosion that could result in blight of their properties.

At least four caravan parks along the coastline of East Riding have already lost pitches.

The Shoreline Management Plan (SMP) is likely to include erosion lines that mean 100s if not 1,000s of properties will be lost in the future. There is no economic case for intervention, but this tends to be accepted, with plans in place for roll-back.

There are a lot of people retiring to the coast. They will buy the property for the sea view knowing that it will erode. They tend to only be concerned that the property has enough time 'to see them out'. There is a question though of what happens when erosion is imminent and whether this view still holds. There is evidence that people have bought a property knowing the risk (and the lifespan) that are now complaining that their property is going to be lost. This has been seen where people have pushed for a change of use from holiday accommodation to 11-month occupancy to full-time residential accommodation. Once this is agreed, they then tend to complain about the risk of erosion and the impacts this has on them, and request protection.

2.5 Distance from the Hazard

The coastline of East Riding has never had defences and so has been eroding for a long time. There are concerns that the rate of erosion seems to have accelerated over recent years. This makes it difficult to estimate with any degree of confidence what the residual life of properties may be. One bungalow was purchased for £86,000 with advice that it would not be affected by erosion for 50 years, but now it is likely to erode within the next eight or so years. There is a moral dilemma associated with those who purchased a property with a reasonable expectation of life by the sea. As erosion accelerates, the residual lives are very short but there is no mechanism in place to help them.

The coastline around Skipsea has retreated by at least 100 feet since the 1970s. Near Cowden, there is the potential for 17-18 metres of coastline to be lost in one go due to the effect of cracks in the cliffs being filled with water which then freezes, forcing the cliff apart.

2.6 Impact of Other Factors

Many of the people looking to buy properties in the area have been visiting the coastline since they were children. When properties come onto the market, they buy them as holiday chalets. Some of the accommodation that was originally intended for use as holiday accommodation has gradually been changed into residential properties (change of use). The number of retirees to the coast has resulted in an imbalance in the population. Any new dwellings that are built in Skipsea tend to be bought by people moving into (and retiring to) the area. This is leading to a problem in terms of the identity of 'East Yorkshire', most of the people moving in are retiring from West Yorkshire. Often they bring with them health issues (from their time spent working in coal mines and steel works).

It is the sea view, clean air and the reminiscence value (visiting the area since they were children) that tends to dominate when people are buying a property. It tends to be an emotional (heart rather than head-driven) choice, which means that properties at risk still sell and are likely to continue to sell.

Hornsea is protected by a concrete promenade, although there are some properties at the end that were built assuming defences would be provided, but they never were. Even though houses have been eroded (e.g. the 'white bungalow'), these houses always sell. It is the sea views that attract people, in spite of the erosion risk.

Until the 1970s, the area around Skipsea was predominantly a farming community. There is no real economic activity other than caravans; the farming community has almost completely disappeared. The caravan parks are often very large and provide accommodation for those who once holidayed in the area and now live in the area. The caravan parks have their own social clubs and often their own shops. As a result, people staying in the parks tend not to use the village facilities (this is unlikely to be the case for all caravan parks, though). There is little integration between the village and the people staying in the caravan parks. The money generated by the caravan parks does not filter into the village economy.

Tourism is, however, the only real way to bring money into the local economy. The area of Bridlington Bay is identified as the second best sailing area in the country. This could be used to market the whole area, with the potential to develop marinas in key villages down the coast. Such an approach would require the construction of hard points along the coast to protect the villages, with allowance for erosion between the hard points. This could allow the local economy to develop and protect houses at the same time. However, there is an issue of the affordability of such a scheme, and how this would be promoted over schemes along other lengths of coastline or inland areas at risk of flooding. The economics seem unlikely to stack up.

There is no access to the beach at Skipsea, not even from the caravan parks. One caravan park used to put steps down every summer, but since it changed ownership this has not happened. This means that people stay in or buy a caravan and then cannot use the beach. There was a footpath down to the beach put in once the road had been closed, but this was then blocked off, again removing access to the beach.

The construction of two rock groynes in Mappleton, along with a ramp down to the beach, means that there is now good access to the beach (before people had to scramble down the cliffs). The groynes have helped to stabilise the beach resulting in the development of an important recreational area; this has helped develop local tourism. The cost of rock groynes makes this too expensive to repeat elsewhere along the coast.

Properties that are about to erode at Skipsea tend to be pushed over the edge (rather than demolished and removed). This means that the beach is in a real mess. Part of the problem is that the owner of the property has to pay for it to be demolished, but they do not have any money. A lot of money is spent on removing this debris from the coastline, in particular because of health and safety. In fact, the district council has received calls to complain after debris has been removed because this is perceived as removing material that could be acting as protection against erosion. In Scarborough, all the properties at imminent risk of erosion have to be demolished and removed as the coastline is designated as an SSSI.

Robin Hood's Bay is 80% holiday homes. It seems illogical to spend limited taxpayers money on defending second homes when an economic case cannot be made to defend people's only homes.

