7 Coastal Erosion: Potential Losses and Benefits

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OVERVIEW

This chapter gives the procedures and techniques for assessing the potential benefits of investment in coastal erosion risk management. These benefits principally arise from delaying the processes of erosion, and thereby delaying the loss of land and property for the duration of the life of any proposed protection works.

Key points to understand are:

- Erosion is effectively permanent and irreversible;
- This means that future uses of that land or property are lost;
- Decisions about investment versus no investment must start from a realistic evaluation of the "do nothing" option.

Coast protection works, which are designed to arrest this process of erosion, normally have a finite life.

- Hence the benefit from a particular coast protection project should be seen as a temporary - but usually lengthy – extension to the useful life of the land and property protected;
- The most reasonable assumption thereafter is that the original long-term erosion rates as before will start again;
- Coast protection projects are compared with a 'do nothing' option. This 'do-nothing' option may involve 'walk-away' and hence the prospect of substantial erosion of coastal property (see the Environment Agency guidance on 'do nothing');

The approach to assessing these losses and benefits has not altered significantly since the MCM 2005. The changes here only comprise providing up-to-date data on average property annual rental values in the UK (Tables 7.3 and 7.4), where there have been some net reductions in these values since 2005 (then expressed as property prices). Given that, generally, there have been increases in the costs of coast protection works over this time, this means that it is now less likely than in 2005 that protecting property from loss to the sea will be economically viable.

Recent research and guidance "acknowledges that there is a likelihood of increased rates of depression and anxiety for people whose homes are at risk of erosion". Please refer to Environment Agency (2021) for carrying out the mental health impact of erosion assessment.

LESSONS FROM EXPERIENCE

- Flooding and erosion are often inextricably inter-linked; probabilities can become very complex to calculate;
- Unless they are very near the edge of cliffs, houses alone generally provide a poor base for the justification of major coastal risk management works;
- Accurate and realistic erosion rates and probabilities are the key to accurate benefit estimation;
- The prices of houses situated on the tops of cliffs do not accurately reflect their risk of falling into the sea and the loss of one person's view is another person's gain: the view itself is not lost;
- The environmental benefits of coastal risk management are mixed: some assets gain (e.g. eroding cliffs revealing important archaeological or geological sites), others involve losses (e.g. the loss of habitats for bird species);
- The recreation benefits of coastal risk management have been widely ignored and yet they are often a key reason for scheme implementation;
- Delay is a real option that should be considered seriously;
- A systematic comparison of investment versus no investment must start from a realistic evaluation of the "do nothing" option.

THE RECOMMENDED APPROACH

The recommended approach for assessing the benefits of coast protection is summarised in Figure 7.1. The key points about this approach are as follows:

1. Estimates are needed of erosion rates and cliff top edges projected for 50 or even 100 years into the future.

Alternatively, a probabilistic approach to erosion can be taken, resulting in a range of probabilities that a particular parcel of land or property will be eroded and therefore lose its use value.

2. A procedure is provided for evaluating the losses due to erosion, or the extension to the expected life and use of the property and land due to a delay in the erosion process resulting from investment in coastal risk management. Techniques are provided for finding the appropriate values for properties (residential and NRPs) whose market prices are likely to be affected by perceived erosion risk.

Figure 7.1 *Flow Chart of the assessment process*

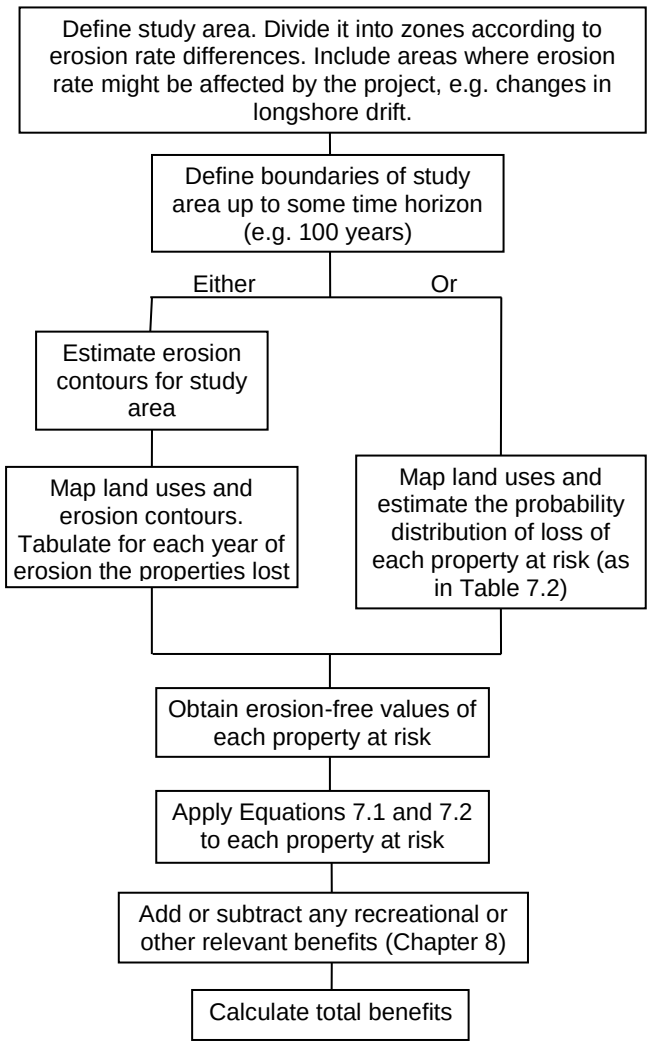

Table 7.1 Basic data for a hypothetical project to delay coastal erosion

Property	Value (£)	Mean year lost
House A	80,000	4
House B	60,000	7
3 mobile homes	3,000	10
Public house	240,000	13
House C	120,000	16
House D	90,000	17

Table 7.2	A best estimate of the probability that house 'A' will be lost in any given year						
Year	0	1	2	3	4	5	6
Probability	0.05	0.1	0.15	0.2	0.35	0.1	0.05

Step One: Collect data on the study area's characteristics

EROSION RATES AND EROSION 'CONTOURS'

- Produce a set of predicted erosion 'contours' for the coastline in question, initially using, say, 5-year intervals, for at least the projected life of the proposed coastal protection works. Use smaller time intervals if erosion rates are particularly rapid;
- These erosion predictions will not be certain, and will need to be based on averages of the likely effects of storms of different magnitudes, and sensitivity analysis used to gauge the significance for benefit totals of the assumptions made here;
- For properties at risk from erosion there will be some minimum acceptable safety margin between the cliff top edge and the building: this is the point of erosion where the use of the property is assumed to be lost. Defra has recommended a 2-year margin.

CALCULATING BENEFITS BY ASSESSING THE PROBABILITIES OF EROSION

Since erosion is often episodic, with sudden losses of land and slides of cliffs, the use of erosion contour lines can be misleading whereby it is assumed that erosion will reach a certain point inland in a given year. Therefore, the use of a probabilistic approach should be considered, depending on the distribution of probabilities of cliff falls and hence losses over time.

Table 7.1 gives some data for a hypothetical project and Table 7.2 gives a best estimate of the probability that house "A" will be lost in any given year where the same probability function also applies to all the other properties. If it is assumed that the scheme has an engineering life of 20 years at which point it fails, then the present value of erosion benefits is £215,758.

If, instead, we assume that each property is lost in the year at which the probability of loss is the maximum (i.e. year 4 for house "A"), then the present value of erosion benefits is £205,000. So, in this case the probabilistic approach makes very little difference. However, where the distribution of probabilities (as in Table 7.2) is very asymmetric there can be much larger differences in calculated benefits.

The FCERM-AG economic appraisal spreadsheets use the probabilistic approach (see FCERM-AG supplementary guidance). If the probability of loss for a given property is set to 1.00 in a given year then the method can be used deterministically.