3. Bacton Workshop (North Norfolk and North Suffolk Case Studies)

3.1 Overview

The Bacton workshop was held on 2 December 2008 at Bacton Village Hall at 7.30pm. There was a total of 11 attendees:

- Lee Walker, Happisburgh Parish Council;
- David Gale, Bacton Parish Council;
- Cecil Wilkins, Bacton Parish Council;
- Malcolm Kerby, Coastal Concern Action Group;
- Ralph West, Overstrand Parish Council;
- Joe Aylward, Overstrand Parish Council;
- Chris Finch, Bacton Parish Council;
- Christopher West, Mundesley Parish Council;
- John Whitby, Mundesley Parish Council;
- Angie Tillet, Councillor for Poppyland Ward; and
- Peter Fitch, Overstrand Parish Council.

The discussions from the workshop are summarised below, and report the views and opinions of attendees to the workshop.

Concern was expressed that not all parish councillors had seen the questionnaire or the invitation to be involved in the survey. As a result, they received only short notice of the workshops, which meant some councillors were unable to attend. The short timescale for return of questionnaires also made it difficult for parish councils to respond as many did not meet between receiving the invitations and the deadline.

3.2 Awareness of Risk

Many people bought into the villages before publication of the SMP and the change of policy. After publication of the SMP, people buying into the area would have known the risks. Those buying into the area before publication of the SMP were not fully aware of the risks. The publication of SMPs in other areas is 'immoral' given the evidence of what has happened in North Norfolk.

Some people moving into the area do consider the risk of buying properties on crumbling cliffs and choose to purchase properties further back. The government is pushing the 'caveat emptor' approach and there is a need for some personal responsibility. The main issue is that people purchased properties before the defences were abandoned. They were not aware that the defences would be abandoned in the future. At Happisburgh, it was the loss of the lifeboat ramp that made people realise that erosion was for real.

Generally, people moving into the area from outside are more likely to overestimate the risks. They are likely to associate the whole parish with the risks. Those living in the area may underestimate the risks. For example, they may not accept that erosion will occur; they cannot picture their home being allowed to erode and a future image of the village where only half of it remains.

Overstrand had private defences until 1953. These were provided and maintained by those with properties along the cliffs. The surge of 1953 washed them all away and they were replaced by defences provided by the government. These are now not to be maintained.

3.3 Adjustment for Risk

Prices in Happisburgh are around 25-30% lower than prices in other parishes, even properties that are half a mile (or more) inland. Erosion is speeding up due to the hard defences on either side, this is resulting in the whole parish suffering from blight.

The US government underwrites much of the risk associated with flooding, erosion, hurricanes, etc. (e.g. once a disaster area has been announced). France has the Loi Barnier, which also pays compensation to those who have to move out of their homes because of risks to the property.

The property market relies on confidence. Anything that shakes confidence will affect property values. It is important, therefore, that decisions that would affect confidence in an area and its assets are not made until there is a package of

social justice in place. Adjustment to risk tends to follow a pattern where the initial perception of the risk results in a drop in confidence. There is then some recovery due to people reassessing the risks (the recovery can vary though, sometimes it may be full recovery, other times only partial). These impacts occur because of a change in perception of the risks. Once lines are drawn on a map, though, there is a clear message of what the risks are and where. This should give people knowledge of the risks (not perception). The 100-year line is blight and it results in far greater blight than is caused by other risks or nuisances. However, complications arise because of uncertainty. The erosion lines should really be erosion zones. The outputs of erosion mapping (should this be made public) could blight thousands of homes.

The housing market also relies on mortgages. There will be no sales if there are no mortgages. There is a general rule followed by lenders that a mortgage offer will only be made if there is 25 years (length of the mortgage) + 30 years after in terms of residual life (i.e. 55 years). Houses with less than 55 years residual life become unmortgageable. There will be some buyers, e.g. cash buyers such as retirees, but the available market in which to sell the property is significantly reduced. Even properties where there is a lot of equity in the property cannot get advances, e.g. to build extensions, even though the SMP has not been accepted yet. Properties will only become mortgageable if they can get insurance. This requires the government to underwrite the properties at risk in the at risk areas.

An additional problem has arisen in terms of what the risk really is. For example, planning was refused for a bungalow that would have been half on the 100-year erosion line and half outside it. This raised a new issue that the access road to the proposed bungalow, but also to other existing properties, would be lost in 60 years time. This meant the impacts had suddenly been moved forwards by 40 years. Therefore, the value of properties that were previously outside the 100-year line is now affected. This reflects the importance of taking account of assets that support the properties. If the access road is lost, the properties would be affected much sooner and more properties would be affected. At Mundesley, one of the first assets to be lost will be the road – no space has been allocated for roll-back of the road.

In Overstrand, most of the services for the village are located under the High Street. The sewage pumping station will be lost long before these services. The loss of the pumping station and then the services will affect many properties including those behind the 100-year line. The cost to replace all these services to ensure that properties outside the 100-year line remain habitable would be enormous. The impact of losing the electricity line will be felt up to five miles inland, but this has not been factored into the economic appraisal.