Step Two: Collect valuation data for properties at risk

THE IDEA OF BENEFIT AS A DELAYED LOSS

The benefit of coast protection works is an extension to the life of, or the delay in the loss of, erosion-prone property and land for a period of time equal to the life of the protection works (scheme life). This assumes that erosion after the end of the project's life would proceed at the same rate as it would have done without the project.

Thus, a property that is predicted to be lost by erosion in 20 years' time without protection would, with effective coast protection works having a life of 50 years, be expected then to be lost in 70 years' time. Thus, the benefits of coast protection are critically affected by the timing of the extension of the life of the property.

THE PROCEDURE FOR VALUING PROPERTY LIFE EXTENSION

The procedure recommended here for valuing erosion-prone properties, involves the following stages:

- Determine the erosion-free market value of similar properties in the local area: market-based property prices;
- Use the Equation 7.1 [see Step 3] to determine the present value of the use of that property up until the time when it is lost through erosion at current erosion rates;
- Use the Equation 7.2 [see Step 3] to determine the present value of the use of the property with the extended life provided by the coast protection scheme (i.e. the life as above plus the anticipated lifetime of the scheme).

EROSION-FREE PROPERTY PRICES

- The property and land prices required are market freehold values, not adjusted for erosion risk. Tables 7.3 and 7.4 provide data sets for values of the main types of dwelling found in this country. These values can be used in the equations below, but greater reliability may be achieved by obtaining values locally for the specific types of property to be affected by the project. Values used for residential property should reflect its location type – such as being near the sea – but it should be safe (i.e. based on properties which do not have an erosion risk);
- Defra (2004) provides guidance on distributional impacts in their interim guidance note.

LOCALLY APPROPRIATE PROPERTY PRICES CAN BE OBTAINED THROUGH:

- The Coast Protection Authority's own valuation department, if it has one;
- Local estate agents: use typical or average values for the type of property which ignore the risk of the properties being lost through erosion without a coast protection scheme also and ignore factors such as a sea view.

Table 7.3 *UK dwelling prices and average annual rental values by Region*

Region	New dwellings (Jan 23 - Dec 23) £	All dwellings price (Jan 23-Dec 23) £	Annual Average Rent (Feb 24) £
North East	239,776	157,374	7,980
North West	291,211	212,075	12,096
Yorkshire & Humberside	266,616	205,979	10,224
East Midlands	334,724	246,089	10,632
West Midlands	338,708	248,626	11,412
East	435,265	347,590	14,580
London	524,993	520,026	24,840
South East	449,885	386,529	16,116
South West	382,093	322,587	13,980
England	376,172	302,976	13,540
Northern Ireland	215,920	175,599	9,984
Scotland	263,904	187,327	10,956
Wales	285,408	212,577	10,176

Source: H.M. Land Registry (2024), https://www.gov.uk/government/statistical-data-sets/uk-house-price-index-data-downloads-february-2024 (dwelling prices are calculated as an average over the 12 month period indicated);

Homelet (Average rent: Feb 24: https://homelet.co.uk/homelet-rental-index)

Table 7.4 *Residential property prices and annual rent by dwelling type*

Average 2024 values by residential property type						
	Region	**Detached**	**Semi-detached**	**Terraced**	**Flat/ Maisonette**	**All**
Property price (£)	England	477,208	292,548	247,576	245,362	302,976
	Wales	325,697	207,453	165,393	133,545	212,577
	Scotland	336,666	200,503	158,187	128,187	187,327
Annual rent (£)	England	21,326	13,074	11,064	10,965	13,540
	Wales	15,591	9,931	7,917	6,393	10,176
	Scotland	19,690	11,727	9,252	7,497	10,956

Property prices from: H.M. Land Registry (2024), (https://www.gov.uk/government/statistical-data-sets/uk-house-price-index-data-downloads-february-2024
*Annual rent for each property type has been calculated as a proportion of the average annual rent (see Table 7.3)
Source: Homelet (2024), https://homelet.co.uk/homelet-rental-index#Data