The beach is now disappearing at high tide. This raises the question of if it continues can it be stopped? It is essential that it is understood that it cannot be stopped. The next question, therefore, is: is it possible to reduce the effect by letting the sea in elsewhere? The problem is that water tables are higher than anyone can remember.

The question of second homes was also raised, in particular should second homes be subject to the same type and level of 'compensation' as first homes? The fact that it is a second home should not affect the value of an asset that is an investment bought by somebody who has worked hard and paid their taxes. The shift in policy has resulted in blight, but is it right to pay people for making an inappropriate choice over where to live/invest?

3.4 Acceptance of Risk

Properties on the high coast (i.e. not at risk of flooding) have been increasing in value. It is only recently that the values have begun to drop. The prices are still higher than elsewhere.

There are significant impacts on the communities. People often buy their homes to pass onto their children; now they have no investment value. The children love being near the coast and are being 'robbed' of the place in which they grew up. Despite this, it is not always retirees that are moving in.

One of the community impacts relates to a loss of sense of belonging. Coastal erosion risk causes people to start to worry. In general, people do not like to have to move. Most like to put down roots and pass them onto their children. The house itself is an asset, but there is also an additional issue related to the destruction of communities.

People generally have not fully understood the blight issue. Families are being refused remortgages even though they are inland. Many of the properties for sale in parishes identified as being 'at risk' have not had a viewing, let alone a buyer. People are also being refused contents insurance because they are within one quarter of a mile from the sea. Being within one quarter of a mile from the sea immediately withdraws 70% of insurance companies. If you enter a Mundesley postcode into the online comparison sites, you cannot get an online quote because of the postcode.

There are also people living in the at risk properties that are effectively trapped. It is impossible to sell the property to move elsewhere. People wanting to downsize because they feel that their garden is too large cannot. They are forced to stay where they are.

3.5 Distance from the Hazard

The impact of dredging is accelerating erosion. There is research showing that dredging is not affecting erosion rates but no one has any confidence or trust in the results as they have been produced by those with a vested interest (e.g. the dredging industry). The erosion started at the same time as the dredging started.

Beach Road in Happisburgh was identified as having 60-70 years life in 1991, but it has already been lost. The prediction of erosion rates is difficult. This can affect how people adjust for risk, often encouraging them to be pessimistic about the erosion lines and, hence, the time until a property is predicted to erode.

3.6 Impact of Other Factors

There is a premium payable for sea views; people are willing to pay more. Plots of land in a development near the sea in Overstrand were bought for much more than the local current price and very expensive houses were built on them by individuals from outside the area. They had checked with the local planning authorities and were assured the coast was protected and the plots would be safe for a long period of time. This was prior to the SMP except in one case where the SMP had been presented to the local authorities but not made public. There was a rider to the local authority of advice, to the effect 'subject to a change in National policy'.

People are willing to pay a lot extra for sea views, providing the property will 'see them out'. Properties are continuing to sell because of their sea views. Not everyone is willing to pay for a sea view though, bearing in mind the risks. When asked about the value of a sea view, one estate agent has suggested this is 100% (i.e. a doubling of the property price), although this is not backed up by experience. The benefit of a sea view may be increased ability to sell as well as any added value.

One bungalow in Happisburgh was sold for £9,000 with an estimated three years life. A lady bought it because she was happy to pay £9,000 for three years overlooking the sea (it would have cost more in rent to live elsewhere). The property lasted three years and two weeks, so she was happy. The people selling the property though are likely to have felt that they lost out because they had to sell the bungalow for a heavily discounted price.

One of the main problems with roll-back is where to get the money to purchase the land. Caravan parks cannot afford to buy the land needed since they cannot sell what they already own to raise the capital. They also need to replace all the infrastructure that is lost. Without full social justice there is no mechanism that will allow roll-back to be achieved. The designation of Area of Outstanding Natural Beauty (AONB) is also important when considering the potential for roll-back of caravan parks, although it may be possible to over-rule this where necessary.

Businesses tend not be valued as there is a presumption that they can be moved, but that is not realistically the case. Most businesses in the area are reliant on tourism. Loss of tourism leads to loss of businesses and consequently to loss of employment. These intangibles are not taken into account.

Listed buildings are also an important issue. There are 22 listed buildings in Happisburgh, including the church. It may be easy to put a value on the church, but it is much more difficult to value loss of the churchyard and the graves and the importance of this to the local community. How do you explain to people what will happen to the graves?

Appendix 4: Locations where Individual Property Prices were considered

Location	Likely to be perceived at risk	Immediately inland for comparison
Blackgang Road, Niton	0	9
Bembridge	32	31
Luccombe	28	0
Whitecliff Bay	0	9
Corton	20	46
Happisburgh	24	10
Mundesley	18	22
Skipsea/Ulrome	1	26
Aldbrough	12	15
Scalby Ness	24	26
Robin Hood's Bay	34	8
Flatcliffs, Filey	12	24

Ergon House
Horseferry Road
London SW1P 2AL
www.defra.gov.uk