Step Three: Perform the calculations

The two formulae identified in Step 2 are as follows:

Equation 7.1

$$PV\ (\text{without scheme}) = MV\ (1 - 1 / (1 + r)^{p})$$

Equation 7.2

$$PV\ (\text{with scheme}) = MV * (1 - 1 / (1 + r)^{p+s})$$

where:
PV is Present value
PV asset value = $MV * (1 - [1 / (1 + r)^{\text{year of loss}}])$,
where r = discount rate
PV is Asset loss = MV – PV asset value =
$MV * [1 / (1 + r)^{\text{year of loss}}]$
p = expected life of property with no coast protection project
s = expected life of the coast protection project

This amounts to:

PV benefit = PV asset value (with scheme) – PV asset value (without scheme) or PV benefit = PV asset losses (without scheme) – PV asset loses (with scheme)

Both calculations of PV benefit produce the same answer.

Step Four: Interpret the results

The benefit of carrying out the scheme is the difference between the two values of present value which represent the gain from 's' years of equivalent annual benefit ('s' being the scheme's effective life).

The procedure, very simply, involves the calculation of the discounted value of the property loss with coast protection less the discounted value of the same property loss without any proposed protection works.

The greater the life of the scheme the larger the benefit, but not proportionately, because losses further into the future are discounted more heavily than those incurred in the medium or short term.

The benefits calculated as above need to be compared with the costs of the scheme, both capital and maintenance. Costs in the future need to be discounted to present values.

- A ratio of benefit-cost greater than 1.0 indicates that the scheme is economically worthwhile;
- Delay in scheme implementation will increase the benefit-cost ratio, as the cliff edge gets nearer to the property, with erosion.

KEY POINTS WITHIN THE BENEFIT ASSESSMENT PROCESS

- Realistic erosion rates and probabilities are the key to accurate benefit estimation;
- Assessment of the effective life of any scheme is important to determine, with as much accuracy as possible, as this determines the delay of erosion and 'drives' the benefit calculations;
- The recreation benefits of coast protection (see Chapter 8) are often very large and can be a key reason for scheme implementation. They can be costly to assess (with site surveys), so caution is necessary here;
- All appraisals should be based on the existing properties at risk. No allowance should be made for new developments or possible regeneration of sea frontages.

REMAINING ISSUES

1. House value trends not covered here

Coastal risk management works are generally appraised for a long expected project life of perhaps 50 or even 100 years. Whilst general inflation over this time is ignored in benefit-cost analysis, potential changes in relative real prices are relevant (HM Treasury, 2022).

However, no conclusive reason and no reliable method for making future predictions of long-term house price or rental trends have been found. The standard approach of assuming constant relative prices is therefore recommended, for benefits and costs.

2. Other matters not covered here

The following are not covered here but are tackled in the full MCM:

- Infrastructure loss (promenades and associated structures);
- Infrastructure loss integral to properties at risk from erosion (gas; water; electricity; etc);

- Infrastructure lost that is serving areas not at risk from erosion at the same time (gas; water; electricity; etc);
- Valuing non built-up land: agricultural land and other open space.

SOME COMMON MISCONCEPTIONS

- Property and land must be protected at all cost;
- Decisions in the future about coast protection should reinforce planning decisions made in the past;
- A valuable promenade is a benefit if it is to be protected (even if it is falling down);
- There is no merit in delay;
- The sea will not win in the end.

SOME KEY LESSONS FROM EXPERIENCE

- Flooding and erosion are often inextricably interlinked; probabilities can become very complex to calculate;
- Market prices of houses situated on the tops of cliffs do not accurately reflect their risk of falling into the sea;
- Many people claim that the loss of a view from a property, if that property is lost due to erosion, is important. But the loss of one person's view is another person's gain: the view itself is not lost (so there is no economic loss);
- The environmental benefits of coast protection are mixed: some assets gain (e.g. eroding cliffs revealing important geological sites); others involve losses (e.g. the loss of habitats for birds);
- Delay is a real option that should be seriously considered.

REFERENCES

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